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Bird species diversity in relation to indigenous tree species for sustainable tourism development Urhonigbe Forest Reserve, Nigeria

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Abstract

This research investigation focused on exploring the diversity of bird species concerning indigenous tree species within the Urhonigbe Forest Reserve in Edo State, Nigeria, to promote sustainable tourism development. The primary objective of the study was to ascertain the correlation between bird community composition, species richness, evenness, diversity, and the presence of indigenous trees, thereby contributing to sustainable tourism efforts. The research was conducted within the Urhonigbe forest reserve, situated between longitudes 6°05'38" and 6°06'45"E, and latitudes 5°57'59" and 5°59'31"N, within Edo State. The study area was divided into two distinct parts: secondary forest and undisturbed forest compartments. The secondary forest area underwent enrichment with exotic timber trees. Data collection took place during two seasons of the year, namely the wet and dry seasons, spanning from January to March and June to September 2023. The diversity and abundance of bird species on six selected indigenous trees in the study area were assessed using the point count method. A total of 24 point counts were established, with 12 in each compartment. The chosen trees included *Albizia zygia*, *Dialium guineense*, *Ficus exasperata*, *Spondias mombin*, *Vitex donania*, and *Parkia biglobosa*. The findings revealed a diversity index of ninety-five (95) and an abundance of two hundred and seventy-two (272) bird species recorded. Among these, the order Passeriformes exhibited the highest bird species diversity, with values of 14.83 and 12.25 recorded in the two compartments. Notably, the fruit trees Ficus exasperata displayed the highest bird species diversity at 14.83, followed by *Dialium guineense* at 11.6, respectively. Additionally, the analysis of feeding guilds indicated that frugivores, omnivores, and insectivores displayed the highest bird species diversity in the study area.

Keywords: Bird species, Diversity Indigenous, Plant species, Tourism development

Introduction

The relationship between bird species diversity and indigenous tree species is a fascinating aspect of ecology and biodiversity conservation. Indigenous tree species, also known as native tree species, are those that naturally occur and have evolved in a particular region over long periods. Indigenous trees often provide diverse habitats, including forests, woodlands, and savannas, which support a variety of bird species. Different bird species have evolved to inhabit specific types of tree habitats based on factors such as canopy structure, tree height, and foliage density (Mathew, et al, 1983) Indigenous trees produce fruits, seeds, nectar, and insects, which serve as important food sources for birds. Different bird species have specialized diets and foraging behaviors, relying on specific tree species for nutrition. For example, fruit-eating birds may depend on the fruits of certain tree species for sustenance. Indigenous trees provide nesting sites and shelter for birds to raise their young and protect them from predators and adverse weather conditions. Trees with dense foliage, suitable branch structures, and cavity formations are particularly important for nesting birds species diversity in relation to indigenous trees can vary across different seasons and regions due to migration patterns and seasonal changes in food availability and habitat conditions (Rajpar & Zakaria, 2011). Some bird species may migrate to regions with suitable indigenous tree habitats during specific times of the year. Indigenous trees contribute to the overall stability and health of ecosystems by promoting soil fertility, regulating water cycles, and supporting other native plant and animal species. Healthy tree populations can sustain diverse bird communities by providing a stable ecological foundation (Faanes, 2008), Human activities such as deforestation, habitat fragmentation, and invasive species introduction can negatively impact both indigenous trees and bird populations. Conservation efforts aimed at preserving and restoring indigenous tree habitats play a crucial role in maintaining bird species diversity and overall ecosystem resilience. Studies and monitoring efforts often employ various methods, including bird surveys, habitat assessments, and ecological modeling, to assess the relationship between bird species diversity and indigenous tree species. Conservation strategies may involve habitat restoration, sustainable land management practices, and community engagement to safeguard both indigenous trees and bird populations for future generations (Manu, 2000) Studying bird species in relation to indigenous tree species helps ecologists and researchers understand the intricate dynamics of ecosystems. This study aimed to determine the relationship between bird community composition,

species richness, evenness, diversity, and indigenous trees. Further investigations were carried out to compare the structural properties of bird communities between two selected locations.

Material and methods

Study area

In 1935, the Urhonigbe forest reserve was established and officially gazetted. Positioned between longitudes 6°05'38" and 6°06'45"E and latitudes 5°57'59" and 5°59'31"N, this reserve spans approximately 30,791 hectares and is located in Edo State, situated southeast of the Sakponba Forest Reserve (Fig. 1). It is bordered by the settlements of Urhonigbe A and Evboesi to the East and West, respectively, and exhibits a somewhat reversed "C" shape (Isichei, 1995). Within the forest reserve lies a 64-hectare Strict Natural Reserve (SNR), with Urhonigbe positioned at the southern end and Obazagbon in the northeast. Surrounding the reserve are several Bini towns and villages. The highest elevation within the Urhonigbe Forest Reserve reaches 75 meters above sea level, with a gentle slope and a mean height of 60 meters (Mengistu & Salami, 2007). The global climate is typified by an average annual temperature of 27°C, indicative of a typical humid tropical rainforest climate. Significant rainfall occurs from March to November, with an average annual precipitation ranging from 1778 mm to 2286 mm, evenly distributed throughout this period. December to February marks the dry season. The prevalent soil type is sandy loam, characterized by high permeability and considerable base-leaching, largely influenced by its texture. Consequently, the substantial annual rainfall, coupled with these soil characteristics, leads to high soil acidity, with pH levels ranging from 4.30 to 5.00. Tropical rainforests constitute the predominant natural vegetation across the globe, characterized by towering emergent growth beneath numerous canopies and intertwined vines known as lianas. Among the commonly encountered trees in this region are *Melicia excelsa, Afzelia bipindensis, Antiaris africana, Brachystegia nigerica, Lophira alata, Lovoa trichiliodes, Terminalia ivorensis, Terminalia superba,* and *Triplochiton scleroxylon*. However, the natural vegetation has undergone substantial depletion, giving way to secondary regrowth forest thickets and fallow regrowth at various stages of development or replaced by perennial and annual crops, except for areas designated as forest reserves (Keay, 1989).

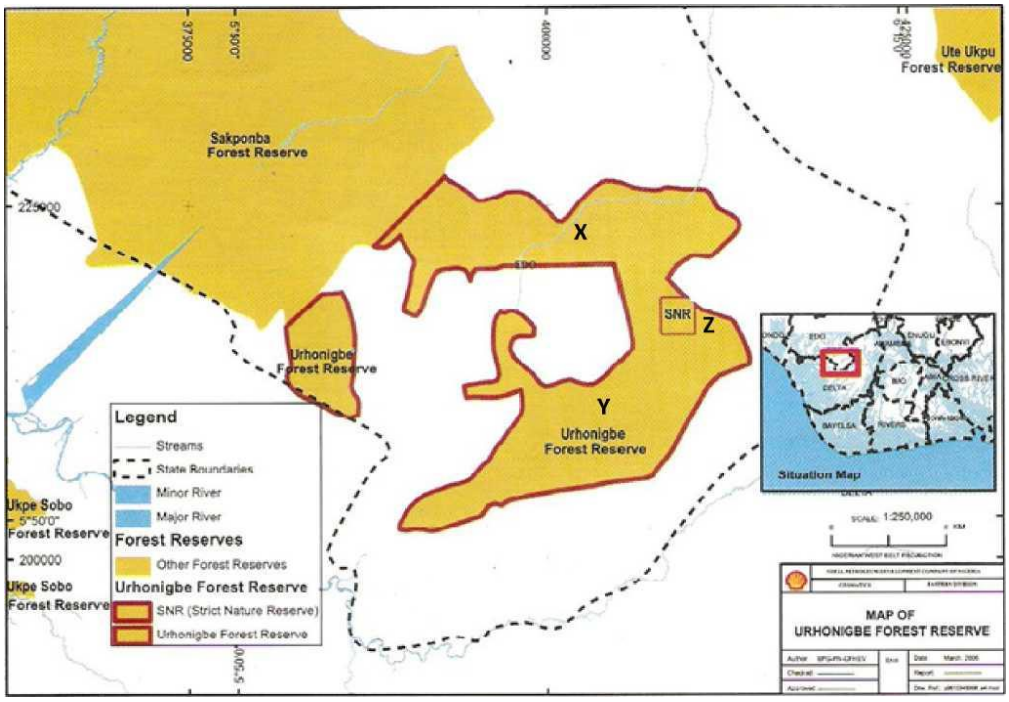

Figure 1. Map of the study area

Data collection

This study was carried out in Urhonigbe Forest Reserve Edo state south Nigeria. The study area was divided into two parts secondary forest and undisturbed forest compartments. Data were collected in the two seasons of the year (wet and dry seasons) January to March and June to September 2023. To examine the diversity and abundance of bird species on six selected indigenous trees in the study area point count method according to (Buckland et al, 2008) was used. A total of 24 point counts were set up and 12 point count in each compartment. The selected trees are *Albizia zygia, Dialium guineense, Ficus exasperate, Spondias mombin, Vitex donania, Parkia biglobosa.* In this method counting stations or predefined spots are established in roosting sites, wetland and feeding sites as well as forest edges. Counting bands of 50m radius were used for all the stations. The minimum distance between the two counting stations was 200m. The number of counting stations was determined by the site size. On arrival at the sites, birds were allowed time to settle before recording all the birds seen or heard for a predetermined time (20 minutes). A pair of binoculars with a magnification 7x 50 was used in the identification of bird species. Bird calls were also recorded with a voice recorder and played back later for confirmation. Physical features of birds sighted but could not be identified immediately were taken and a field guidebook of West African birds (Burrow and Demey, 2011)was used to identify the bird species,

and bird calls were used to confirm the presence of nocturnal bird species within the study sites. The survey was conducted between 0.600 hours and 10.00 hours and 1600 hours to 1800 hours, the survey was not conducted beyond 10.00 hours in the morning in other to reduce daylight effect. Excel spreadsheet was used to enter data from the field survey before both descriptive and analytical (tables, frequency, and graph). The analysis of bird species diversity indices was done using the computer program PAST Model version 3.

Results

The findings reveal that a total of ninety-five (95) bird species were recorded, with an abundance of two hundred and seventy-two (272) individuals (see Table 1). Within the study area, the order Passeriformes exhibited the highest bird species diversity, with values of 14.83 and 12.25 recorded in two compartments, respectively. Among fruit trees, *Ficus exasperata* displayed the highest bird species diversity at 14.83, followed by *Diallum guineense* at 11.6 (refer to Table 2). Regarding feeding guilds, frugivorous, omnivores, and insectivores exhibited the highest bird species diversity in the study area. Table 3 illustrates the family composition of bird species, with Pycnonotidae having a diversity index of 10, followed by Nectariniidae at 7, and Capitonidae at 6. Figure 2 depicts the SHE analysis, which examined the relationship between species richness and the Shannon-Wiener diversity index, as well as evenness measured using the Shannon-Wiener evenness. The results indicate a positive relationship between species richness and species evenness in the study area (Figure 3).

Table 1. Diversity index of bird species in the study area

Diversity index	Dry season	Lower	Upper	Wet season	Lower	Upper
Taxa_S	95	91	95	85	75	84
Individuals	272	272	272	173	173	173
Dominance_D	0.01317	0.01395	0.01717	0.01567	0.01614	0.02135
Simpson_1-D	0.9868	0.9828	0.986	0.9843	0.9786	0.9839
Evenness_e^H/S	0.8962	0.7808	0.8588	0.8736	0.7814	0.8673
Brillouin	3.96	3.832	3.923	3.708	3.563	3.678
Menhinick	5.76	5.518	5.76	6.462	5.702	6.386
Margalef	16.77	16.05	16.77	16.3	14.36	16.11
Equitability_J	0.9759	0.9455	0.9665	0.9696	0.9435	0.9675
Fisher_alpha	51.86	47.94	51.86	66.13	50.34	64.37
Berger-Parker	0.03309	0.02941	0.05515	0.05202	0.03468	0.07514

Table 2. Bird species diversity per Order and tree species in the study

Name of Bird species	*Albizia zygia*		*Dialium guineense*		*Ficus exasperate*		*Spondias mombin*		*Vitex donania*		*Parkia biglobosa*	
Order	S1	S11	S1	S11	S1	S11	S1	S11	S1	S11	S1	S11
Accipitriformes	0.34	-	0.21	-	0.23	0.33	-	0.43	0.66	0.52	-	0.95
Apodiformes	0.32	-	0.22	0.21	-	-	-	0.23	-	0.21	-	0.44
Bucerotiformes	0.92	0.77	0.66	0.34	0.45	0.88	0.21	0.88	0.23	0.77	-	0.97
Columbiformes	0.32	0.22	0.66	0.56		0.79	0.23	0.23	0.28	0.28	0.28	0.56
Coraciiformes	0.87	0.96	1.6	0.77	0.86	0.23	1.07	0.32	1.11	0.69	1.2	1.55
Cuculiformes	1.14	0.23	1.08	-	0.79	0.88	0.65	1.04	0.89	1.19	0.28	1.73
Musophagiformes	1.42	2.31	0.32	-	0.21	-	0.21	-	0.22	0.21	0.22	0.34
Passeriformes	6.84	4.22	11.6	10.36	14.83	12.25	8-.5	9.34	2.95	4.36	3.15	5.86
Piciformes	4.14	-	8.17	-	2.28	0.63	0.54	1.01	0.63	0.89	0.89	2.05
Pelecaniformes	0.22	-	0.21	-	0.21	-	0.21	-	0.22	0.23	-	0.21

Table 3. Feeding guilds of the bird species in the study area

Name of Tree species	*Albizia zygia*		*Dialium guineense*		*Ficus exasperate*		*Spondias mombin*		*Vitex donania*		*Parkia biglobosa*	
Feeding guilds	S1	S11	S1	S11	S1	S11	S1	S11	S1	S11	S1	S11
Carnivores	1.36	1.19	3.1	1.64	1.88	2.32	2	2.67	2.66	2.4	1.8	4.19
Omnivores	1.25	1.76	0.98	1.23	0.88	1.65	0.63	1.87	0.67	1.1	0.22	1.63
Insectivores	1.46	1.4	2.15	0.34	1.59	0.54	1.54	1.13	1.44	1.66	1.17	2.01
Granivorous	1.01	0.22	1.51	0.9	0.75	1.1	0.98	0.47	1.13	0.28	1.16	1.63
Frugivorous.	12.24	3.08	19.38	19.03	20.18	11.99	1.74	15.33	3.86	8.08	12.24	1.33
Nectarivorous	1.32	1.6	2.24	0.87	1.68	0.21	1.26	0.64	1.32	1.84	1.54	2.04

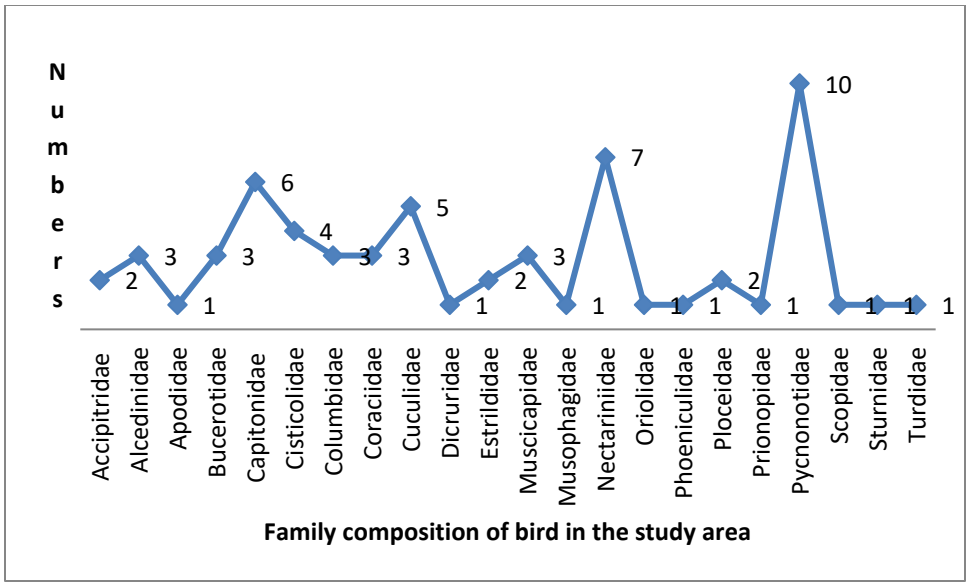

Figure 2. Family composition of bird species in the study area

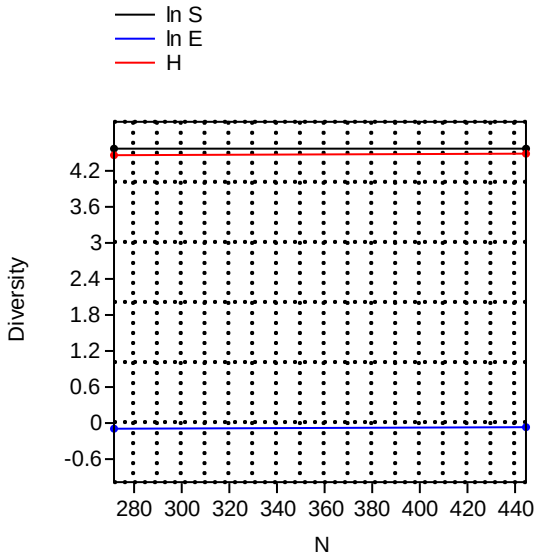

Figure 3. The SHE analysis of bird species in the study area

Discussion

Sustainable tourism development frequently involves the safeguarding of natural ecosystems. By advocating for the conservation and revival of native tree species, tourism projects can play a crucial role in safeguarding and preserving habitats that are essential for supporting a wide array of bird populations. Consequently, this contributes significantly to the overall conservation of biodiversity and ecological equilibrium. Findings from a research study revealed that the diversity

of bird species recorded was ninety-five (95), with an abundance of 272 individuals. Notably, the order Passeriformes exhibited the highest number of bird species within the study area. This finding aligns with previous studies by Bhullar and Majer (2000) and Chong et al. (2014), which observed greater beta diversity among bird populations in parks characterized by indigenous plant species compared to those with non-native flora. The conclusions drawn from the bird observations echo previous research, indicating that certain avian species show a preference for native woody plants, while others are more influenced by the density and structure of vegetation rather than the origin of the woody plant species. The introduction of non-native tree species often occurs due to the scarcity of native tree flora or the predominance of slow-growing species that are not readily available for use. Globally, fast-growing tree species such as Eucalyptus, pines, and poplars are widely planted. In India alone, it is estimated that approximately 4.8 million hectares of Eucalyptus and 60,000 hectares of Populus deltoides are cultivated (Chandra, 2001). According to the findings of the research study, the highest diversity of bird species was observed in habitats dominated by *Ficus exasperata* and *Diallium guineense*. The observation aligns with findings from Farwig et al. (2008), who similarly concluded that plantations of indigenous trees support greater bird diversity compared to those of exotic species. This is further supported by Kissling et al. (2007), who noted that the availability and diversity of fruit resources in specific landscapes influence the abundance of frugivorous birds. Analyzing the feeding guilds of bird species in the study area, it was found that frugivores constituted 20.1% and omnivores 11119.38 individuals, marking the highest occurrences (Supplementary Table 1). This outcome corresponds with the research by Kaur and Kumar (2018), which highlighted a predominance of omnivorous birds compared to other feeding habits. Advocates often emphasize the benefits of indigenous (native) trees over alien (exotic/non-native) species, emphasizing that native trees are integral to the local ecology and have co-adapted with other native species. Promoting indigenous trees is seen as a means of enhancing habitat and food sources for broader biodiversity. The researchers noted that the Ministry of Agriculture is implementing a forest enrichment program in secondary forests using exotic plants such as Tectona grandis and Gmelina arborea. The conversion of natural forests for agricultural purposes has posed a significant threat to the existence of numerous bird species (Peh et al., 2006). The rapid decline in the extent of natural forested areas has compelled avian species to seek survival and breeding opportunities in shrub and open-area habitats. Shrub habitats typically comprise understory woody or sapling vegetation, less than 3 meters in height, characterized by specific environmental

conditions rich in food resources like berries and insects, as well as providing secure shelter and nesting sites for a variety of bird species.

Conclusion

Ninety-five bird species, spanning 23 families and Orders, were documented, with a total abundance of 272 individuals. Encouraging diversity among bird species by cultivating and safeguarding indigenous plant species in Edo State, Nigeria, stands as a critical facet of biodiversity preservation and ecosystem stewardship. Birds heavily rely on plants for sustenance, nesting grounds, and refuge, thus maintaining a varied array of native flora directly supports the proliferation of various avian species. The preservation and advancement of indigenous plant species alongside the enhancement of bird species diversity serve as pivotal elements in sustainable tourism endeavors. This contributes significantly to ecological preservation, economic advancement, cultural conservation, and environmental education. By integrating sustainability and biodiversity conservation principles into tourism planning and management, endeavors are aimed at ensuring that tourism activities not only benefit local communities but also safeguard the natural and cultural legacy for forthcoming generations.

Recommendations

- Revenue generated from tourism activities centered around indigenous plant species and bird species diversity can serve as a financial incentive for conservation endeavors. Sustainable tourism strategies frequently involve the establishment of protected areas, conservation reserves, and community-managed natural resources, all of which play vital roles in conserving biodiversity and preserving habitats for plants and birds.
- Indigenous plant species and bird species diversity often intersect with the cultural heritage and traditional wisdom of local communities. Many indigenous plants and birds carry cultural significance and are fundamental to the cultural identity and customs of indigenous peoples. Sustainable tourism projects that integrate indigenous knowledge and facilitate cultural exchange contribute to the safeguarding and rejuvenation of traditional practices associated with plants and birds, fostering cultural appreciation and understanding among tourists.
- Create landscapes and environments that replicate natural ecosystems by integrating a diverse array of indigenous plant species, encompassing trees, shrubs, grasses, and

flowering plants, to establish varied habitats for avian species.

- Introduce a broad spectrum of indigenous species to accommodate a range of bird species with distinct dietary preferences and habitat requirements. Prioritize plants that yield fruits, seeds, nectar, and insects to attract a diverse array of bird species. Opt for plant varieties that occupy various ecological niches to optimize habitat diversity, ensuring the inclusion of species that offer nesting sites, perching spots, refuge from predators, and year-round food sources.
- Integrate native trees and shrubs into landscaping endeavors to furnish essential habitat elements such as nesting locations, perches, and food resources for birds. Select plant species that bloom and bear fruit at different intervals throughout the year to furnish birds with a continuous and varied food supply across seasons.
- Avoid the introduction of invasive exotic species that can outcompete native vegetation and disrupt the balance of local ecosystems. Such invasive plants may fail to provide suitable habitat or food sources for indigenous bird species. Instead, utilize native plant species in habitat restoration initiatives to rehabilitate degraded ecosystems and establish crucial habitats for birds and other wildlife.
- Engage local communities in the preservation and rehabilitation of native plant species and bird habitats. Promote awareness about the significance of indigenous plants for birds and the broader ecosystem. Discourage the planting of exotic plant species within the study area.
- Implement monitoring programs to evaluate the effectiveness of habitat restoration endeavors and their impact on the diversity of bird species over time. Adapt conservation strategies based on monitoring outcomes to achieve desired conservation objectives. Advocate for policies that prioritize the conservation and restoration of indigenous plant species and the habitats they support at local, regional, and national levels.

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Appendix 1. Checklist of species per tree species in the study area

Name of Bird species	*Albizia zygia*		*Dialium guineense*		*Ficus exasperate*		*Spondias mombin*		*Vitex donania*		*Parkia biglobosa*	
	S1	S11	S1	S11	S1	S11	S1	S11	S1	S11	S1	S11
Kaupifalco onogrammicus	0.34	-	-		0.23	-	-	0.43	0.22	-	-	0.66
Polyboroides typus	-	-	0.21	-	-	0.33	-	-	0.44	0.52	-	0.25
Tockus faciatus	0.37	-	0.22	-	-	0.55	0.21		0.23	-	-	0.53
Lophoceros nasutus	0.22	-	0.44	-	0.23	-	-	0.33	-	0.44	-	-
Horizocerus albocristatus	0.33	0.77		0.34	0.22	0.33		0.55		0.33		0.44
Pogoniulus atroflavus	0.23					0.31					0.22	0.31
Gymnobucco calvus	0.24		0.21		0.33		0.33		0.41		0.22	0.42
Pogoniulus scolopaceus	2.71		1.65			0.32		0.56		0.66		0.54
Pogoniulus chrysoconus	0.44		5.99		1.21			0.23				
Gymnobucco peli	0.22		0.32		0.21		0l21		0.22	0.23	0.22	0.34
Pogoniulus subsulphureus	0.3				0.53		0.21	0.22			0.23	0.44
Camaroptera chloronota	0.35	0.21	0.43						0.31	0.23	0.23	0.42
Prinia bairdii	0.21	0.23	0.21	0 22	0.33		0.44	0.28		0.23	0.28	0.29
Camaroptera brevicaudata	0.24		0.23		0.21	0.54	0.26		0.25	0.28		0.28
Turtur brehmeri		0,21	0.22	0.23		0.28		0.23			0.28	
Spilopelia senegalensis	0.32		0.21	0.33		0.28	0.23		0.28			0.28
Streptopelia semitorquata		0.22	0.23			0.23				0.28		0.28
urystomus glaucurus	0.22		0.21	0.21			0.28				0.32	
Coracias abyssinicus	0.21		0.32	0.22	0.23		0.23		0.23		0.32	0.32
Coracias cyanogaster		0.32	0.32	0.21		0.23		0.32				0.32
Prinia subflava	0.23		0.21	0.22			0.23		0.22	0.23		0.22
Chrysococcyx caprius	0.21	0.23	0.21	0 22	0.33		0.44	0.28		0.23	0.28	0.29
Cercococcyx mechowi	0.34	-	-		0.23	-	-	0.43	0.22	-	-	0.66
Chrysococcyx klaas	-	-	0.21	-	-	0.33	-	-	0.44	0.52	-	0.25
Chrysococcyx cupreus	0.37	-	0.22	-	-	0.55	0.21		0.23	-	-	0.53
Ceuthmochares aereus	0.22	-	0.44	-	0.23	-	-	0.33	-	0.44	-	-

Dicrurus adsimilis	0.33	0.77		0.34	0.22	0.33		0.55		0.33		0.44
Nigrita canicapillus	0.23	-		-		0.31	-	-	-	-	0.22	0.31
Nigrita luteifrons	0.24	-	0.21	-	0.33		0.33	-	0.41		0.22	0.42
Fraseria ocreata	2.71	-	1.65	-		0.32		0.56	-	0.66	-	0.54
Trochocercus nitens	0.44	-	5.99	-	1.21			0.23	-	-	-	-
Cossypha cyanocampter	0.22	-	0.32	-	0.21		0l21		0.22	0.23	0.22	0.34
Pogoniulus scolopaceus	0.34	-	-	-	0.23	-	-	0.43	0.22	-	-	0.66
Pogoniulus chrysoconus	-	-	0.21	-	-	0.33	-	-	0.44	0.52	-	0.25
Gymnobucco peli	0.37	-	0.22	-	-	0.55	0.21		0.23	-	-	0.53
Pogoniulus subsulphureus	0.22	-	0.44	-	0.23	-	-	0.33	-	0.44	-	-
Camaroptera chloronota	0.33	0.77		0.34	0.22	0.33		0.55		0.33		0.44
Prinia bairdii	0.23	-	-	-	-	0.31	-	-	-	-	0.22	0.31
Camaroptera brevicaudata	0.24	-	0.21	-	0.33	-	0.33	-	0.41	-	0.22	0.42
Turtur brehmeri	2.71	-	1.65			0.32		0.56		0.66		0.54
Spilopelia senegalensis	0.44	-	5.99		1.21	-		0.23	-	-	-	-
Streptopelia semitorquata	0.22	-	0.32		0.21		0l21		0.22	0.23	0.22	0.34
urystomus glaucurus	0.34	-	-		0.23	-	-	0.43	0.22	-	-	0.66
Coracias abyssinicus	-	-	0.21	-	-	0.33	-	-	0.44	0.52	-	0.25
Coracias cyanogaster	0.37	-	0.22	-	-	0.55	0.21		0.23	-	-	0.53
Prinia subflava	0.22	-	0.44	-	0.23	-	-	0.33	-	0.44	-	-
hrysococcyx caprius	0.33	0.77	-	0.34	0.22	0.33		0.55		0.33		0.44
Cercococcyx mechowi	0.23	-	-	-		0.31	-	-	-	-	0.22	0.31
Chrysococcyx klaas	0.24	0.32	0.21	-	0.33	-	0.33	0.32	0.41		0.22	0.42
Chrysococcyx cupreus	0.22	0.32	0.32	-	0.21	-	0.21	0.32	0.22	0.23	0.22	
Ceuthmochares aereus	-	-	-	-	0.21	-	0.21		0.22	0.23		0.34
Dicrurus adsimilis	0.22		0.32	-	0.21	-	0.21	0.32	0.22	0.23	0.22	0.34
Nigrita canicapillus	-	-	0.32	-	0.21	-	0.21	0.32	0.22		0.22	
Nigrita luteifrons	0.22		0.32	-	0.21	-	0l21			0.23	0.22	0.34
Fraseria ocreata	0.22		0.32	-	0.21	-	0.21		0.22	0.23	0.22	
Trochocercus nitens	0.22	0.32		-	0.21	-	0.21	0.32				0.34

Cossypha cyanocampter		0.32	0.32	-	0.21		0.21	0.32	0.22	0.23	0.22	
Pogoniulus scolopaceus	0.22	-	0.32	-	0.21	-	0.21		0.22	0.23	0.22	0.34
Pogoniulus chrysoconus	0.22	-		-	0.21	-	0.21		0.22	0.23	0.22	0.34
Gymnobucco peli	-	-	0.32	-	0.21	-	0.21			0.23		0.34
Pogoniulus subsulphureus	0.22	-	0.32	-	0.21	-	0.21	0.32	0.22	0.23	0.22	-
Camaroptera chloronota	0.22	-	0.32	-	0.21	-	0.21	0.32	0.22	0.23	0.22	0.34
Tauraco persa	0.22	0.32	-	-	0.21	-	-	-	-	0.23	0.22	0.34
Cinnyris chloropygius	0.22	0.32	-	-	0.21	-		0.32	0.22	0.23	0.22	-
Chalcomitra adelberti	-	-	0.32	-	0.21	-	0.21	0.32	0.22	0.23	0.22	0.34
Hedydipna collaris	0.22	-	0.32	-	0.21	-	0.21	-	-	0.23	-	0.34
Cyanomitra verticalis	0.22	-	0.32	-	0.21	-		-	-	0.23	0.22	0.34
Anabathmis reichenbachii	0.22	0.32	0.32	-	0.21	-	0.21	-	0.22	0.23	0.22	0.34
Sheppardia cyornithopsis	-	0.32	0.32	-	0.21	-	0.21	-	0.22	0.23	0.22	0.34
Cinnyris coccinigastrus	0.22	0.32	0.32	-	0.21	0.21	0.21	0l21	0.22	0.23	0.22	0.34
Cinnyris venustus	0.22	0.32	0.32	-	0.21		0.21	-	0.22	0.23	0.22	-
Oriolus hosii		0.32	0.32	0.34	0.21	0.21	0.21	0.21	0.22		0.22	0.34
Phoeniculus castaneiceps	0.22	0.32	0.32	0.34	0.21	0l21		0.21	0.22	0.23	0.22	0.34
Velliot's Black Weaver	0.22	-	0.32		0.21		0.21		0.22	-	0.22	
Village Weaver	-	-	0.32	0.34	0.21		0.21	0.24	0.22	-	0.22	0.34
Prionops caniceps	-	-	0.32	-	0.21		0.21	-	0.22	0.23	-	0.34
Eurillas ansorgei	0.22	0.21		-	0.21	0.34	0.21	-	0.22	0.21	0.22	0.34
Bleda syndactylus	0.22		0.32	-	0.21		0.21	-	0.22	0.22	0.22	-
Pycnonotus barbatus	0.22	0.21	0.32	-	0.21	0.34	0.21	-	-	0.23	0.22	0.22
Bleda eximius	0.22	0.22	0.32	0.34	0.21	0.34	0.21	0.21	0.22	-		0.23
Baeopogon indicator		0.22			0.21		0.21	0.21	0.22	-	0.22	0.34
Phyllastrephus icterinus	0.22	0.22	0.32	0.34	0.21	0.34	-	0.21	0.22	-	0.22	-
Eurillas virens	0.22	0.22	0.32	0.23	0.21	-	0.21	0.21	-	-	0.22	0.34
Eurillas curvirostris	-	-	-	-	0.21	-	0.21	0.21	0.22	0.23		0.21
Crinifer piscator	-	-	0.32	-	0.21	-	0.21	-	0.22	0.21	0.22	0.34
Chlorocichla simplex	0.22	0.22	0.32	-		0.22		-	0.22	0.23	0.22	0.23

Phyllastrephus scandens	0.22	0.22	0.32	-	0.21	0.22	0.21	-	-	0.23	0.22	-
Poeoptera lugubris	-	0.22	-	0.34	0.21	0.22	0.21	0.22	0.22	-	-	-
Turdus pelios	-	-	0.32	0.21		0.22	0.21	0.22	0.22		0.22	0.22
Ceyx lecontei	0.22	-	0.32	0.34		0.22	0.21	0.22	0.22	0.23	0.22	0.34
Halcyon badia	-	-	0.32	0.22	0.21	0.22	0.21	0.22	0.22	0.23	0.22	-
Halcyon malimbica	0.22	0.32	0	0.22	0.21	0.22	0.21	0.22	0.22		0.22	0.34
Halcyon senegalensis	0.22	0.32	0.32	0.22	0.21	0.22	0.21	0.22	0.22	0.23	0.22	0.23
Cypsiurus parvus	0.32	-	0.22	0.21	-	-	-	0.23		0.21	-	0.44
Scopus umbretta	0.22	-	0.21	-	0.21	-	0.21	-	0.22	0.23	-	0.21