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Inter-annual variation in the structure of avian communities in Zambezi rural riparian forest

Original Article

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Abstract:

In terms of biodiversity, riparian forests are among the richest habitats in the world, but in the tropical regions of the world, these forests are understudied. In the present study, the avian community was quantified in the Zambezi rural riparian forest in NE Namibia for two years, with a similar rainfall (423 mm in 2013 vs. 428 mm in 2014). In total, 135 breeding bird species were recorded in the study area. Sörensen Similarity Index was I=0.79. There were two dominant species: *Quelea quelea* and *Euplectes orix*. The group of subdominants were represented by 11 species. The species composition and population densities only slightly differed between the years 2013 and 2014. The proportions of three main feeding guilds, insectivores, granivores, and frugivores were similar in the riparian forests. This feature distinguishes this community from others studied so far in southern Africa, where either granivores or insectivores are the dominant guilds.

Key words:
tropical riparian forests, avian community, population density

Apstrakt:

Međugodišnja varijacija u strukturi zajednica ptica u ruralnim riparijalnim šumama reke Zambezi

U pogledu biodiverziteta, riparijalne šume spadaju među najbogatija staništa, ali su u tropskim oblastima nedovoljno proučene. U ovoj studiji kvantifikovana je zajednica ptica u ruralnim riparijalnim šumama reke Zambezi na severoistoku Namibije, tokom dve godine, sa sličnim godišnjim vrednostima padavina (423 mm u 2013. i 428 mm u 2014.). Ukupno je zabeleženo 135 vrsta gnezdarica. Sörensenov indeks sličnosti iznosio je I=0,79. Dominantne vrste bile su *Quelea quelea* i *Euplectes orix*, dok je grupu subdominantnih činilo 11 vrsta. Sastav vrsta i gustine populacija su blago varirali između analiziranih godina, 2013. i 2014. U smislu ishrane, udeo pripadnika tri glavne gilde (insektivori, granivori i frugivori) bio je sličan u riparijalnim šumama. Ova karakteristika razlikuje ovu zajednicu od drugih u južnoj Africi, gde preovladavaju granivorne ili insektivorne vrste.

Ključne reči:
tropske riparijalne šume, zajednica ptica, gustina populacije

Introduction

Among different biomes in southern Africa, the tropical riparian forests appear to be especially rich in terms of biodiversity (Hockey et al., 2005). In Namibia, most of these forests lay in Zambezi, Limpopo and Okavango river valleys (Mucina & Rutherford, 2024). Despite this, little is known about animal communities occupying these forests. It is also true with respect to avian communities, which are often the most intensively studied animal communities in other biomes. In southern Africa, the structure of avian communities has been investigated only in the acacia savanna in Eswatini (Monadjem, 2003; Monadjem, 2005), acacia savanna along Vaal River in South Africa (Seymour & Simmons, 2008) and in the *Tamarix* vegetation in Karoo, South Africa (Brooke, 1992).

In other parts of the world, birds associated with tropical riparian forests are also understudied. Species diversity and community structure of birds were studied along Paraiba do Sul River in Atlantic Forests, Sao Paulo State, Brazil (De Paula Laurenço & de Toledo, 2019); in Alta Foresta, Mato Grosso, Brazil (Lees & Peres, 2008); gallery forests in Costa Rica (Seaman & Schultze, 2010); rainforest in New Guinea (Korejs et al., 2023); monsoonal forest in Hong Kong (Chan et al., 2008); oil palm-forest mosaic in Malaysia (Azman et al., 2011; Michell

et al., 2018); savanna in Australia (Woinarski et al., 2000), and forests in south-western Australia (Palmer & Bennett, 2006).

The purpose of this study is to determine the structure of an avian community in a rural riparian forest, in terms of: 1) species diversity, 2) dominance structure, 3) guilds proportions, and 4) population densities of particular species making up the community.

Study area

Studies were conducted in the Zambezi riparian forest in a rural setting. The area is situated near Katima Mulilo, Zambezi Region, NE Namibia. A transect was established along the Zambezi River between 29°83'S, 18°93'E and 29°25'S, 21°30'E (**Fig. 1**).

The riparian forest is interspersed with some traditional rural homesteads with gardens; small fields, pastures for sheep and cattle, water canals (backwaters), grassy depressions flooded almost on an annual basis, and afforested areas with main tree species such as Acacias (*Acacia* spp.), African Teak (*Pterocarpus angolensis*), Albizias (*Albizia* spp.), Apple Leaves (*Lonchocarpus nelsii*), Burkea (*Burkea africana*), Combretum (*Combretum* spp.), Camel-thorn (*Acacia erioloba*), Jackal Berry (*Diospyros mespiliformis*), Mopane (*Colophospermum mopane*), Pod Mahogany (*Afzelia quanzensis*), Silver Cluster-leaf (*Terminalia sericea*), Sausage Tree (*Kigelia africana*), Sycamore Fig (*Ficus sycomorus*), White Bauhinia (*Bauhinia petersiana*), Zambezi Teak (*Baikiaea plurijuga*), and Silver Tree (*Terminalia sericea*).

Fig. 1. The location of the transect (yellow line) along the Zambezi River

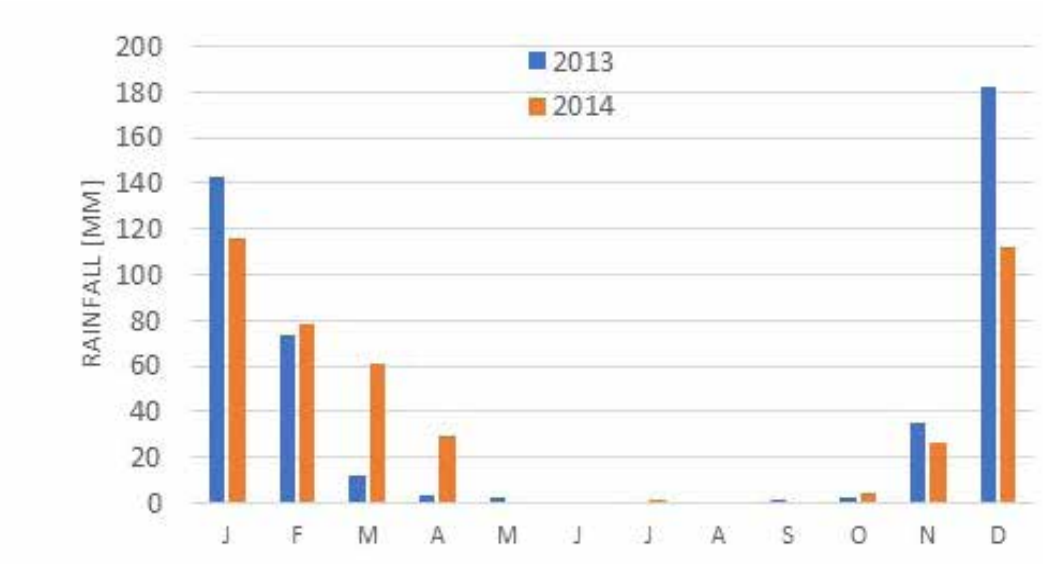

Fig. 2. Monthly rainfall in Katima Mulilo in 2013 and 2014

The monthly distribution of rainfall in 2013 and 2014 is shown in **Fig. 2**. The total amount of rainfall was similar in both years (423 mm in 2013 vs. 428 mm in 2014).

Methods

The line transect method in the American version (Sutherland, 1996; Bibby et al., 2012) has been employed to quantify avian assemblages (frequency of occurrence and relative abundance of each species) along the designed transect. Counts on transects were conducted three times (February/March, May, September), both in 2013 and 2014. The transect was 6 km long.

Counts were conducted in the mornings by walking slowly from c. 6 a.m. till c. 11 a.m. and recording all birds seen and heard. For resident birds, a breeding pair was a census unit, while for non-resident species, the census unit was an individual. A bird calling and/or showing other territorial or breeding behaviour was regarded as an actual breeder, i.e. it represented a breeding pair. Caution was taken to not register the same individuals by noting the movements of counted birds in the field and by paying special attention to simultaneously calling birds. Following assumptions of the line transect method, the maximal number of breeding pairs on the transect in whatever of the three counts conducted in a given year was assumed as the number of all potentially breeding birds (Bibby et al., 2012).

The dominance of each species is expressed as the percentage of the total number of pairs of a given species in relation to the total number of all pairs of all species recorded. Dominant species: >5%, subdominant: 2-4.99%.

The following guilds were distinguished:
Diet: G – granivorous, I – insectivorous, F – frugivorous, N – nectarivorous, R – carnivorous.
Nesting: T – in trees or shrubs, H – in holes, B – in/on buildings, V – herbaceous vegetation.
Habitat: F – forest interior, E – ecotone (forest/open area), O – „open" area (grassland/savanna).
Residency: R – resident throughout the year, A – intra-African migrant, C – nomad.

The following indices were used to characterize the diversity and evenness of the communities:
1) Shannon's diversity index: $H'=-\sum p_i \ln p_i$
where: p_i is the proportion of breeding pairs belonging to the *i*th species
2) Simpson's diversity index: $D=((\sum n(n-1))/N(N-1)$
where: n is the total number of breeding pairs belonging to a given species, N is the total number of breeding pairs of all species
3) Pielou's evenness index: $J'=(-\sum p_i \ln p_i)/\ln S$,
where: p_i is the proportion of breeding pairs belonging to the *i*th species; S is the total number of species. J' varies between 0 and 1. The less variation between species in a community, the higher J' is.
4) Community dominance index: $DI=(n_1+n_2)/N$
where: n_1, n_2 is number of pairs of two most abundant species, N is total number of pairs of all species.
5) Sörensen's Coefficient: I=2C/A+B
where: A is the number of bird species in one breeding season, B is the number of bird species in another breeding season, and C is the number of bird species common to both breeding seasons.

The ch^2-test was used to test differences in population densities between 2013/14 and 2015/16. For statistical testing, only those species with at least 10 breeding pairs in both seasons were included. Systematics and nomenclature of bird species follow Hockey et al. (2005), with later nomenclatorial changes.

Results

In 2013-2014, a total of 135 breeding bird species were recorded in the study area: 103 species in 2013, 118 species in 2014 (**Tabs. 1** and **2**); 87 species were common for 2013 and 2014. Sörensen similarity Index was I=0.79. In addition, 7 non-breeding Palearctic species were recorded: 3 in 2014 and 6 in 2015.

There were two dominant species: Red-billed Quelea *Quelea quelea* and Southern Red Bishop *Euplectes orix*. Both are nomad breeders; the Red-billed Quelea was recorded as dominant in 2013 and was not recorded at all in the next year. On the other hand, the Southern Red Bishop was recorded as dominant in 2014, while in 2013 it was uncommon (0.2%). The group of subdominants were represented by 11 and 9 species in 2013 and 2014 respectively, as listed in **Tab. 1**. The following species were subdominants in both years: *Cercotrichas leucophrys*, *Lybius torquatus*, *Phyllastrephus terrestris*, *Prinia subflava*, *Streptopelia capicola*, *Turtur chalcospilos*, and *Uraeginthus angolensis*.

The following species were more common (statistically significant difference) in 2013 than in 2014: *Cercotichas leucophrys*, *Francolinus sephaena*, *Lamprotornis australis*, *Mirafra rufocinnamomea*, *Nettapus auratus*, *Telophorus sulfureopectus*, *Trachyphonus vaillantii*, and *Vidua macroura*. On the other hand, more common in 2014 than in 2013 were *Dicrurus adsimilis*, *Euplectes orix*, *Ploceus velatus*, *Spilopelia senegalensis*, *Streptopelia semitorquata*, and *Turtur chalcospilos.* The abundance of 26 species was not significantly different in 2013 and 2014. For 19 species the numbers of breeding pairs were identical in both years (**Tab. 2**).

Table 1. Characteristics of the breeding bird community

Parameter	2013	2014
Number of species and breeding pairs		
Number of spp.	103	118
Number of pairs	823	801
Overall density	137.2	133.5
Dominance structure		
Dominance index	0.17	0.19
Number of dominant species	1	1
Percentage of dominants	12.2	14.4
Number of subdominant species	11	9
Percentage of subdominants	34.5	27.7
Diversity indices		
H’	3.95	4.06
J’	0.85	0.85
D	0.97	0.97

Most species were breeding, either as African residents or infra-African migrants. Seven species (*Merops apiaster*, *Acrocephalus arundinaceus*, *Acrocephalus palustris*, *Hirundo rustica*, *Lanius collurio*, *Muscicapa striata*, and *Phylloscopus trochilus*) were non-breeding Palearctic migrants. In 2013, the proportion of Palearctic migrants (159 individuals of three species) was much higher than in 2014 (18 individuals of six species) because there was an influx of c. 150 individuals of *Merops apiaster* in 2013 (none recorded 2014). Among breeding birds, most were African residents; very few were intra-African migrants (0.6% and 0.2% in 2013 and 2014 respectively).

The proportions of main feeding guilds were much the same in 2013 and 2014 (**Fig. 3**). The main nesting guild was tree/shrub nesting birds, with similar proportions in 2013 and 2014 (**Fig. 3**). However, the proportion of hole-nesting birds was much higher in 2013 than in 2014, while in the case of the guild nesting in herbaceous vegetation, the reverse was recorded (much higher proportion in 2014 than in 2013).

Table 2. Number of breeding pairs, linear density and dominance of birds breeding in a riparian forest (6 km) in a rural setting in 2013 and 2014. Explanations: **N** – number of breeding pairs, **D** – linear density (pairs per km), **Dom** – dominance

Species	2013			2014			X^2-test
	N	D	Dom	N	D	Dom	
Accipiter spp.	0	0	0.0	1	0.2	0.1	
Actophilornis africanus	6	1	0.7	6	1	0.7	0.0
Alopochen aegyptiacus	1	0.2	0.1	0	0	0.0	
Anastomus lamelligerus	1	0.2	0.1	0	0	0.0	
Anthoscopus caroli	0	0	0.0	1	0.2	0.1	
Apalis flavida	10	1.7	1.2	10	1.7	1.2	0.0
Apus affinis	0	0	0.0	2	0.3	0.2	
Ardea ibis	2	0.3	0.2	9	1.5	1.1	4.1*
Ardeola ralloides	1	0.2	0.1	1	0.2	0.1	
Batis molitor	5	0.8	0.6	10	1.7	1.2	1.9
Bostrychia hagedash	1	0.2	0.1	1	0.2	0.1	
Bucorvus leadbeateri	1	0.2	0.1	0	0	0.0	
Buphagus erythrorhynchus	3	0.5	0.4	0	0	0.0	
Butorides rufiventris	2	0.3	0.2	0	0	0.0	
Butorides striatus	0	0	0.0	1	0.2	0.1	
Bycanistes bucinator	2	0.3	0.2	2	0.3	0.2	
Camaroptera brevicaudata	0	0	0.0	1	0.2	0.1	
Campephaga flava	0	0	0.0	1	0.2	0.1	

Campethera abingoni	3	0.5	0.4	2	0.3	0.2	
Centropus cupreicaudus	5	0.8	0.6	5	0.8	0.6	0.0
Centropus senegalensis	4	0.7	0.5	4	0.7	0.5	
Centropus spp.	0	0	0.0	4	0.7	0.5	
Centropus superciliosus	10	1.7	1.2	6	1	0.7	2.0
Cercotrichas leucophrys	33	5.5	4.0	22	3.7	2.7	4.1*
Ceryle rudis	2	0.3	0.2	8	1.3	1.0	3.4
Chlorocichla flaviventris	9	1.5	1.1	9	1.5	1.1	0.0
Chrysococcyx cupreus	0	0	0.0	1	0.2	0.1	
Cinnyricinclus leucogaster	0	0	0.0	5	0.8	0.6	
Circaetus cinerascens	1	0.2	0.1	1	0.2	0.1	
Circus ranivorous	1	0.2	0.1	0	0	0.0	
Cisticola chiniana	17	2.8	2.1	14	2.3	1.7	0.5
Cisticola juncidis	0	0	0.0	8	1.3	1.0	
Cisticola spp.	0	0	0.0	2	0.3	0.2	
Coracias caudata	2	0.3	0.2	2	0.3	0.2	
Corvinella melanoleuca	1	0.2	0.1	0	0	0.0	
Corvus albus	2	0.3	0.2	2	0.3	0.2	
Corythaixoides concolor	11	1.8	1.3	14	2.3	1.7	0.5
Crithagra atrogularis	5	0.8	0.6	1	0.2	0.1	
Dendrocygna viduata	0	0	0.0	1	0.2	0.1	
Dicrurus adsimilis	1	0.2	0.1	13	2.2	1.6	8.3*
Dondropicos fuscescens	2	0.3	0.2	3	0.5	0.4	
Dryoscopus cubla	7	1.2	0.9	7	1.2	0.9	0.0
Egretta garzetta	0	0	0.0	1	0.2	0.1	
Emberiza flaviventris	0	0	0.0	2	0.3	0.2	
Eyrystomus glaucurus	0	0	0.0	1	0.2	0.1	
Erythropygia leuconotus	10	1.7	1.2	10	1.7	1.2	0.0
Estrilda astrild	12	2	1.5	7	1.2	0.9	2.7
Euptectes orix	2	0.3	0.2	115	19.2	14.4	83.3**
Falco dickinsoni	2	0.3	0.2	0	0	0.0	
Falco rupicoloides	0	0	0.0	1	0.2	0.1	
Francolinus sephaena	12	2	1.5	3	0.5	0.4	20.3**
Francolinus swainsonii	2	0.3	0.2	3	0.5	0.4	
Halcyon albiventris	0	0	0.0	2	0.3	0.2	
Halcyon leucocephala	1	0.2	0.1	1	0.2	0.1	
Halcyon senegalensis	2	0.3	0.2	3	0.5	0.4	
Haliaeetus vocifer	5	0.8	0.6	3	0.5	0.4	
Hedydipna collaris	2	0.3	0.2	1	0.2	0.1	
Hirundo abyssinica	6	1	0.7	18	3	2.2	

Hirundo smithii	0	0	0.0	4	0.7	0.5	
Indicator indicator	1	0.2	0.1	0	0	0.0	
Indicator minor	1	0.2	0.1	1	0.2	0.1	
Kaupifalco monogrammicus	1	0.2	0.1	0	0	0.0	
Lagonosticta senegala	11	1.8	1.3	7	1.2	0.9	1.7
Lagonosticta nitidula	0	0	0.0	1	0.2	0.1	
Lamprotornis australis	14	2.3	1.7	1	0.2	0.1	126.8**
Lamprotornis nitens	6	1	0.7	8	1.3	1.0	0.4
Laniarius bicolor	14	2.3	1.7	11	1.8	1.4	0.6
Lophaetus occipitalis	0	0	0.0	1	0.2	0.1	
Lybius torquatus	26	4.3	3.2	18	3	2.2	2.7
Matacilla aguimp	1	0.2	0.1	1	0.2	0.1	
Merops bullockoides	1	0.2	0.1	6	1	0.7	
Merops hirundineus	1	0.2	0.1	0	0	0.0	
Merops nubicoides	1	0.2	0.1	6	1	0.7	
Merops pusillus	7	1.2	0.9	5	0.8	0.6	
Micronisus gabar	0	0	0.0	1	0.2	0.1	
Milvus eagyptius	3	0.5	0.4	1	0.2	0.1	
Mirafra rufocinnamomea	13	2.2	1.6	1	0.2	0.1	108.0**
Muscicapa caerulescens	0	0	0.0	1	0.2	0.1	
Myioparus plumbeus	0	0	0.0	1	0.2	0.1	
Nattapus auritus	14	2.3	1.7	4	0.7	0.5	18.8*
Nectarinia mariquensis	12	2	1.5	7	1.2	0.9	2.7
Nectarinia senegalensis	0	0	0.0	2	0.3	0.2	
Nectarinia talatala	4	0.7	0.5	3	0.5	0.4	
Nectarinidae spp.	17	2.8	2.1	17	2.8	2.1	0.0
Nilaus afer	7	1.2	0.9	5	0.8	0.6	0.6
Oriolus auratus	0	0	0.0	4	0.7	0.5	
Oriolus larvatus	1	0.2	0.1	1	0.2	0.1	
Ortygospiza atricollis	1	0.2	0.1	2	0.3	0.2	
Parus niger	1	0.2	0.1	4	0.7	0.5	
Passer diffusus	2	0.3	0.2	3	0.5	0.4	
Phalacrocorax africanus	7	1.2	0.9	8	1.3	1.0	0.1
Phoeniculus purpureus	2	0.3	0.2	6	1	0.7	
Phyllastrephus terrestris	31	5.2	3.8	21	3.5	2.6	3.6
Plectropterus gambensis	0	0	0.0	9	1.5	1.1	
Ploceus velatus	18	3	2.2	5	0.8	0.6	25.4**
Pogoniulus chrysocomus	8	1.3	1.0	7	1.2	0.9	0.1
Poicephalus meyeri	5	0.8	0.6	3	0.5	0.4	
Prinia subflava	32	5.3	3.9	23	3.8	2.9	2.6
Prinia flavicans	0	0	0.0	1	0.2	0.1	
Prionops plumatus	2	0.3	0.2	2	0.3	0.2	
Prionops retzii	0	0	0.0	5	0.8	0.6	

Pytilia afra	1	0.2	0.1	1	0.2	0.1	
Quelea quelea	100	16.7	12.2	0	0	0.0	
Rhinopomastus cyanomelas	2	0.3	0.2	3	0.5	0.4	
Spermestes cucullatus	0	0	0.0	1	0.2	0.1	
Spilopelia senegalensis	2	0.3	0.2	14	2.3	1.7	7.7*
Streptopelia capicola	20	3.3	2.4	31	5.2	3.9	2.9
Streptopelia decipiens	0	0	0.0	4	0.7	0.5	
Streptoperia semitroquata	10	1.7	1.2	21	3.5	2.6	4.3*
Sylvietta rufescens	6	1	0.7	3	0.5	0.4	
Tachybaptus ruficollis	1	0.2	0.1	0	0	0.0	
Tauraco schalowi	13	2.2	1.6	12	2	1.5	0.1
Tchagra australis	1	0.2	0.1	1	0.2	0.1	
Tchagra senegala	0	0	0.0	3	0.5	0.4	
Tchagra spp.	1	0.2	0.1	3	0.5	0.4	
Telophorus sulfureopectus	14	2.3	1.7	7	1.2	0.9	5.3*
Thalassornis leuconotus	4	0.7	0.5	0	0	0.0	
Tockus erythrorhynchus	1	0.2	0.1	0	0	0.0	
Tockus nasutus	8	1.3	1.0	10	1.7	1.2	0.3
Trachyphonus vaillantii	18	3	2.2	10	1.7	1.2	4.8*
Treron calva	4	0.7	0.5	1	0.2	0.1	
Tringa glareola	1	0.2	0.1	0	0	0.0	
Turdides jardineii	8	1.3	1.0	1	0.2	0.1	
Turdoides hartlaubii	3	0.5	0.4	8	1.3	1.0	2.3
Turdus libonyanus	0	0	0.0	1	0.2	0.1	
Turnix sylvatica	1	0.2	0.1	1	0.2	0.1	
Turtur chalcospilos	20	3.3	2.4	36	6	4.5	5.3*
Upupa epops	16	2.7	1.9	5	0.8	0.6	18.2**
Uraeginthus angolensis	38	6.3	4.6	31	5.2	3.9	1.2
Urocolius indicus	19	3.2	2.3	13	2.2	1.6	2.1
Vanellus armatus	2	0.3	0.2	2	0.3	0.2	
Vanellus senegallus	6	1	0.7	4	0.7	0.5	0.8
Vidua halybeata	0	0	0.0	1	0.2	0.1	
Vidua macroura	30	5	3.6	4	0.7	0.5	126.8**
Zosterops senegalensis	1	0.2	0.1	1	0.2	0.1	
Total number of pairs	823		100.0	801		100.0	

Discussion

In total, 135 bird species were recorded in the riparian forest (this study, **Tab. 2**). In the neighbouring *Mopane-Terminalia* forest and Kalahari Woodland mixed with rural areas, the numbers were much lower, i.e. 51 and 56, respectively (**Tab. 3**). In the Mopane Woodland, situated in north-central Namibia, the number of breeding species was 85 (Kopij, 2013a and 2013b), while in the Kaokoland Savanna, in

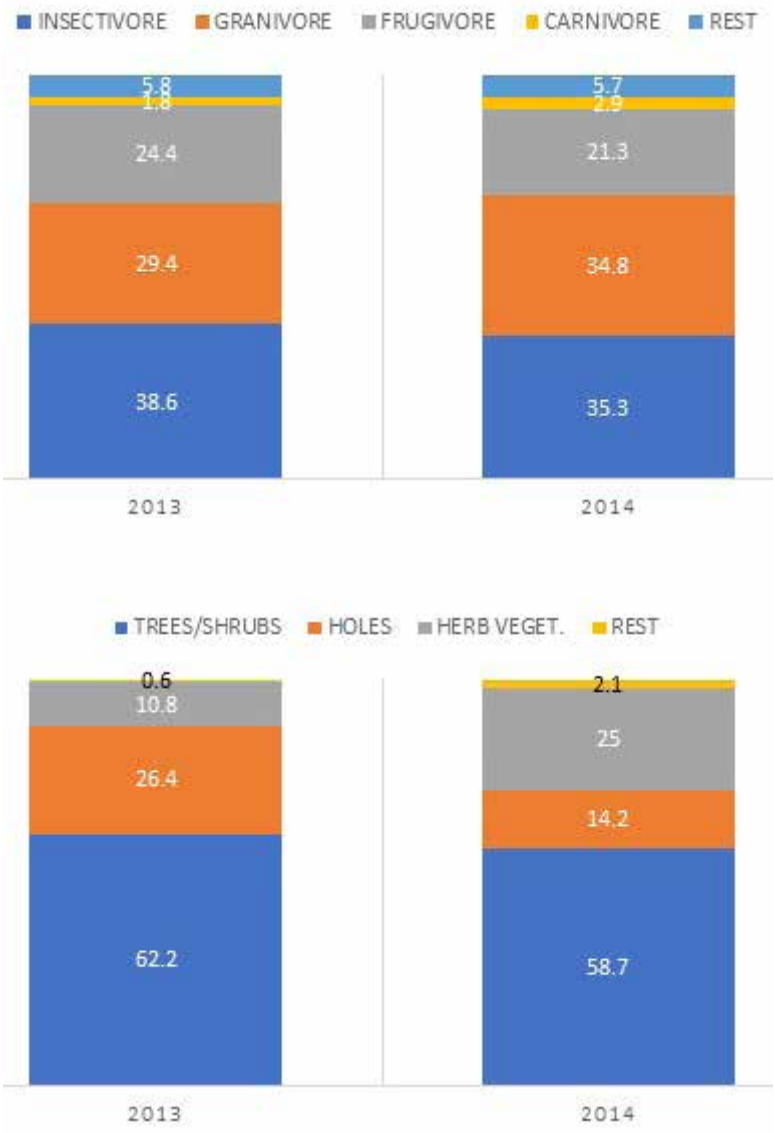

Fig. 2. Proportions of feeding (columns in the upper row) and nesting guilds (columns in the lower row) in 2013. and 2014

Table 3. Linear population densities (pairs per 1 km of transect) of selected bird species (=32) in different forest types in rural settings in the Zambezi Region. Habitat types: **1**) Riparian forest (this study), **2**) Mopane/Terminalia forest (Kopij, 2022), **3**) Kalahari Woodland (Kopij, 2021)

Species	Habitat types		
	1	**2**	**3**
Batis molitor	1.7	0.2	1.3
Camaroptera brevicaudata	0.2	0	1.3
Cercotrichas leucophrys	5.5	0.9	0
Chlorocichla flaviventris	1.5	0	1.1
Cisticola chiniana	2.8	0	0.7
Cisticola juncidis	1.3	0	0.2

NW Namibia, it was 64 (Kopij, 2014b). It is clear, therefore, that in Namibia, the number of breeding bird species declines westwards, i.e. with declining precipitation (Mendelsohn et al., 2009). However, within the same region, it may differ markedly depending on the soil type, inundation and topography. All these factors affect, in turn, variance in vegetation type.

There were more breeding species in the riparian forest than in other forest types situated in the Zambezi region. Also the population densities of many species were much higher in the riparian forests than in the other forest types (**Tab. 3**). Out of 32 species compared, only Grey-backed Camaroptera (*Camaroptera brevicaudata*), Southern Grey-headed Sparrow (*Passer diffusus*), Lilac-breasted Roller (*Coracias caudatatus*), and Red-billed Hornbill (*Tockus erythrorhynchus*) were less numerous in the riparian forests than in other forest types.

In terms of the number of breeding pairs, the proportions of the three main feeding guilds: insectivores, granivores, and frugivores were similar in the riparian forests. However, in terms of the number of species, insectivores comprised almost half of this assemblage. This feature distinguishes this community from others studied so far in southern Africa, where either granivores or insectivores were the dominant guilds (Kopij, 2000, 2001a, 2001b, 2006, 2013a, 2013b, 2014a, 2014b, 2015, 2016, 2017, 2018, 2021, 2022). In riparian forests of Africa, the fruit trees are usually abundant and may benefit frugivorous birds (especially bulbuls), while seeds may not be so abundant, as these are in more open savanna or grassland biomes. Typical granivores, such as doves and sparrows, may therefore breed in lower densities in riparian forests than in the neighbouring more open habitats dominated by grasses.

The species composition only slightly differed between the years 2013 and 2014. There was also no shift in species diversity, or in the community structure. This interannual stability can be linked to almost the same level

Coracias caudatus	0.3	0.2	0.7
Corythaixoides concolor	2.3	0.7	1.3
Dicrurus adsimilis	2.2	1.2	1.3
Dondropicos fuscescens	0.5	0.1	0.2
Dryoscopus cubla	1.2	0	0.7
Laniarius bicolor	2.3	0	1.1
Lybius torquatus	4.3	0.1	1.0
Nilaus afer	1.2	0.1	0.2
Passer diffusus	0.5	1.2	0.2
Phyllastrephus terrestris	5.2	0	0.7
Ploceus velatus	3.0	0.3	0
Pogoniulus chrysocomus	1.3	0	0.2
Poicephalus meyeri	0.8	0	1.6
Prinia subflava	5.3	0.2	0.4
Spilopelia senegalensis	2.3	0	2.0
Streptopelia capicola	5.2	2.6	6.7
Streptopelia decipiens	0.7	0	0
Streptopelia semitroquata	3.5	0.1	1.3
Telophorus sulfureopectus	2.3	0.1	0.4
Tockus erythrorhynchus	0.2	0.7	0
Tockus nasutus	1.7	1.1	0.9
Trachyphonus vaillantii	3.0	0.3	0
Turtur chalcospilos	6.0	0.3	3.1
Upupa epops	2.7	0.3	0
Uraeginthus angolensis	6.3	2.0	5.6
Urocolius indicus	3.2	0.2	0
Number of all pairs	823	409	338
Number of all breeding species	135	56	51

of precipitation in these two years compared. The amount of rainfall is usually the main limiting factor governing both the distribution and population densities of most bird species in Africa (Maclean, 1990).

A high number of species and high densities of their populations compared to other forest types in the Zambezi Region (**Tab. 3**) suggest that riparian forests play an important role as breeding and feeding habitat for birds, especially frugivores and nectarivores. It may also play a role as a corridor allowing dispersal, migration and free movements within a mosaic of natural and human-modified environments (Seaman & Schulze, 2010). The riparian forest corridor may be therefore considered as a main instrument to offset the negative effects of habitat loss and fragmentation (Turner, 1996; Lees & Peres, 2008), and for that reason, it deserves special protection.

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