**Cropland can support high bird diversity in rural tropical landscapes**

 SHEENA DAVIS

**Supplementary Table 1: *Bird species recorded in the study landscape.*** *A list of species observed in the landscape during the sampling period, this is inclusive of species that were only seen in the landscape but not recorded at any of the sampling points. Number of recordings at each sampling site and threat status of the species has also been included. Eastern Arc Endemic species are shown by the symbol \* (*Rovero *et al, 2014), and range restricted species are denoted by the symbol ª. Species that were categorised as range restricted are those found only in East Africa (namely Zambia, Malawi, Tanzania, Mozambique, Kenya, Burundi, Rwanda, Uganda, South Sudan, Ethiopia, Eritrea, Djibouti, and Somalia).*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species name**  | **Family**  | **Diet** | **Number of sites recorded** | **Average number of times recorded** | **Threat Status**  |
| *Accipiter tachiro* | Accipitridae | VertFishScav | **-** | **-** | LC |
| *Acrocephalus baeticatus* | Acrocephalidae | Invertebrate | 2 | 1.17 | LC |
| *Acrocephalus gracilirostris* | Acrocephalidae | Invertebrate | 17 | 8.25 | LC |
| *Acrocephalus palustris* | Acrocephalidae | Invertebrate | 1 | 0.25 | LC |
| *Acrocephalus scirpaceus* | Acrocephalidae | Invertebrate | 1 | 0.33 | LC |
| *Agricola pallidus* | Muscicapidae | Invertebrate | 1 | 0.50 | LC |
| *Amandava subflava* | Estrildidae | PlantSeed | 19 | 57.58 | LC |
| *Amblyospiza albifrons* | Ploceidae | Omnivore | 7 | 6.58 | LC |
| *Andropadus importunus* | Pycnonotidae | FruiNect | 4 | 2.25 | LC |
| *Anomalospiza imberbis* | Viduidae | PlantSeed | 3 | 2.25 | LC |
| *Anthreptes reichenowi* | Nectariniidae | Invertebrate | 1 | 0.25 | **NT** |
| *Anthus cinnamomeus* | Motacillidae | Invertebrate | 2 | 1.25 | LC |
| *Apalis flavida* | Cisticolidae | Invertebrate | 15 | 7.33 | LC |
| *Apalis melanocephala* | Cisticolidae | Invertebrate | 1 | 0.50 | LC |
| *Apalis thoracica* | Cisticolidae | Invertebrate | - | - | LC |
| *Apaloderma narina* | Trogonidae | Invertebrate | 5 | 6.50 | LC |
| *Apaloderma vittatum* | Trogonidae | Invertebrate | 1 | 1.00 | LC |
| *Ardea melanocephala* | Ardeidae | VertFishScav | 6 | 3.58 | LC |
| *Arizelocichla milanjensis\*ª* | Pycnonotidae | Omnivore | 1 | 1.00 | **NT** |
| *Bostrychia hagedash* | Threskiornithidae | Invertebrate | 1 | 0.50 | LC |
| *Bradypterus baboecala* | Locustellidae | Invertebrate | 19 | 13.17 | LC |
| *Buteo buteo* | Accipitridae | VertFishScav | 4 | 1.33 | LC |
| *Bycanistes brevis* | Bucerotidae | FruiNect | 6 | 2.92 | LC |
| *Bycanistes bucinator* | Bucerotidae | FruiNect | 14 | 12.33 | LC |
| *Camaroptera brevicaudata* | Cisticolidae | Invertebrate | 22 | 20.08 | LC |
| *Campephaga flava* | Campephagidae | Invertebrate | 1 | 0.25 | LC |
| Campethera abingoni | Picidae | Invertebrate | - | - | LC |
| *Campethera nubica* | Picidae | Invertebrate | 1 | 0.75 | LC |
| *Ceblepyris caesius* | Campephagidae | Invertebrate | - | - | LC |
| *Cecropis abyssinica* | Hirundinidae | Invertebrate | 6 | 29.33 | LC |
| *Centropus superciliosus* | Cuculidae | Omnivore | 81 | 61.67 | LC |
| *Cercotrichas leucophrys* | Muscicapidae | Invertebrate | - | - | LC |
| *Ceuthmochares australis* | Cuculidae | Invertebrate | 4 | 2.00 | LC |
| *Chalcomitra senegalensis* | Nectariniidae | Omnivore | 2 | 0.50 | LC |
| *Chlorocichla flaviventris* | Pycnonotidae | Omnivore | 3 | 3.00 | LC |
| *Chrysococcyx caprius* | Cuculidae | Invertebrate | 14 | 9.67 | LC |
| *Chrysococcyx klaas* | Cuculidae | Invertebrate | 4 | 1.67 | LC |
| *Cichladusa arquata* | Muscicapidae | Invertebrate | 6 | 4.08 | LC |
| *Cinnyricinclus leucogaster* | Sturnidae | FruiNect | 4 | 2.25 | LC |
| *Cinnyris bifasciatus* | Nectariniidae | Omnivore | 2 | 0.75 | LC |
| *Cinnyris rufipennis*\*ª | Nectariniidae | FruiNect | - | - | **VU** |
| *Cinnyris talatala* | Nectariniidae | Invertebrate | - | - | LC |
| *Cisticola brachypterus* | Cisticolidae | Invertebrate | 9 | 3.92 | LC |
| *Cisticola chiniana* | Cisticolidae | Invertebrate | 10 | 4.00 | LC |
| *Cisticola erythrops* | Cisticolidae | Invertebrate | 1 | 0.25 | LC |
| *Cisticola marginatus* | Cisticolidae | Invertebrate | 20 | 8.33 | LC |
| *Cisticola natalensis* | Cisticolidae | Invertebrate | 5 | 1.58 | LC |
| Coccopygia quartinia | Estrildidae | PlantSeed | - | - | LC |
| *Colius striatus* | Coliidae | FruiNect | 15 | 10.75 | LC |
| *Columba livia* | Columbidae | PlantSeed | 1 | 1.50 | LC |
| *Coracias caudatus* | Coraciidae | Omnivore | 4 | 2.08 | LC |
| *Coracias garrulus* | Coraciidae | Invertebrate | 2 | 0.75 | LC |
| *Corvus albus* | Corvidae | VertFishScav | 3 | 1.75 | LC |
| *Corvus splendens* | Corvidae | VertFishScav | 5 | 4.25 | LC |
| *Corythornis cristatus* | Alcedinidae | VertFishScav | 6 | 2.58 | LC |
| *Cossypha heuglini* | Muscicapidae | Invertebrate | 31 | 15.58 | LC |
| *Cossypha natalensis* | Muscicapidae | Invertebrate | 14 | 10.00 | LC |
| *Crithagra mozambica* | Fringillidae | PlantSeed | 16 | 10.08 | LC |
| *Crithagra xanthopygiaª* | Fringillidae | PlantSeed | 1 | 0.75 | LC |
| *Cryptolybia olivacea*\*ª | Lybiidae | FruiNect | - | - | LC |
| *Cuculus clamosus* | Cuculidae | Invertebrate | 2 | 1.00 | LC |
| *Cuculus solitarius* | Cuculidae | Invertebrate | 1 | 0.25 | LC |
| *Cyanomitra olivacea* | Nectariniidae | FruiNect | 9 | 5.25 | LC |
| *Cypsiurus parvus* | Apodidae | Invertebrate | 7 | 5.33 | LC |
| *Dendropicos fuscescens* | Picidae | Invertebrate | 1 | 0.50 | LC |
| *Dicrurus adsimilis* | Dicruridae | Invertebrate | 9 | 3.25 | LC |
| *Dicrurus ludwigii* | Dicruridae | Invertebrate | 12 | 7.75 | LC |
| *Dryoscopus cubla* | Malaconotidae | Omnivore | 29 | 14.33 | LC |
| *Egretta ardesiaca* | Ardeidae | VertFishScav | - | - | LC |
| *Elanus axillaris* | Accipitridae | VertFishScav | 4 | 2.67 | LC |
| *Estrilda astrild* | Estrildidae | PlantSeed | 31 | 56.42 | LC |
| *Estrilda erythronotos* | Estrildidae | PlantSeed | - | - | LC |
| *Euplectes albonotatus* | Ploceidae | PlantSeed | 15 | 10.67 | LC |
| *Euplectes axillaris* | Ploceidae | PlantSeed | 50 | 95.17 | LC |
| *Elminia albonotata* | Stenostiridae | Invertebrate | - | - | LC |
| *Euplectes capensis* | Ploceidae | PlantSeed | 6 | 2.50 | LC |
| *Euplectes macroura* | Ploceidae | PlantSeed | 1 | 0.75 | LC |
| *Euplectes nigroventrisª* | Ploceidae | PlantSeed | 76 | 188.67 | LC |
| *Euplectes orix* | Ploceidae | Omnivore | 16 | 23.08 | LC |
| *Eurystomus glaucurus* | Coraciidae | Invertebrate | 2 | 1.50 | LC |
| *Falco biarmicus* | Falconidae | VertFishScav | 5 | 2.25 | LC |
| *Gallirex porphyreolophus* | Musophagidae | FruiNect | 8 | 5.50 | LC |
| *Guttera pucheraniª* | Numididae | Omnivore | - | - | LC |
| *Gypohierax angolensis* | Accipitridae | FruiNect | 6 | 3.17 | LC |
| *Halcyon albiventris* | Alcedinidae | Invertebrate | 12 | 4.67 | LC |
| *Halcyon chelicuti* | Alcedinidae | Invertebrate | 9 | 3.42 | LC |
| *Hedydipna collaris* | Nectariniidae | Invertebrate | 8 | 4.50 | LC |
| *Hippolais icterina* | Acrocephalidae | Invertebrate | 1 | 0.33 | LC |
| *Hirundo rustica* | Hirundinidae | Invertebrate | 15 | 42.58 | LC |
| *Hirundo smithii* | Hirundinidae | Invertebrate | 1 | 0.67 | LC |
| *Indicator indicator* | Indicatoridae | FruiNect | 2 | 1.00 | LC |
| *Ispidina picta* | Alcedinidae | Invertebrate | 1 | 0.25 | LC |
| *Kaupifalco monogrammicus* | Accipitridae | Invertebrate | 1 | 0.25 | LC |
| *Lagonosticta rubricata* | Estrildidae | PlantSeed | 19 | 16.00 | LC |
| *Lagonosticta senegala* | Estrildidae | PlantSeed | 5 | 2.83 | LC |
| *Laniarius aethiopicus* | Malaconotidae | Omnivore | 39 | 23.42 | LC |
| *Lonchura cucullata* | Estrildidae | NA | 34 | 111.92 | LC |
| *Lophaetus occipitalis* | Accipitridae | VertFishScav | 2 | 0.58 | LC |
| *Lophoceros alboterminatus* | Bucerotidae | Omnivore | 15 | 11.42 | LC |
| *Lybius torquatus* | Lybiidae | FruiNect | 1 | 0.50 | LC |
| *Macronyx croceus* | Motacillidae | Invertebrate | 2 | 1.00 | LC |
| *Malaconotus blanchoti* | Malaconotidae | VertFishScav | 5 | 2.58 | LC |
| *Melocichla mentalis* | Macrosphenidae | Invertebrate | 12 | 6.00 | LC |
| *Merops albicollis* | Meropidae | Invertebrate | 7 | 20.50 | LC |
| *Merops apiaster* | Meropidae | Invertebrate | 1 | 2.00 | LC |
| *Merops bullockoides* | Meropidae | Invertebrate | 1 | 3.50 | LC |
| *Merops persicus* | Meropidae | Invertebrate | 2 | 8.00 | LC |
| *Merops pusillus* | Meropidae | Invertebrate | 15 | 12.92 | LC |
| *Milvus migrans* | Accipitridae | VertFishScav | 6 | 5.75 | LC |
| *Motacilla aguimp* | Motacillidae | Invertebrate | 2 | 1.00 | LC |
| *Muscicapa adusta* | Muscicapidae | Invertebrate | 1 | 0.33 | LC |
| *Muscicapa striata* | Muscicapidae | Invertebrate | 1 | 0.25 | LC |
| *Nicator gularis* | Nicatoridae | Invertebrate | 3 | 2.50 | LC |
| *Notopholia corusca* | Sturnidae | FruiNect | - | - | LC |
| *Numida meleagris* | Numididae | PlantSeed | 2 | 4.67 | LC |
| *Oriolus larvatus* | Oriolidae | Omnivore | 5 | 4.50 | LC |
| *Passer domesticus* | Passeridae | PlantSeed | 2 | 8.08 | LC |
| *Passer griseus* | Passeridae | PlantSeed | 5 | 3.00 | LC |
| *Phoeniculus purpureus* | Phoeniculidae | Invertebrate | 4 | 6.00 | LC |
| *Phyllastrephus cabanisi* | Pycnonotidae | Invertebrate | - | - | LC |
| *Phyllastrephus debilisª* | Pycnonotidae | Invertebrate | - | - | LC |
| *Phyllastrephus fischeriª* | Pycnonotidae | Invertebrate | 4 | 5.50 | LC |
| *Phyllastrephus terrestris* | Pycnonotidae | Omnivore | 4 | 1.83 | LC |
| *Platysteira peltata* | Platysteiridae | Invertebrate | 1 | 0.25 | LC |
| *Ploceus burnieriª* | Ploceidae | PlantSeed | 17 | 14.33 | **VU** |
| *Ploceus intermedius* | Ploceidae | Invertebrate | 2 | 6.75 | LC |
| *Ploceus melanocephalus* | Ploceidae | Omnivore | 2 | 1.00 | LC |
| *Ploceus ocularis* | Ploceidae | Invertebrate | 32 | 21.50 | LC |
| *Ploceus reichardiª* | Ploceidae | PlantSeed | - | - | LC |
| *Pogoniulus bilineatus* | Lybiidae | FruiNect | 1 | 0.50 | LC |
| *Pogoniulus pusillus* | Lybiidae | FruiNect | 7 | 3.00 | LC |
| *Pogoniulus simplexª* | Lybiidae | FruiNect | - | - | LC |
| *Pogonornis melanopterus* | Lybiidae | Omnivore | 1 | 1.00 | LC |
| *Poicephalus cryptoxanthus* | Psittacidae | PlantSeed | 1 | 1.00 | LC |
| *Polemaetus bellicosus* | Accipitridae | VertFishScav | 1 | 0.50 | **VU** |
| *Prinia subflava* | Cisticolidae | Invertebrate | 50 | 29.50 | LC |
| *Prionops plumatus* | Vangidae | Invertebrate | 1 | 3.00 | LC |
| *Psalidoprocne pristoptera* | Hirundinidae | Invertebrate | 2 | 0.75 | LC |
| *Pternistis afer* | Phasianidae | PlantSeed | 8 | 3.83 | LC |
| *Pycnonotus barbatus* | Pycnonotidae | FruiNect | 93 | 147.75 | LC |
| *Quelea erythrops* | Ploceidae | PlantSeed | 3 | 5.50 | LC |
| *Quelea quelea* | Ploceidae | PlantSeed | 2 | 15.00 | LC |
| *Rhinopomastus cyanomelas* | Phoeniculidae | Invertebrate | 1 | 0.50 | LC |
| *Sarothrura elegans* | Rallidae | Invertebrate | 1 | 0.25 | LC |
| *Schoenicola brevirostris* | Locustellidae | Invertebrate | 1 | 0.25 | LC |
| *Scopus umbretta* | Scopidae | VertFishScav | 5 | 3.25 | LC |
| *Scotopelia peli* | Strigidae | VertFishScav | 1 | 3.00 | LC |
| *Smithornis capensis* | Calyptomenidae | Invertebrate | 1 | 1.00 | LC |
| *Spermestes bicolor* | Estrildidae | PlantSeed | 20 | 46.83 | LC |
| *Spermestes fringilloides* | Estrildidae | PlantSeed | 2 | 1.50 | LC |
| *Stactolaema leucotis* | Lybiidae | FruiNect | - | - | LC |
| *Stephanoaetus coronatus* | Accipitridae | VertFishScav | - | - | **NT** |
| *Streptopelia capicola* | Columbidae | PlantSeed | 10 | 7.50 | LC |
| *Streptopelia semitorquata* | Columbidae | PlantSeed | 65 | 47.92 | LC |
| *Tauraco livingstonii* | Musophagidae | FruiNect | - | - | LC |
| *Tchagra senegalus* | Malaconotidae | Invertebrate | 11 | 5.08 | LC |
| *Terpsiphone viridis* | Monarchidae | Invertebrate | - | - | LC |
| *Tockus erythrorhynchus* | Bucerotidae | Omnivore | 2 | 2.50 | LC |
| *Treron calvus* | Columbidae | FruiNect | 3 | 3.25 | LC |
| *Trochocercus cyanomelasª* | Monarchidae | Invertebrate | 2 | 0.75 | LC |
| *Turdoides jardineii* | Leiotrichidae | Invertebrate | 23 | 20.25 | LC |
| *Turtur afer* | Columbidae | PlantSeed | 59 | 37.58 | LC |
| *Turtur chalcospilos* | Columbidae | PlantSeed | 1 | 0.50 | LC |
| *Turtur tympanistria* | Columbidae | PlantSeed | 1 | 0.50 | LC |
| *Tychaedon quadrivirgata* | Muscicapidae | Invertebrate | 2 | 1.00 | LC |
| *Upupa epops* | Upupidae | Invertebrate | - | - | LC |
| *Uraeginthus angolensis* | Estrildidae | PlantSeed | 20 | 16.42 | LC |
| *Vidua chalybeata* | Viduidae | PlantSeed | 1 | 1.00 | LC |
| *Vidua funerea* | Viduidae | PlantSeed | 5 | 5.33 | LC |
| *Vidua macroura* | Viduidae | PlantSeed | 27 | 15.33 | LC |
| *Zosterops senegalensis* | Zosteropidae | FruiNect | 1 | 0.25 | LC |

**Supplementary Table 2: *Dietary category grouping***. *A sample of the categorisation process used to group species by dietary preference.*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Species name**  | **Diet. Inv** | **Diet. Vend** | **Diet. Vect** | **Diet. Vfish** | **Diet. Vunk** | **Diet. Scav** | **Diet. Fruit** | **Diet. Nect** | **Diet. Seed** | **Diet. Plant** | **Diet Type** |
| *Acrocephalus baeticatus* | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Invertebrate |
| *Acrocephalus gracilirostris* | 80 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Invertebrate |
| *Acrocephalus palustris* | 80 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | Invertebrate |
| *Acrocephalus scirpaceus* | 70 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 10 | Invertebrate |
| *Agricola pallidus* | 80 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | Invertebrate |
| *Amandava subflava* | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 20 | PlantSeed |
| *Amblyospiza albifrons* | 40 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 30 | 0 | Omnivore |
| *Andropadus importunus* | 30 | 0 | 0 | 0 | 0 | 0 | 70 | 0 | 0 | 0 | FruiNect |

**Supplementary Table 3: *Regression coefficients for single predictor Generalised Linear Models.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Regression Coefficients** |  |  |
| **Response variable**  | **Predictive Variable** | **Value**  | **Std.Error** | **P.value**  | **df** | **Deviance explained**  |
| *Overall species richness* | Percentage canopy closure | -0.00421 | 0.001344 | 0.00174 \*\* | 123 | 0.031 |
|  | Distance to forest | 8.75E-05 | 5.70E-05 | 0.125 | 123 | 0.000 |
|  | Distance to rivers  | -9.42E-07 | 4.26E-05 | 0.982 | 123 | 0.000 |
|  | Distance to plantation | -6.21E-06 | 6.90E-06 | 0.368 | 123 | 0.002 |
|  | Distance to small-holder farm | -5.42E-05 | 6.89E-05 | 0.431 | 123 | 0.002 |
|  | Distance to human settlement  | 3.48E-05 | 4.01E-05 | 0.385 | 123 | 0.002 |
|  | Distance to road | 4.68E-05 | 4.00E-05 | 0.242 | 123 | 0.004 |
| *Invertebrate eating species richness* | Percentage canopy closure | -0.00482 | 0.00241 | 0.0456 \* | 123 | 0.019 |
|  | Distance to forest | 6.73E-05 | 1.02E-04 | 0.511 | 123 | 0.002 |
|  | Distance to rivers  | -2.16E-05 | 7.61E-05 | 0.777 | 123 | 0.000 |
|  | Distance to plantation | -5.14E-07 | 1.22E-05 | 0.966 | 123 | 0.000 |
|  | Distance to small-holder farm | -1.47E-04 | 1.29E-04 | 0.253 | 123 | 0.006 |
|  | Distance to human settlement  | -3.61E-05 | 7.26E-05 | 0.619 | 123 | 0.001 |
|  | Distance to road | 5.80E-05 | 7.07E-05 | 0.412 | 123 | 0.003 |
| *Seed/plant easting species richness* | Percentage canopy closure | -0.00347 | 0.002277 | 0.128 | 123 | 0.008 |
|  | Distance to forest | 1.54E-04 | 9.45E-05 | 0.102 | 123 | 0.009 |
|  | Distance to rivers  | 6.72E-05 | 7.14E-05 | 0.347 | 123 | 0.003 |
|  | Distance to plantation | -1.88E-05 | 1.20E-05 | 0.118 | 123 | 0.009 |
|  | Distance to small-holder farm | 7.16E-05 | 1.10E-04 | 0.516 | 123 | 0.001 |
|  | Distance to human settlement  | 1.72E-04 | 6.65E-05 |  0.00987 \*\*  | 123 | 0.022 |
|  | Distance to road | 4.00E-05 | 6.88E-05 | 0.561 | 123 | 0.001 |
| *Fruit eating species richness* | Percentage canopy closure | -0.00232 | 0.003769 | 0.538919 | 123 | 0.003 |
|  | Distance to forest | -0.00023 | 0.0001933 | 0.243 | 123 | 0.013 |
|  | Distance to rivers  | -0.00013 | 0.0001282 | 0.313696 | 123 | 0.009 |
|  | Distance to plantation | 1.54E-05 | 1.94E-05 | 0.4279 | 123 | 0.005 |
|  | Distance to small-holder farm | -0.00029 | 0.0002255 | 0.203 | 123 | 0.016 |
|  | Distance to human settlement  | -0.00018 | 0.0001232 | 0.138 | 123 | 0.020 |
|  | Distance to road | 1.36E-05 | 1.17E-04 | 0.90772 | 123 | 0.000 |
| *Vertebrate eating species richness* | Percentage canopy closure | -1.68E-02 | 9.05E-03 | 0.06367. | 123 | 0.031 |
|  | Distance to forest | 6.06E-04 | 2.42E-04 |  0.0122 \* | 123 | 0.039 |
|  | Distance to rivers  | -1.42E-05 | 2.33E-04 | 0.951 | 123 | 0.000 |
|  | Distance to plantation | -6.35E-05 | 4.11E-05 | 0.122734 | 123 | 0.019 |
|  | Distance to small-holder farm | 0.000225 | 0.0003229 | 0.487 | 123 | 0.003 |
|  | Distance to human settlement  | 0.000205 | 0.0002095 | 0.328 | 123 | 0.007 |
|  | Distance to road | 5.75E-05 | 2.17E-04 | 0.791 | 123 | 0.001 |

**Supplementary Table 4: *Regression coefficients for multi predictor Generalised Linear Models*.** *Regression coefficients for each predictive variable included in the multi-predictor models for Overall species richness, invertebrate feeding species richness and seed/plant eating species richness. The best fitting model that explained total species richness in the landscape included the variable; percentage canopy closure within a 150m buffer. The best fitting model that explained invertebrate feeding species richness in the landscape included the variable percentage canopy closure within a 150m buffer. The best fitting model that explained seed/plant feeding species richness in the landscape included the variable, distance from human settlement.*

|  |  |  |
| --- | --- | --- |
|  |  | **Regression Coefficients** |
| **Response variable**  | **Predictive Variable** | **Value**  | **Std.Error** | **P.value**  |
| *Overall species richness* | Percentage canopy closure | -3.72E-03 | 2.04E-03 | 0.068 |
|  | Distance to forest | 3.03E-04 | 1.58E-04 | 0.0547 |
|  | Distance to rivers  | -3.10E-05 | 4.50E-05 | 0.4904 |
|  | Distance to plantation | -7.02E-06 | 9.81E-06 | 0.4744 |
|  | Distance to small-holder farm | -3.67E-04 | 3.64E-04 | 0.3128 |
|  | Distance to human settlement  | 6.16E-05 | 9.79E-05 | 0.5291 |
|  | Distance to road | 6.39E-05 | 5.33E-05 | 0.2307 |
|  | Distance to forest: Distance to human settlement | -2.64E-07 | 1.48E-07 | 0.0752 |
|  | Distance to plantation: Distance to human settlement | 2.08E-09 | 1.96E-08 | 0.9155 |
|  | Distance from small holder farms: Distance to human settlement  | 2.71E-07 | 2.26E-07 | 0.2301 |
| *Invertebrate eating species richness*  | Percentage canopy closure | -2.96E-03 | 3.62E-03 | 0.414 |
|  | Distance to forest | 3.14E-04 | 2.71E-04 | 0.247 |
|  | Distance to rivers  | -7.19E-05 | 8.04E-05 | 0.371 |
|  | Distance to plantation | -7.59E-06 | 1.72E-05 | 0.659 |
|  | Distance to small-holder farm | -3.31E-04 | 6.47E-04 | 0.609 |
|  | Distance to human settlement  | -1.21E-04 | 1.79E-04 | 0.497 |
|  | Distance to road | 1.41E-04 | 9.12E-05 | 0.123 |
|  | Distance to forest: Distance to human settlement | -8.02E-08 | 2.67E-07 | 0.764 |
|  | Distance to plantation: Distance to human settlement | 5.14E-09 | 3.56E-08 | 0.885 |
|  | Distance from small holder farms: Distance to human settlement  | 1.19E-07 | 4.02E-07 | 0.767 |
| *Seed/plant easting species richness* | Percentage canopy closure | -4.70E-03 | 3.52E-03 | 0.18086 |
|  | Distance to forest | 4.53E-04 | 2.69E-04 | 0.09234 |
|  | Distance to rivers  | 7.29E-05 | 7.64E-05 | 0.34001 |
|  | Distance to plantation | 7.92E-07 | 1.74E-05 | 0.96367 |
|  | Distance to small-holder farm | -2.00E-04 | 6.14E-04 | 0.74471 |
|  | Distance to human settlement  | 4.83E-04 | 1.61E-04 | 0.00270 \*\* |
|  | Distance to road | -8.73E-05 | 9.66E-05 | 0.3661 |
|  | Distance to forest: Distance to human settlement | -6.26E-07 | 2.42E-07 | 0.00969 \*\* |
|  | Distance to plantation: Distance to human settlement | -2.00E-08 | 3.29E-08 | 0.543 |
|  | Distance from small holder farms: Distance to human settlement  | 3.17E-07 | 3.77E-07 | 0.3994 |

**Supplementary Table 6: *Detection efficiency of bird species across the study landscape*.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Land use**  | **Mean detection**  | **Standard deviation of the mean**  | **Maximum detection** | **Pairwise Wilcoxon**  |
| Cropland | 9.5 | 3.46 | 20 | No significant difference between land use types |
| Forest | 7 | 3.3 | 18 | No significant difference between land use types |
| Grassland | 8 | 2.48 | 14 | No significant difference between land use types |
| Human Settlement  | 10 | 0 | 15 | No significant difference between land use types |

**Supplementary Table 7: *Comparison of species listed on the GBIF checklist against those observed during the sampling period.*** *The downloaded GBIF species list for the study area showed a total of 576 bird species. Of these 576 species 131 were observed during the sampling period, while 17 were observed in the study area but were not listed on the GBIF species list.*

|  |  |  |
| --- | --- | --- |
| **Species present on the GBIF list but not observed during this study** | **Species present on the GBIF list and observed during this study** | **Species observed during this study but not present on the GBIF list** |
| *Accipiter badius* | *Acrocephalus baeticatus* | *Acrocephalus palustris* |
| *Accipiter melanoleucus* | *Acrocephalus gracilirostris* | *Corythornis cristatus* |
| *Accipiter minullus* | *Acrocephalus scirpaceus* | *Crithagra xanthopygia* |
| *Accipiter ovampensis* | *Agricola pallidus* | *Euplectes capensis* |
| *Accipiter tachiro* | *Amandava subflava* | *Euplectes macroura* |
| *Acrocephalus arundinaceus* | *Amblyospiza albifrons* | *Gallirex porphyreolophus* |
| *Acrocephalus schoenobaenus* | *Andropadus importunus* | *Hippolais icterina* |
| *Actitis hypoleucos* | *Anomalospiza imberbis* | *Ispidina picta* |
| *Actophilornis africanus* | *Anthreptes reichenowi* | *Muscicapa striata* |
| *Agapornis personatus* | *Anthus cinnamomeus* | *Phyllastrephus fischeri* |
| *Alcedo cristata* | *Apalis flavida* | *Phyllastrephus terrestris* |
| *Alcippe abyssinica* | *Apalis melanocephala* | *Pogonornis melanopterus* |
| *Alopochen aegyptiaca* | *Apaloderma narina* | *Pternistis afer* |
| *Amadina fasciata* | *Apaloderma vittatum* | *Sarothrura elegans* |
| *Anaplectes rubriceps* | *Ardea melanocephala* | *Scotopelia peli* |
| *Anas sparsa* | *Arizelocichla milanjensis* | *Spermestes cucullata* |
| *Anastomus lamelligerus* | *Bostrychia hagedash* | *Tychaedon quadrivirgata* |
| *Anthoscopus caroli* | *Bradypterus baboecala* |  |
| *Anthreptes longuemarei* | *Buteo buteo* |  |
| *Anthreptes neglectus* | *Bycanistes brevis* |  |
| *Anthreptes rubritorques* | *Bycanistes bucinator* |  |
| *Anthus caffer* | *Camaroptera brachyura* |  |
| *Anthus nyassae* | *Campephaga flava* |  |
| *Anthus similis* | *Campethera nubica* |  |
| *Apalis alticola* | *Cecropis abyssinica* |  |
| *Apalis binotata* | *Centropus superciliosus* |  |
| *Apalis chapini* | *Ceuthmochares australis* |  |
| *Apalis chariessa* | *Chalcomitra senegalensis* |  |
| *Apalis cinerea* | *Chlorocichla flaviventris* |  |
| *Apalis thoracica* | *Chrysococcyx caprius* |  |
| *Apus affinis* | *Chrysococcyx klaas* |  |
| *Apus apus* | *Cichladusa arquata* |  |
| *Apus barbatus* | *Cinnyricinclus leucogaster* |  |
| *Apus caffer* | *Cinnyris bifasciatus* |  |
| *Aquila nipalensis* | *Cisticola brachypterus* |  |
| *Aquila pomarina* | *Cisticola chiniana* |  |
| *Aquila rapax* | *Cisticola erythrops* |  |
| *Aquila spilogaster* | *Cisticola marginatus (galactotes)* |
| *Arcanator orostruthus* | *Cisticola natalensis* |  |
| *Ardea alba* | *Colius striatus* |  |
| *Ardea cinerea* | *Columba livia* |  |
| *Ardea goliath* | *Coracias caudatus* |  |
| *Ardea purpurea* | *Coracias garrulus* |  |
| *Ardeola idae* | *Corvus albus* |  |
| *Ardeola ralloides* | *Corvus splendens* |  |
| *Ardeola rufiventris* | *Cossypha heuglini* |  |
| *Arizelocichla chlorigula* | *Cossypha natalensis* |  |
| *Arizelocichla masukuensis* | *Crithagra mozambica* |  |
| *Arizelocichla neumanni* | *Cuculus clamosus* |  |
| *Arizelocichla nigriceps* | *Cuculus solitarius* |  |
| *Artisornis metopias* | *Cyanomitra olivacea* |  |
| *Asio capensis* | *Cypsiurus parvus* |  |
| *Atimastillas flavicollis* | *Dendropicos fuscescens* |  |
| *Aviceda cuculoides* | *Dicrurus adsimilis* |  |
| *Batis crypta* | *Dicrurus ludwigii* |  |
| *Batis minor* | *Dryoscopus cubla* |  |
| *Batis mixta* | *Elanus axillaris (caeruleus)* |  |
| *Batis molitor* | *Estrilda astrild* |  |
| *Batis soror* | *Euplectes albonotatus* |  |
| *Bias musicus* | *Euplectes axillaris* |  |
| *Bocagia minuta* | *Euplectes nigroventris* |  |
| *Bradornis fuliginosus* | *Euplectes orix* |  |
| *Bradornis microrhynchus* | *Eurystomus glaucurus* |  |
| *Bradypterus barratti* | *Falco biarmicus* |  |
| *Bradypterus cinnamomeus* | *Gypohierax angolensis* |  |
| *Bradypterus lopezi* | *Halcyon albiventris* |  |
| *Bubalornis niger* | *Halcyon chelicuti* |  |
| *Bubo africanus* | *Hedydipna collaris* |  |
| *Bubo lacteus* | *Hirundo rustica* |  |
| *Bubulcus ibis* | *Hirundo smithii* |  |
| *Bucorvus abyssinicus* | *Indicator indicator* |  |
| *Bucorvus leadbeateri* | *Kaupifalco monogrammicus* |  |
| *Bugeranus carunculatus* | *Lagonosticta rubricata* |  |
| *Buphagus africanus* | *Lagonosticta senegala* |  |
| *Buphagus erythrorhynchus* | *Laniarius aethiopicus* |  |
| *Burhinus capensis* | *Lophaetus occipitalis* |  |
| *Burhinus vermiculatus* | *Lophoceros alboterminatus* |  |
| *Buteo oreophilus* | *Lybius torquatus* |  |
| *Butorides striata* | *Macronyx croceus* |  |
| *Calamonastes undosus* | *Malaconotus blanchoti* |  |
| *Calidris ferruginea* | *Melocichla mentalis* |  |
| *Calidris minuta* | *Merops albicollis* |  |
| *Campephaga phoenicea* | *Merops apiaster* |  |
| *Campethera abingoni* | *Merops bullockoides* |  |
| *Campethera bennettii* | *Merops persicus* |  |
| *Campethera cailliautii* | *Merops pusillus* |  |
| *Caprimulgus clarus* | *Milvus migrans* |  |
| *Caprimulgus europaeus* | *Motacilla aguimp* |  |
| *Caprimulgus fossii* | *Muscicapa adusta* |  |
| *Caprimulgus natalensis* | *Nicator gularis* |  |
| *Caprimulgus pectoralis* | *Numida meleagris* |  |
| *Caprimulgus ruwenzorii* | *Oriolus larvatus* |  |
| *Cecropis daurica* | *Passer domesticus* |  |
| *Cecropis senegalensis* | *Passer griseus* |  |
| *Centropus cupreicaudus* | *Phoeniculus purpureus* |  |
| *Centropus grillii* | *Platysteira peltata* |  |
| *Cercococcyx montanus* | *Ploceus burnieri* |  |
| *Ceryle rudis* | *Ploceus intermedius* |  |
| *Ceuthmochares aereus* | *Ploceus melanocephalus* |  |
| *Ceyx pictus* | *Ploceus ocularis* |  |
| *Chalcomitra amethystina* | *Pogoniulus bilineatus* |  |
| *Charadrius asiaticus* | *Pogoniulus pusillus* |  |
| *Charadrius marginatus* | *Poicephalus cryptoxanthus* |  |
| *Charadrius pecuarius* | *Polemaetus bellicosus* |  |
| *Charadrius tricollaris* | *Prinia subflava* |  |
| *Chlorophoneus nigrifrons* | *Prionops plumatus* |  |
| *Chlorophoneus sulfureopectus* | *Psalidoprocne pristoptera* |  |
| *Chroicocephalus cirrocephalus* | *Pycnonotus barbatus* |  |
| *Chrysococcyx cupreus* | *Quelea erythrops* |  |
| *Cichladusa guttata* | *Quelea quelea* |  |
| *Ciconia abdimii* | *Rhinopomastus cyanomelas* |  |
| *Ciconia ciconia* | *Schoenicola brevirostris* |  |
| *Ciconia episcopus* | *Scopus umbretta* |  |
| *Cinnyris erythrocercus* | *Smithornis capensis* |  |
| *Cinnyris loveridgei* | *Spermestes bicolor* |  |
| *Cinnyris ludovicensis* | *Spermestes fringilloides* |  |
| *Cinnyris mariquensis* | *Streptopelia capicola* |  |
| *Cinnyris moreaui* | *Streptopelia semitorquata* |  |
| *Cinnyris pulchellus* | *Tchagra senegalus* |  |
| *Cinnyris rufipennis* | *Tockus erythrorhynchus* |  |
| *Cinnyris shelleyi* | *Treron calvus* |  |
| *Cinnyris venustus* | *Trochocercus cyanomelas* |  |
| *Circaetus cinereus* | *Turdoides jardineii* |  |
| *Circaetus fasciolatus* | *Turtur afer* |  |
| *Circaetus pectoralis* | *Turtur chalcospilos* |  |
| *Circus aeruginosus* | *Turtur tympanistria* |  |
| *Circus macrourus* | *Uraeginthus angolensis* |  |
| *Circus pygargus* | *Vidua chalybeata* |  |
| *Circus ranivorus* | *Vidua funerea* |  |
| *Cisticola aridulus* | *Vidua macroura* |  |
| *Cisticola cantans* | *Zosterops senegalensis* |  |
| *Cisticola chubbi* |  |  |
| *Cisticola fulvicapilla* |  |  |
| *Cisticola juncidis* |  |  |
| *Cisticola nana* |  |  |
| *Cisticola nigriloris* |  |  |
| *Cisticola njombe* |  |  |
| *Cisticola robustus* |  |  |
| *Clamator jacobinus* |  |  |
| *Clamator levaillantii* |  |  |
| *Coccopygia melanotis* |  |  |
| *Coccopygia quartinia* |  |  |
| *Columba arquatrix* |  |  |
| *Columba delegorguei* |  |  |
| *Columba guinea* |  |  |
| *Columba larvata* |  |  |
| *Coracias naevius* |  |  |
| *Coracias spatulatus* |  |  |
| *Coracina caesia* |  |  |
| *Coracina pectoralis* |  |  |
| *Corvus albicollis* |  |  |
| *Cossypha anomala* |  |  |
| *Cossypha caffra* |  |  |
| *Coturnix delegorguei* |  |  |
| *Creatophora cinerea* |  |  |
| *Crithagra hyposticta* |  |  |
| *Crithagra melanochroa* |  |  |
| *Crithagra mennelli* |  |  |
| *Crithagra reichardi* |  |  |
| *Crithagra reichenowi* |  |  |
| *Crithagra sulphurata* |  |  |
| *Crithagra whytii* |  |  |
| *Cryptospiza reichenovii* |  |  |
| *Cuculus gularis* |  |  |
| *Cursorius temminckii* |  |  |
| *Cyanomitra verticalis* |  |  |
| *Delichon urbicum* |  |  |
| *Dendrocygna viduata* |  |  |
| *Dendroperdix sephaena* |  |  |
| *Dioptrornis chocolatinus* |  |  |
| *Egretta ardesiaca* |  |  |
| *Egretta garzetta* |  |  |
| *Egretta intermedia* |  |  |
| *Elminia albonotata* |  |  |
| *Emberiza cabanisi* |  |  |
| *Emberiza flaviventris* |  |  |
| *Ephippiorhynchus senegalensis* |  |  |
| *Eremomela icteropygialis* |  |  |
| *Eremomela scotops* |  |  |
| *Eremopterix leucopareia* |  |  |
| *Erythrocercus livingstonei* |  |  |
| *Erythropygia leucophrys* |  |  |
| *Erythropygia quadrivirgata* |  |  |
| *Estrilda erythronotos* |  |  |
| *Estrilda paludicola* |  |  |
| *Estrilda perreini* |  |  |
| *Estrilda rhodopyga* |  |  |
| *Euplectes ardens* |  |  |
| *Euplectes hartlaubi* |  |  |
| *Euplectes hordeaceus* |  |  |
| *Euplectes psammacromius* |  |  |
| *Eurillas virens* |  |  |
| *Eurocephalus ruppelli* |  |  |
| *Falco ardosiaceus* |  |  |
| *Falco chicquera* |  |  |
| *Falco cuvierii* |  |  |
| *Falco dickinsoni* |  |  |
| *Falco naumanni* |  |  |
| *Falco peregrinus* |  |  |
| *Falco subbuteo* |  |  |
| *Falco tinnunculus* |  |  |
| *Francolinus afer* |  |  |
| *Francolinus coqui* |  |  |
| *Francolinus hildebrandti* |  |  |
| *Francolinus squamatus* |  |  |
| *Fraseria caerulescens* |  |  |
| *Fraseria plumbea* |  |  |
| *Gallinula chloropus* |  |  |
| *Geokichla gurneyi* |  |  |
| *Glareola pratincola* |  |  |
| *Glaucidium capense* |  |  |
| *Glaucidium perlatum* |  |  |
| *Guttera pucherani* |  |  |
| *Gymnoris superciliaris* |  |  |
| *Gyps africanus* |  |  |
| *Gyps rueppellii* |  |  |
| *Halcyon leucocephala* |  |  |
| *Halcyon senegalensis* |  |  |
| *Haliaeetus vocifer* |  |  |
| *Hieraaetus pennatus* |  |  |
| *Hieraaetus wahlbergi* |  |  |
| *Himantopus himantopus* |  |  |
| *Hippolais languida* |  |  |
| *Hirundo angolensis* |  |  |
| *Histurgops ruficauda* |  |  |
| *Hyliota flavigaster* |  |  |
| *Hypargos niveoguttatus* |  |  |
| *Iduna natalensis* |  |  |
| *Iduna pallida* |  |  |
| *Iduna similis* |  |  |
| *Illadopsis rufipennis* |  |  |
| *Indicator minor* |  |  |
| *Indicator variegatus* |  |  |
| *Ixobrychus minutus* |  |  |
| *Jynx ruficollis* |  |  |
| *Lagonosticta nitidula* |  |  |
| *Lagonosticta rhodopareia* |  |  |
| *Lamprotornis chalybaeus* |  |  |
| *Lamprotornis chloropterus* |  |  |
| *Lamprotornis hildebrandti* |  |  |
| *Lamprotornis superbus* |  |  |
| *Lamprotornis unicolor* |  |  |
| *Laniarius ferrugineus* |  |  |
| *Laniarius fuelleborni* |  |  |
| *Laniarius major* |  |  |
| *Laniarius sublacteus* |  |  |
| *Lanius cabanisi* |  |  |
| *Lanius collaris* |  |  |
| *Lanius collurio* |  |  |
| *Lanius humeralis* |  |  |
| *Lanius isabellinus* |  |  |
| *Lanius minor* |  |  |
| *Lanius phoenicuroides* |  |  |
| *Leptoptilos crumenifer* |  |  |
| *Linurgus olivaceus* |  |  |
| *Lissotis melanogaster* |  |  |
| *Lonchura cucullata* |  |  |
| *Lonchura nigriceps* |  |  |
| *Lophoceros nasutus* |  |  |
| *Lophoceros pallidirostris* |  |  |
| *Lophotis gindiana* |  |  |
| *Luscinia megarhynchos* |  |  |
| *Lybius melanopterus* |  |  |
| *Macheiramphus alcinus* |  |  |
| *Macronyx fuelleborni* |  |  |
| *Macrosphenus kretschmeri* |  |  |
| *Megaceryle maxima* |  |  |
| *Melaenornis fischeri* |  |  |
| *Melaenornis pammelaina* |  |  |
| *Melaniparus griseiventris* |  |  |
| *Melaniparus rufiventris* |  |  |
| *Melierax metabates* |  |  |
| *Melierax poliopterus* |  |  |
| *Melittophagus pusillus* |  |  |
| *Merops boehmi* |  |  |
| *Merops nubicus* |  |  |
| *Merops oreobates* |  |  |
| *Microcarbo africanus* |  |  |
| *Micronisus gabar* |  |  |
| *Milvus aegyptius* |  |  |
| *Mirafra rufocinnamomea* |  |  |
| *Modulatrix stictigula* |  |  |
| *Monticola angolensis* |  |  |
| *Motacilla capensis* |  |  |
| *Motacilla clara* |  |  |
| *Motacilla flava* |  |  |
| *Mycteria ibis* |  |  |
| *Myrmecocichla aethiops* |  |  |
| *Neafrapus boehmi* |  |  |
| *Necrosyrtes monachus* |  |  |
| *Nectarinia famosa* |  |  |
| *Nectarinia kilimensis* |  |  |
| *Neotis denhami* |  |  |
| *Nilaus afer* |  |  |
| *Notopholia corrusca* |  |  |
| *Nycticorax nycticorax* |  |  |
| *Oena capensis* |  |  |
| *Oenanthe isabellina* |  |  |
| *Oenanthe oenanthe* |  |  |
| *Oenanthe pileata* |  |  |
| *Onychognathus morio* |  |  |
| *Onychognathus tenuirostris* |  |  |
| *Onychognathus walleri* |  |  |
| *Oriolus auratus* |  |  |
| *Oriolus chlorocephalus* |  |  |
| *Otus senegalensis* |  |  |
| *Pachycoccyx audeberti* |  |  |
| *Parus rufiventris* |  |  |
| *Passer diffusus* |  |  |
| *Passer eminibey* |  |  |
| *Passer suahelicus* |  |  |
| *Pelecanus onocrotalus* |  |  |
| *Pelecanus rufescens* |  |  |
| *Pentholaea arnotti* |  |  |
| *Pernis apivorus* |  |  |
| *Phalacrocorax carbo* |  |  |
| *Philomachus pugnax* |  |  |
| *Phyllastrephus cabanisi* |  |  |
| *Phyllastrephus cerviniventris* |  |  |
| *Phyllastrephus flavostriatus* |  |  |
| *Phyllastrephus placidus* |  |  |
| *Phyllastrephus strepitans* |  |  |
| *Phylloscopus ruficapilla* |  |  |
| *Phylloscopus trochilus* |  |  |
| *Platalea alba* |  |  |
| *Plectropterus gambensis* |  |  |
| *Plegadis falcinellus* |  |  |
| *Plocepasser mahali* |  |  |
| *Ploceus baglafecht* |  |  |
| *Ploceus bertrandi* |  |  |
| *Ploceus bicolor* |  |  |
| *Ploceus capensis* |  |  |
| *Ploceus cucullatus* |  |  |
| *Ploceus jacksoni* |  |  |
| *Ploceus nicolli* |  |  |
| *Ploceus nigricollis* |  |  |
| *Ploceus reichardi* |  |  |
| *Ploceus subaureus* |  |  |
| *Ploceus velatus* |  |  |
| *Ploceus xanthops* |  |  |
| *Ploceus xanthopterus* |  |  |
| *Poeoptera kenricki* |  |  |
| *Pogoniulus chrysoconus* |  |  |
| *Pogoniulus leucomystax* |  |  |
| *Pogoniulus simplex* |  |  |
| *Pogonocichla stellata* |  |  |
| *Poicephalus meyeri* |  |  |
| *Poicephalus robustus* |  |  |
| *Polihierax semitorquatus* |  |  |
| *Poliocephalus ruficollis* |  |  |
| *Polyboroides typus* |  |  |
| *Porphyrio alleni* |  |  |
| *Porphyrio porphyrio* |  |  |
| *Prinia erythroptera* |  |  |
| *Prionops retzii* |  |  |
| *Prionops scopifrons* |  |  |
| *Prodotiscus zambesiae* |  |  |
| *Psalidoprocne holomelaena* |  |  |
| *Pseudalethe fuelleborni* |  |  |
| *Pseudhirundo griseopyga* |  |  |
| *Psophocichla litsitsirupa* |  |  |
| *Ptilopsis granti* |  |  |
| *Ptyonoprogne fuligula* |  |  |
| *Pycnonotus tricolor* |  |  |
| *Pyrenestes minor* |  |  |
| *Pytilia afra* |  |  |
| *Pytilia melba* |  |  |
| *Quelea cardinalis* |  |  |
| *Rhinopomastus minor* |  |  |
| *Rhinoptilus chalcopterus* |  |  |
| *Riparia paludicola* |  |  |
| *Riparia riparia* |  |  |
| *Rostratula benghalensis* |  |  |
| *Rynchops flavirostris* |  |  |
| *Sarkidiornis melanotos* |  |  |
| *Saxicola torquatus* |  |  |
| *Scepomycter rubehoensis* |  |  |
| *Scepomycter winifredae* |  |  |
| *Schoutedenapus myoptilus* |  |  |
| *Setophaga striata* |  |  |
| *Sheppardia aurantiithorax* |  |  |
| *Sheppardia lowei* |  |  |
| *Sheppardia sharpei* |  |  |
| *Sporaeginthus subflavus* |  |  |
| *Stactolaema leucotis* |  |  |
| *Stactolaema olivacea* |  |  |
| *Stephanoaetus coronatus* |  |  |
| *Sterna nilotica* |  |  |
| *Streptopelia decipiens* |  |  |
| *Streptopelia senegalensis* |  |  |
| *Strix woodfordii* |  |  |
| *Swynnertonia swynnertoni* |  |  |
| *Sylvia abyssinica* |  |  |
| *Sylvia borin* |  |  |
| *Sylvia lugens* |  |  |
| *Sylvia nisoria* |  |  |
| *Sylvietta rufescens* |  |  |
| *Sylvietta whytii* |  |  |
| *Tachymarptis aequatorialis* |  |  |
| *Tauraco livingstonii* |  |  |
| *Tauraco persa* |  |  |
| *Tauraco porphyreolophus* |  |  |
| *Tchagra australis* |  |  |
| *Telacanthura ussheri* |  |  |
| *Telophorus cruentus* |  |  |
| *Terathopius ecaudatus* |  |  |
| *Terpsiphone viridis* |  |  |
| *Threskiornis aethiopicus* |  |  |
| *Tmetothylacus tenellus* |  |  |
| *Tockus alboterminatus* |  |  |
| *Tockus deckeni* |  |  |
| *Tockus flavirostris* |  |  |
| *Tockus ruahae* |  |  |
| *Torgos tracheliotos* |  |  |
| *Trachyphonus vaillantii* |  |  |
| *Tricholaema lacrymosa* |  |  |
| *Trigonoceps occipitalis* |  |  |
| *Tringa glareola* |  |  |
| *Tringa nebularia* |  |  |
| *Tringa ochropus* |  |  |
| *Tringa stagnatilis* |  |  |
| *Turdoides hypoleuca* |  |  |
| *Turdoides sharpei* |  |  |
| *Turdus abyssinicus* |  |  |
| *Turdus libonyana* |  |  |
| *Tyto alba* |  |  |
| *Upupa epops* |  |  |
| *Uraeginthus bengalus* |  |  |
| *Uraeginthus cyanocephalus* |  |  |
| *Urocolius macrourus* |  |  |
| *Vanellus albiceps* |  |  |
| *Vanellus armatus* |  |  |
| *Vanellus coronatus* |  |  |
| *Vanellus crassirostris* |  |  |
| *Vanellus lugubris* |  |  |
| *Vanellus senegallus* |  |  |
| *Vanellus spinosus* |  |  |
| *Vidua hypocherina* |  |  |
| *Vidua obtusa* |  |  |
| *Vidua paradisaea* |  |  |
| *Vidua purpurascens* |  |  |
| *Xenoperdix udzungwensis* |  |  |
| *Zapornia flavirostra* |  |  |
| *Zosterops anderssoni* |  |  |
| *Zosterops poliogastrus* |  |  |

**Supplementary Material**

#Cropland can support high bird diversity in rural tropical landscapes

# ###(1) read in relevant packages/functions ---------------------------------------

necessary.packages<-c("devtools","XML","httr","rvest","MASS","pixmap",

 "ggplot2","MuMIn","VennDiagram",

 "tseries","raster","graphics",

 "rtiff","jpeg","gamlss",

 "Kendall","R.utils","plyr","reshape","stringr",

 "rgdal","sp","leaflet","maptools",

 "rredlist","taxize","gplots",

 "FD","RColorBrewer", "tidyr", "ggplot2","dplyr")

already.installed<-necessary.packages%in%installed.packages()[, 'Package'] #asks if the necessary packages are already installed in the library?

if (length(necessary.packages[!already.installed])>=1) { #if any are NOT installed, download them now.

 install.packages(necessary.packages[!already.installed],dep=T) #are the dependencies really necessary (there are lots!)?

}

sapply(necessary.packages,function(p) {require(p,quietly=T,character.only=T)})

library(pixmap)

library(png)

stderr <- function(x, na.rm=FALSE) {

 if(is.matrix(x))

 apply(x,2,stderr,na.rm=rm)

 else if(is.vector(x))

 sqrt(var(x,na.rm=na.rm)/length1(x))

 else if(is.data.frame(x))

 sapply(x,stderr,na.rm=na.rm)

 else sqrt(var(as.vector(x),na.rm=na.rm)/length1(x))

}

remove\_outliers <- function(x, na.rm = TRUE, ...) {

 qnt <- quantile(x, probs=c(.25, .75), na.rm = na.rm, ...)

 H <- 1.5 \* IQR(x, na.rm = na.rm)

 y <- x

 y[x < (qnt[1] - H)] <- NA

 y[x > (qnt[2] + H)] <- NA

 y

}

perbar=function(xx){

 q=ggplot(data=data.frame(xx),aes(x=xx))+

 geom\_bar(aes(y = (..count..)),width=.5,fill="orange")

 q=q+ geom\_text(aes(label = scales::percent((..count..)/sum(..count..))), stat="bin",colour="darkgreen",vjust=0.35) +xlab("Species Response")

 q=q+ theme(axis.text=element\_text(size=12,angle=45),

 axis.title=element\_text(size=12,face="bold"))

 q=q+theme(axis.title.x=element\_text(vjust=-0.35),axis.title.y=element\_text(vjust=+0.35))

 q=q+ylab("Count")

 q

}

readinteger <- function()

{

 n <- readline(prompt="Enter an integer: ")

 return(as.integer(n))

}

length1 <- function (x) {

 length(!is.na(x)[!is.na(x)=="TRUE"])

}

Dsquared <- function(model = NULL,

 obs = NULL,

 pred = NULL,

 family = NULL, # needed only when 'model' not provided

 adjust = FALSE,

 npar = NULL) { # needed only when 'model' not provided

 # version 1.4 (31 Aug 2015)

 model.provided <- ifelse(is.null(model), FALSE, TRUE)

 if (model.provided) {

 if (!("glm" %in% class(model))) stop ("'model' must be of class 'glm'.")

 if (!is.null(pred)) message("Argument 'pred' ignored in favour of 'model'.")

 if (!is.null(obs)) message("Argument 'obs' ignored in favour of 'model'.")

 obs <- model$y

 pred <- model$fitted.values

 } else { # if model not provided

 if (is.null(obs) | is.null(pred)) stop ("You must provide either 'obs' and 'pred', or a 'model' object of class 'glm'.")

 if (length(obs) != length(pred)) stop ("'obs' and 'pred' must be of the same length (and in the same order).")

 if (is.null(family)) stop ("With 'obs' and 'pred' arguments (rather than a model object), you must also specify one of two model family options: 'binomial' or 'poisson' (in quotes).")

 else if (!is.character(family)) stop ("Argument 'family' must be provided as character (i.e. in quotes: 'binomial' or 'poisson').")

 else if (length(family) != 1 | !(family %in% c("binomial", "poisson"))) stop ("'family' must be either 'binomial' or 'poisson' (in quotes).")

 if (family == "binomial") {

 if (any(!(obs %in% c(0, 1)) | pred < 0 | pred > 1)) stop ("'binomial' family implies that 'obs' data should be binary (with values 0 or 1) and 'pred' data should be bounded between 0 and 1.")

 link <- log(pred / (1 - pred)) # logit

 } # end if binomial

 else if (family == "poisson") {

 if (any(obs %%1 != 0)) stop ("'poisson' family implies that 'obs' data should consist of whole numbers.")

 link <- log(pred)

 } # end if poisson

 model <- glm(obs ~ link, family = family)

 } # end if model not provided

 D2 <- (model$null.deviance - model$deviance) / model$null.deviance

 if (adjust) {

 if (model.provided) {

 n <- length(model$y)

 #p <- length(model$coefficients)

 p <- attributes(logLik(model))$df

 } else {

 if (is.null(npar)) stop ("Adjusted D-squared from 'obs' and 'pred' values (rather than a model object) requires specifying the number of parameters in the underlying model ('npar').")

 n <- length(na.omit(obs))

 p <- npar

 } # end if model.provided else

 D2 <- 1 - ((n - 1) / (n - p)) \* (1 - D2)

 } # end if adjust

 return (D2)

}

####