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SEASONAL AND ALTITUDINAL VARIATIONS IN AN AVIAN ASSEMBLAGE IN AN INSELBERG *OLEA-BUDDLEIA* VEGETATION IN THE DRY *CYMBOPOGON-THEMEDA* GRASSVELD, SOUTH AFRICA

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Abstract

The line transect method in American version was employed to assess the dominance and relative densities of all resident bird species associated with an *Olea-Buddleja* inselberg (193 ha). A total of 38 bird species were resident in the study area. The group of dominant species included the Helmeted Guineafowl, Cape Sparrow, Red-eyed Bulbul, Cape Turtle-Dove, Laughing Dove, Chestnut-vented Tit-Babbler, Black-chested Prinia and Cape White-eye. They comprised 74.1% of all resident pairs recorded. The Fiscal Flycatcher, Bokmakierie, Red-faced Mousebird, Swainson's Francolin and Common Fiscal were classified as subdominants. They comprised 11.5% of all pairs recorded. A total of 25 remaining species comprised together 14.4% of all pairs recorded. The avian assemblages on the top and in the foothill of the inselberg was similar. The avian assemblages did not differ significantly also between particular seasons of the year.

Introduction

Seven major biomes are recognised in southern part of the Afrotropical region (1 266 182 km^2): forest, fynbos, savanna, thicket, grassland, Nama Karoo and succulent Karoo (Low and Rebelo 1996). The grassland biome, covers an area of 333 942 km^2 and occupies the central part of this region. It is the mainstay of dairy, beef and wool production and a cornerstone of the maize crop. Large areas of these grasslands are also converted to sorghum, sunflower and peanut cultivations. The grassland biome is considered to have one of the richest biodiversities in southern Africa with many rare, endemic and endangered species (Low and Rebelo 1996). Studies on this issue are however very scanty even in respect to the bird fauna, which is usually relatively better documented in other biomes of this region.

The southern African grasslands can be divided into Highveld grassland (190 015 km^2), mountain grassland (141 218 km^2) and coastal grassland (2 709 km^2). Three major types are distinguished within the Highveld grassland, namely: the wet, moist and dry grassland (Low and Rebelo 1996). The latter 59 079 km^2 in surface, also called *Cymbopogon-Themeda* Veld (Acocks 1997), is especially prone to degradation of natural areas, loss of biodiversity, soil erosion and desertification. At present, more than two thirds of this grassland is already transformed. There are several components within this grassland, which may play a crucial role in nature conservation, especially in biodiversity preservation. These are *Acacia karroo* river valleys (Kopij 1997a, 2000), *Salix* river valleys (Kopij 1997b, 2002), dams, pans and marshlands (Kopij 2000b, 2001), and bushy isolated hills.

The latter, called inselbergs, may be regarded as ecological islands. Despite their obvious ecological importance, no quantitative studies

on animal communities associated with these inselbergs have ever been conducted. The aim of this study was to partly fill the gap in our knowledge, by investigating seasonal and temporal variations in dominance structure of a bird assemblage associated with this habitat.

Methods

The line transect method in American version (Bibby et al. 1992) was employed to assess the dominance and relative densities of all resident bird species. Two routes were designed for counts. The first route, 5.2 km in length, was fixed along a road on the edge of the grassy plain (on the top) and the shrubby vegetation (on the slopes). The second route, 6.7 km in length, was fixed around the foothill, c. 200-300 m below the first route. Transects were, of cause, not straight lines and followed contours. Since the reserve is not circular in shape the transect lines are longer than the reserve diameter indicates.

Three counts were conducted in each season during the years 1995-1996 on the former route: in autumn: 7, 23 March and 15 April; in winter: 14, 22 June and 30 July; in spring: 9 September, 1 and 21 October; in summer: 12, 30 December and 8 January. On the latter route three counts were conducted in summer only (26 December 1995, 2 and 29 February 1996). Each count was carried out in early morning (06:00-09:00), by walking slowly with standardised low speed.

A potentially breeding pair was the census unit *(cf* Bibby et al. 1992). For most species therefore numbers given in Table 1 refer to the number of encounters, which is equal to the number of potentially breeding pairs. The maximal number of potentially breeding pairs of a given species out of three counts was assumed as the real number *(cf* Bibby et al. 1992).

The dominant species is defined as that comprising at least 5% of all pairs recorded, while the subdominant species as the one comprising 2.0-4.9 %. The Sorensen's coefficient: I = 2C/A+B (where A is the number of bird species in area A, B is the number of bird species in area B, C – the number of bird species common to both area) was used to calculate species similarities of the communities of each habitat and season. The Simpson index: $C = 1-\sum p_i^2$ (where p_i is proportion of *i*-species in the community) was used to compare density similarities.

Study Area

Studies were conducted in the Fanklin Game Reserve. The reserve was proclaimed in 1928 at Naval Hill in the centre of Bloemfontein city, South Africa (S29.09986 E26.23102). This is the only game reserve in a city centre to be known in the world. It covers an area of 193 ha and is situated at a height of 1410 to 1499 m a. s. l. The area has a distinctive topography consisting of dolorite koppies separated by valleys and dry watercourses, with mainly sandy soils (Du Preez 1979).

The reserve constitutes typical inselberg (koppie) amidst grassy plain in the Dry Highveld Grassveld. The vegetation is clearly influenced by the Karoo. The summer rainfall averages 550 mm per year, and temperature varies between –11˚C and 41˚C, with an average 18˚C.

Two plant communities were identified in the Franklin Game Reserve, namely: the *Buddleja salinga-Olea africana* and the *Hermannia coccocarpa-Tragus koelerioides.* The former community comprises out of two subcommunities: the *Crassula transvaalensis*

(with three variations, viz. the *Sersia erosa,* the *Haemantus hirsutus/Asparagus suaveolens* and *Abutilon pilosocinereum)* and the *Enneapogon scoparius* (with four variations, viz. the *Nidorella resedifolia/Oxalis depressa,* the *Searsia lancea/Ziziphus mucronata,* the *Talinum caffum/Pollichia campestris* and the *Enneapogon scoparius).*

The *Hermannia/Tragus* community consist out of three subcommunities, namely: the *Themeda triandra/Chrysocoma tenuifolia* (with two variations, viz., *Heteropogon controtus* and the *Chrysocoma tenuifolia),* the *Cynodon incompletus* (with two variations, viz. the *Nierembergia hippomanica/Sisymbriun burchellii* and the *Felicia muricata/Gnaphalium luteoalbum),* and the *Euryops empetifolius* (with two variations, viz. the *Panicum coloratum* and the *Eirospernnini confusum)* (Du Preez 1979).

A total of 279 plant species have been recorded in the Franklin Game Reserve (Du Preez 1979). At present, the reserve accommodates a number of introduced game: Giraffe *Giraffa camelopardalis*, Fallow Deer *Cervus dama*, Red Hartebeest *Alcephalus buselaphus*, Blesbok *Damaliscus dorcas*, Springbok *Antidorcas marsupialis*, Impala *Aepyceros melampus*, Gemsbok *Oryx gazella*, Mountain Rhebok *Redunca fulvorufula*, Ostrich *Struthio camelus*. There are also Rock Dassies *Procavia capensis,* three lagomorph species and nine other species of small mammals (Kopij and Eksteen 1996). A total of 89 bird species were recorded in this reserve, including 55 breeding or probably breeding, six non-breeding summer residents, 19 visitor and 17 vagrant species (Kopij, and De Swardt 1998). Among other vertebrates four reptiles (Kopij and Bates 1997) and two amphibians (Kopij and Bates 1997) have been recorded in this reserve.

Results and discussion

Structure of the assemblage

A total of 38 bird species were resident in the inselberg of the *Olea-Buddleia* vegetation (Table 1). The group of dominant species included the Helmeted Guineafowl, Cape Sparrow, Red-eyed Bulbul, Cape Turtle-Dove, Laughing Dove, Chestnut-vented Tit-Babbler, Black-chested Prinia and Cape White-eye (scientific names of all bird species are included in Table 1). They comprised 74.1% of all resident pairs recorded. The Fiscal Flycatcher, Bokmakierie, Red-faced Mousebird, Swainson's Francolin and Common Fiscal were classified as subdominants (Table 1), comprising together 11.5% of all pairs recorded. The remaining 25 species comprised 14.4% of all pairs recorded (Table 1).

Most birds (72.0%) were associated with shrubs or trees as nesting sites. All remaining nested on the ground (14.1%). Only two species, the Cape Sparrow and African Hoopoe (13.9%), nested in buildings and other man-made structures.

Half of all pairs resident in the *Olea-Buddleia* vegetation were seed-eaters. Two other groups included frugivorous (34.1%) and insectivorous (15.4%).

The foothill vs hill top assemblage

A total of 34 and 20 resident bird species were recorded in the foothill and on the hill top, respectively (Table 2). Both on the top and on the foothill, the group of dominant species included the Cape Turtle-Dove, Laughing Dove, Black-chested Prinia and Cape White-eye. The proportion of the Red-eyed Bulbul and Laughing Dove was higher in the foothills than on the hill top, while that of the Chestnut-vented Tit-Babbler was higher in the hill top than in the foothill (Table 2). The Cape Sparrow was a dominant species on the hill top

but absent in the foothill (Table 2). The Southern Masked Weaver, Olive Thrush and Cape Robin-Chat were only dominant in the foothill.

On the foothill, fairly numerous were Crested Barbet, Common Fiscal, Fiscal Flycatcher, Bokmakierie and Swainson's Francolin, while on the hill top fairly numerous were Swainson's Francolin, Fiscal Flycatcher, Bokmakierie and Crested Barbet. Relatively low density of Rock Bunting, Yellow Canary, Black-throated Canary and Fairy Flycatcher were recorded in the inselberg.

Seasonal variation in the avian assemblage

Doves *Streptopelia* were most numerous in the winter, whereas Fiscal Flycatcher and Red-eyed Bulbul, in the spring (Table 1). In winter the number of the Cape White-eye, Black-chested Prinia, Chestnut-vented Tit-Babbler and Swainson's Francolin rapidly decreased (Table 1). Throughout the year, the number of Common Fiscal, Bokmakierie, Crested Barbet, Cape Robin-Chat and Olive Thrush remained stable. Most other birds were more numerous in summer months than in other seasons of the year. The so-called summer resident bird species (intra-African migrants) included the Red-chested Cuckoo, Diederik, Fairy Flycatcher and Black-throated Canary.

The Sorensen's index of species similarity was the lowest between the spring and autumn communities (I = 0.76) and the highest between winter and spring communities (I = 0.88). Between winter and summer, and winter and autumn communities the Sorensen's index was very similar, viz. 0.82 and 0.84 respectively; also between summer and spring, and summer and autumn communities the index was similar, viz. 0.84 and 0.85 respectively. Much bigger difference

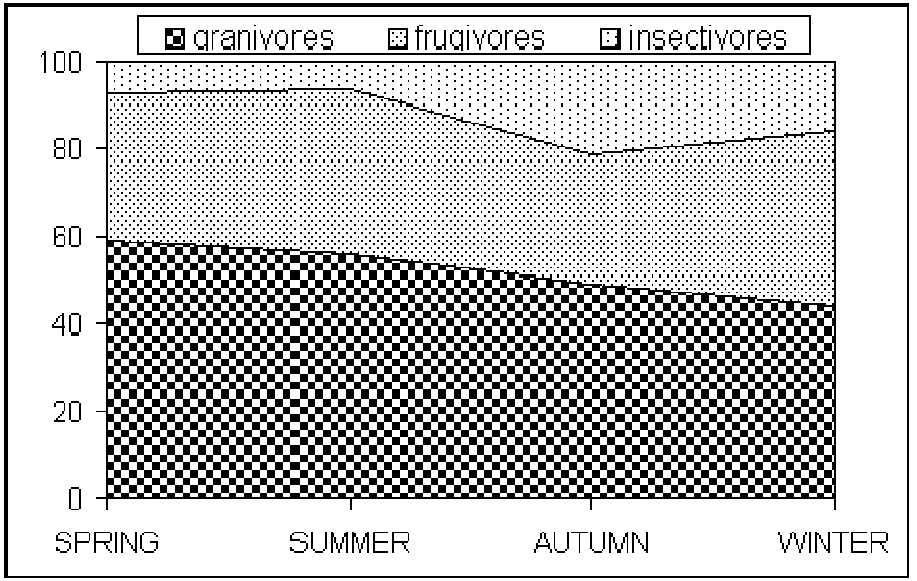

Fig 1 – Seasonal changes in main feeding gilds of birds resident in *Olea-Buddleja* inselberg (proportions in percentage)

in species similarities was however recorded between the foothill and hill top communities (I = 0.67). As far as density similarity is concerned, it remained, however, much the same throughout the year (Table 1), in both sub-habitats investigated (Table 2).

The proportion of the frugivorous birds remained stable throughout the year, while granivorous were slightly more numerous in winter and spring than in summer and autumn (Fig. 1). More obvious seasonal changes were however recorded in the insectivorous group, members of which were much more abundant in summer and autumn than in winter and spring (Fig. 1).

Comparison with avian assemblages in other bushy habitats

In the *Cymbopogon-Themeda* Grassveld, the *Olea-Buddleia* vegetation plays an important role as nesting and feeding habitat for several bird species: the Red-eyed Bulbul, Chestnut-vented Tit-Babbler, Black-chested Prinia, Cape White-eye, Fiscal Flycatcher, Bokmakierie, Common Fiscal, Red-faced Mousebird, and White-backed Mousebirds. In comparison with other natural shrubby vegetation in the *Cymbopogon-Themeda* Grassveld, the *Acacia karroo* vegetation is richer both in terms of the number of species and relative densities of birds.

In relation to the other parts of Bloemfontein city, in the Franklin Game Reserve higher density of Chestnut-vented Tit-Babbler, Spotted-chested Prinia, Fiscal Flycatcher, Acacia Pied Barbet *Tricholaema leucomelas* and Red-eyed Bulbul has been recorded. Those are species typically associated with this type of vegetation. The Common Fiscal, Cape Robin-Chat and Olive Thrush nested in much lower density than in suburbia, probably it is due to lack of some shrubs yielding fruit and possible competition with Bokmakierie, Red-eyed Bulbul, Chestnut-vented Tit-Babbler and Kalahari Scrub-Robin.

Blacksmith Lapwing *Vanellus armatus* and Crowned Lapwing *Vanellus coronatus* also were less numerous in the reserve than in the city (Kopij and Kok 1994) though there are suitable habitat for those species. One should expect Yellow Canary and Black-throated Canary and Cinnamon-breasted Bunting *Emberiza tahapisi* to be more numerous in the reserve than elsewhere in the city, but only single pairs were recorded. However the Crested Barbet, being absent in Bloemfontein several years ago, is at present a common breeding resident all over the city (Kopij 2001a), including the Franklin Game Reserve.

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Table 1 - Seasonal changes in avian assemblages in an inselberg of the *Olea-Buddleja* vegetation. In bold case, dominant species are indicated. Abbreviations: p/10km – number of resident pairs per 10 km of transect length; dom. – domination (in%).

Species	Autumn		Winter		Spring		Summer		Total	
	p/10km	dom.	p/10km	dom.	p/10km	dom.	p/10km	dom.	p/10km	dom.
Red-eyed Bulbul *Pycnonotus nigricans*	**36,5**	**12,4**	**28,8**	**8,4**	**50,0**	**14,9**	**32,7**	**9,1**	**148,1**	**11,1**
Cape Turtle-Dove *Streptopelia capensis*	**26,9**	**9,2**	**38,5**	**11,2**	**28,8**	**8,6**	**42,3**	**11,8**	**136,5**	**10,2**
Laughing Dove *Streptopelia senegalensis*	**21,2**	**7,2**	**42,3**	**12,3**	**19,2**	**5,7**	**26,9**	**7,5**	**109,6**	**8,2**
Helmeted Guineafowl *Numida meleagris*	**15,4**	**5,2**	**76,9**	**22,3**	**76,9**	**22,9**	3,8	1,1	**173,1**	**13,0**
Cape Sparrow *Passer melanurus*	**42,3**	**14,4**	**42,3**	**12,3**	**42,3**	**12,6**	**42,3**	**11,8**	**169,2**	**12,7**
Chestnut-vented Tit-Babbler *Sylvia subcaerulea*	**21,2**	**7,2**	**23,1**	**6,7**	**21,2**	**6,3**	**34,6**	**9,6**	**100,0**	**7,5**
Black-chested Prinia *Prinia flavicans*	**23,1**	**7,8**	**13,5**	3,9	7,7	2,3	**32,7**	**9,1**	**76,9**	**5,8**
Cape White-eye *Zosterops pallidus*	**23,1**	**7,8**	**13,5**	3,9	13,5	4,0	**25,0**	**7,0**	**75,0**	**5,6**
Fiscal Flycatcher *Sigelus silens*	7,7	2,6	5,8	1,7	9,6	2,9	11,5	3,2	34,6	2,6
Bokmakierie *Telophorus zeylonus*	9,6	3,3	7,7	2,2	3,8	1,1	11,5	3,2	32,7	2,4
Red-faced Mosebird *Urocollis indicus*	1,9	0,7	5,8	1,7	19,2	5,7	1,9	0,5	28,8	2,2
Swainson's Francolin *Francolinus swainsonii*	9,6	3,3	1,9	0,6	9,6	2,9	9,6	2,7	30,8	2,3
Common Fiscal *Lanius collaris*	9,6	3,3	3,8	1,1	3,8	1,1	9,6	2,7	26,9	2,0
Southern Masked Weaver *Ploceus velatus*	5,8	2,0	5,8	1,7	3,8	1,1	5,8	1,6	21,2	1,6
Acacia Pied Barbet *Tricholaema leucomelas*	3,8	1,3	1,9	0,6	3,8	1,1	7,7	2,1	17,3	1,3
Cape Robin-Chat *Cossypha caffra*	3,8	1,3	5,8	1,7	1,9	0,6	5,8	1,6	17,3	1,3
Crested Barbet *Trachyphonus vaillantii*	3,8	1,3	5,8	1,7	3,8	1,1	1,9	0,5	15,4	1,2
Olive Thrush *Turdus olivaceus*	3,8	1,3	3,8	1,1	1,9	0,6	5,8	1,6	15,4	1,2
Kalahari Scrub Robin *Erythropygia paena*	5,8	2,0	3,8	1,1	0,0	0,0	5,8	1,6	15,4	1,2
House Sparrow *Passer domesticus*	3,8	1,3	3,8	1,1	3,8	1,1	3,8	1,1	15,4	1,2
Black-throated Canary *Crithagra atrogularis*	1,9	0,7	0,0	0,0	3,8	1,1	3,8	1,1	9,6	0,7
Crowned Lapwing *Vanellus coronatus*	0,0	0,0	0,0	0,0	3,8	1,1	5,8	1,6	9,6	0,7
White-backed Mousebird *Colius colius*	1,9	0,7	3,8	1,1	0,0	0,0	3,8	1,1	9,6	0,7
Yellow Canary *Crithagra sulphuratus*	1,9	0,7	1,9	0,6	0,0	0,0	1,9	0,5	5,8	0,4
Glossy Starling *Lamprotornis nitens*	1,9	0,7	0,0	0,0	1,9	0,6	1,9	0,5	5,8	0,4
Desert Cisticola *Cisticola aridula*	0,0	0,0	0,0	0,0	0,0	0,0	3,8	1,1	3,8	0,3
Blacksmith Plover *Vanellus armatus*	0,0	0,0	0,0	0,0	1,9	0,6	1,9	0,5	3,8	0,3
Fairly Flycatcher *Stenostira scita*	1,9	0,7	0,0	0,0	0,0	0,0	1,9	0,5	3,8	0,3
Diederick *Chrysococcyx caprius*	0,0	0,0	0,0	0,0	0,0	0,0	3,8	1,1	3,8	0,3

Neddicky *Cisticola ruficapilla*	1,9	0,7	0,0	0,0	0,0	0,0	1,9	0,5	3,8	0,3
Lesser Honeyguide *Indicator minor*	1,9	0,7	1,9	0,6	0,0	0,0	0,0	0,0	3,8	0,3
Cinnamon-breasted Bunting *Emberiza tahapisi*	1,9	0,7	1,9	0,6	0,0	0,0	0,0	0,0	3,8	0,3
Red-chested Cuckoo *Cuculus solitarius*	0,0	0,0	0,0	0,0	0,0	0,0	1,9	0,5	1,9	0,1
Orange River Francolin *Scleroptila. levaillantoides*	0,0	0,0	0,0	0,0	0,0	0,0	1,9	0,5	1,9	0,1
Karoo Scrub Robin *Erythropygia coryphaeus*	0,0	0,0	0,0	0,0	0,0	0,0	1,9	0,5	1,9	0,1
Cloud Cisticola *Cisticola textrix*	0,0	0,0	0,0	0,0	0,0	0,0	1,9	0,5	1,9	0,1
Red-eyed Dove *Streptopelia semitorquata*	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
African Hoopoe *Upupa africana*	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total	294,2	100,0	344,2	100,0	336,5	100,0	359,6	100,0	1334,6	100,0
Number of species recorded	28		24		23		34		38	
Number of pairs recorded	153		179		175		187		694	
Simpson’s index	0.92		0.89		0.89		0.93			

Table 2. Altitudinal changes in avian assemblages in an *Olea-Buddleia* koppie. Explanations as in Table 1.

Species	Hill top		Foothill	
	p/10km	dom.	p/10km	dom.
Red-eyed Bulbul	32,7	9,1	40,3	15,2
Cape Turtle-Dove	42,3	11,8	26,9	10,1
Laughing Dove	26,9	7,5	38,8	14,6
Cape Sparrow	42,3	11,8	0,0	0,0
Chestnut-vented Tit-Babbler	34,6	9,6	14,9	5,6
Black-chested Prinia	32,7	9,1	19,4	7,3
Cape White-eye	25,0	7,0	13,4	5,1
Common Fiscal	9,6	2,7	11,9	4,5
Fiscal Flycatcher	11,5	3,2	4,5	1,7
Bokmakierie	11,5	3,2	7,5	2,8
Swainson's Francolin	9,6	2,7	0,0	0,0
Southern Masked Weaver	5,8	1,6	9,0	3,4
Acacia Pied Barbet	7,7	2,1	14,9	5,6
Crowned Lapwing	5,8	1,6	0,0	0,0
Crested Barbet	1,9	0,5	9,0	3,4
Cape Robin-Chat	5,8	1,6	14,9	5,6
Olive Thrush	5,8	1,6	17,9	6,7
Kalahari Scrub Robin	5,8	1,6	0,0	0,0
Diederick	3,8	1,1	1,5	0,6
Black-throated Canary	3,8	1,1	0,0	0,0
House Sparrow	3,8	1,1	0,0	0,0
Desert Cisticola	3,8	1,1	0,0	0,0
Blacksmith Plover	1,9	0,5	0,0	0,0
Yellow Canary	1,9	0,5	0,0	0,0
Neddicky	1,9	0,5	4,5	1,7
Lesser Honeyguide	0,0	0,0	0,0	0,0
Glossy Starling	1,9	0,5	0,0	0,0
Cinnamon-breasted Bunting	0,0	0,0	0,0	0,0
Red-chested Cuckoo	1,9	0,5	0,0	0,0
Orange River Francolin	1,9	0,5	0,0	0,0
Karroo Scrub Robin	1,9	0,5	0,0	0,0

Cloud Cisticola	1,9	0,5	0,0	0,0
Fairly Flycatcher	1,9	0,5	0,0	0,0
Red-eyed Dove	0,0	0,0	4,5	1,7
African Hoopoe	0,0	0,0	3,0	1,1
Helmeted Guineafowl	3,8	1,1	0,0	0,0
Red-faced Mousebird	1,9	0,5	4,5	1,7
White-backed Mousebird	3,8	1,1	4,5	1,7
Total	359,6	100,0	265,7	100,0
Number of species recorded	34		21	
Number of pairs recorded	187		178	
Simpson's index	0,93		0,92	