

Effect of rainfall on the structure and population densities of birds breeding in a suburb of Windhoek, Namibia

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A bird community was quantified in the suburb of Olympia (200 ha) in the city of Windhoek, Namibia. Two years (2014 and 2020) were selected to examine the impact of rainfall and suburb development on species diversity and population densities of the selected bird species in this community. The total amount of rainfall in Windhoek in 2014 was much higher than in 2020 (475 mm and 275 mm, respectively). In total, 36 breeding bird species were recorded in the study area in 2014 and 2020: 27 species in 2014 and 31 species in 2020. The number of species common in 2014 and 2020 was 17. The Sørensen's Similarity Index was therefore rather low (0.59). In overall, population density of 25 selected bird species was much higher in 2020 than in 2014. Population densities of the Laughing Dove, the Southern Masked Weaver, and Chestnut-vented Warbler in 2014 and 2020 were statistically different, whereas population densities of the Red-headed Finch were similar in both years compared.

The breeding bird community in Olympia suburb does not appear to be stable over years, both in regard to species composition and population densities of particular species. This instability may be linked to constant property development of this suburb and around it. Olympia suburb borders on the periphery of the city, which is a savanna slowly transformed into another suburb. Under drought conditions, some species from these surroundings may be attracted to the suburbs by water and food. Hence, contrary to expectation, densities of some species in the suburbs in the year with low rainfall are higher.

Keywords: urban ornithology, avian community, population densities, effect of rainfall

INTRODUCTION

Windhoek is the capital of Namibia situated in the central part of the country in the Khomas

Highlands. Due to the diversification of habitats and the abundance of food and water, the city attracts wildlife from the surrounding Highland Savanna. It would be of great interest to study the urbanization process of various components of the wildlife, to show the extent and mechanism

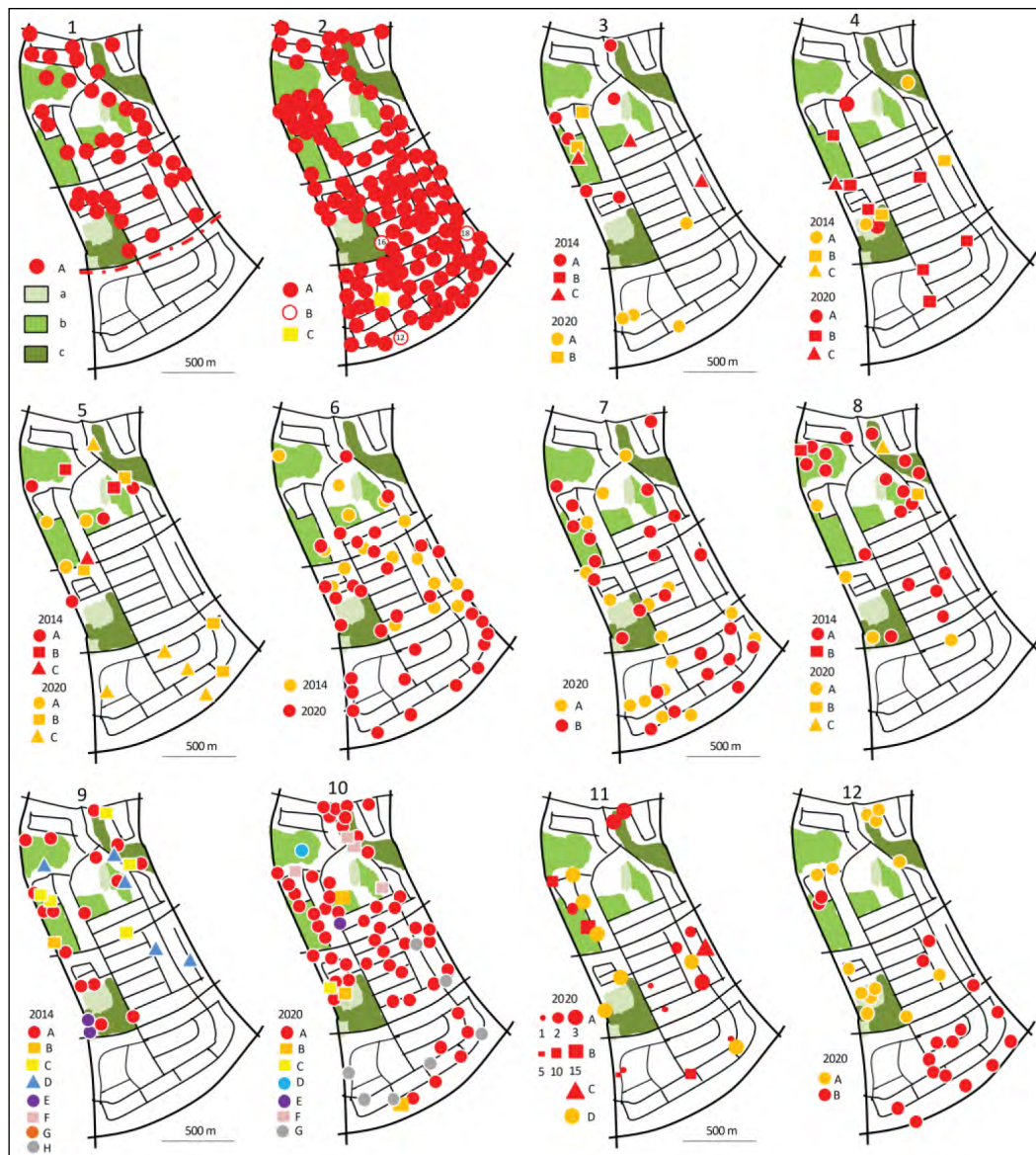
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of this process, and the role the city may play in nature conservation. To date, however, little is known about the wildlife in this city (Barnard, 1998; Kopij, 2014a).

Like in most cities around the world, birds are the most intensively studied group of wildlife in Windhoek. Complete checklists based on several years of observations or ringing were published by Brown (1997), Kaestner (1997), and Thomson (2019). However, quantitative

studies on birds breeding in Windhoek were conducted only in the Botanic Gardens (Kopij, 2021a).

The aim of this study was to quantify a bird community in one district of Windhoek, which can be regarded as representative of the city suburbs. Specifically, two years were selected to examine the impact of rainfall and suburb development on species diversity and population densities of selected bird species (Figs 1–12).



Figs 1–12. Distribution of breeding pairs/occupied territories of bird species in Olympia suburb
 1. Laughing Dove breeding pair in 2014 (excluding the southern part): a – grassy places, b – acacia shrubs, c – shrubby hills; the red dashed line divides the northern and southern parts of the study plot;

2. A – Laughing Dove breeding pairs in 2020, B – non-breeding flock (flock size is given), C – Ring-necked Dove; 3. A – Yellow Canary, B – Orange River White-eye, C – Familiar Chat; 4. A – Acacia Pied Barbet, B – Grey Go-away-bird, C – African Hoopoe; 5. A – Black-chested Prinia, B – Cape Wagtail, C – African Marsh Warbler; 6. Red-headed Finch (in 2014 without the southern part); 7. A – Rosy-faced Lovebird (right), B – Black-throated Canary; 8. A – Chestnut-vented Warbler, B – Long-billed Crombec, C – Black-faced Waxbill; 9. A – Southern Masked Weaver, B – Scaly-throated Finch, C – Pale-winged Starling, D – Pririt Batis, E – Cape Starling, F – Long-billed Crombec, G – Black-chested Prinia, H – Chestnut-vented Warbler; 10. A – Southern Masked Weaver, B – Scaly-throated Finch, C – Fork-tailed Drongo, D – Helmeted Guineafowl, E – Swallow-tailed Bee-eater; F – Scarlet-chested Sunbird, G – Dusky Sunbird; 11. A – African Palm Swift (number of breeding pairs are indicated), B – Little Swift (number of breeding pairs indicated), C – Alpine Swift; D – Red-faced Mousebird; 12. A – White-browed Sparrow Weaver, B – Rock Pigeon.

MATERIAL AND METHODS

Study area

The study area is situated in Olympia suburb within the city of Windhoek (Fig. 13), 2 km south of its centre (Christuskirche). It is confined by Kabila Street in the north, Mugabe Avenue in the east, Western Bypass in the south,

and Fredericks Street in the west. In south-east, Olympia borders on an unbuilt periphery, which is an extensive open dwarf mountain acacia savanna.

Windhoek has hot semi-arid climate, with over 300 sunny days per annum. The average annual rainfall is 300–350 mm, but it may vary from around 100 to 800 mm (Mendelsohn et al.,



Fig. 13. Location of the study area in the city of Windhoek

2009). The total amount of rainfall was much higher in 2014 than in 2020 (475 mm and 275 mm, respectively). Significant differences were also observed in the previous years: while in 2013 the total amount of rainfall was 243 mm, in 2019 it was 110 mm (Fig. 14) (<https://weather.namsearch.com/wdhrainsummary.php>).

The surface size of the study area is around 200 ha. For the purpose of this study, McBride Street divides it into the northern, older suburb (135 ha) and the southern, more recent one (65 ha) (Fig. 12A). There are remnants of natural vegetation left in the northern part. This vegetation (mainly *Acacia* shrubs) occupies most of

the upper parts of four rivulets (tributaries of the Gammans River) in the western and north-eastern parts of the suburb. There are also some open, grassy, not build-up places, usually in the form of sport fields. No such remnants of natural vegetation and no open spaces are left in the southern part.

The natural vegetation in Olympia is classified as Highland shrublands, which is a sort of acacia savanna (Mendelsohn et al., 2009). At present, most of this vegetation has been replaced by buildings, pavements, roads, and gardens (Figs 15–18). Trees and shrubs, both indigenous and exotic, are abundant, but

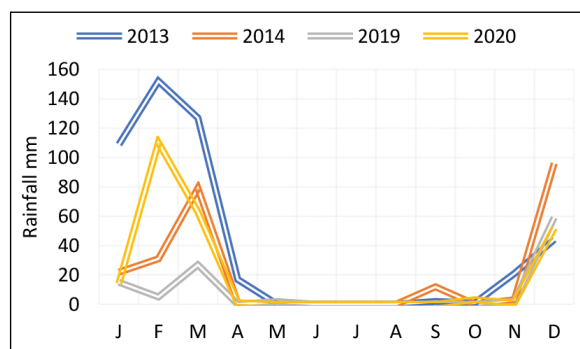


Fig. 14. Rainfall in Windhoek in 2013–2014 and 2019–2020



Figs 15–18. Views of the study area

there are also numerous *Acacia xanthophloa*, *Bauhinia tomentosa*, *Buddleja salinga*, *Celtis Africana*, *Dovialis cafra*, *Kiggelaria Africana*, *Phoenix canariensis* palm, and *Washingtonia filifera* palm.

Methods

The study was conducted in 2014 and 2020, on 29/30 August 2014 and 24/25 August 2020, i.e., in the same season of the year (the end of August), the same time of day (between 6 and 7 a.m. and 10 and 11 a.m.), and under same weather conditions (calm and sunny). Two mornings were required to cover the whole study area. In 2014, birds were counted in the northern part only (135 ha), whereas in 2020, both in the northern (135 ha) and the southern (65 ha) parts.

All birds showing breeding or/and territorial behaviour were plotted on a 1:1000 scale map. Special attention was paid to singing males, especially a few males singing simultaneously. In the case of the Southern Masked Weaver, White-browed Sparrow-Weaver, Scaly-feathered Finch, Rosy-faced Lovebird, and African Palm Swift, nesting sites were counted. Nests were counted in the case of the Little Swift and Alpine Swift.

A breeding pair was a census unit. One or two adult birds (usually male and female in a species with sex dimorphism) showing breeding or territorial behaviour were interpreted as one breeding pair, as was also a singing male.

In the case of the Southern Masked Weaver, White-browed Sparrow-Weaver, and Scaly-feathered Finch, a breeding site was assumed as one breeding pair, unless more than one female was present (the number of females at such places was assumed as representing the number of breeding pairs). A family (a pair with offspring) and an occupied nest were interpreted as one breeding pair.

The following more common species were excluded from counting in 2014: House Sparrow, African Red-eyed Bulbul, White-backed Mousebird, Black-throated Canary, White-browed Sparrow-Weaver, African Palm Swift, and Speckled Pigeon. Only the first three species mentioned above were excluded in 2020; their numbers were, however, roughly estimated (based on observations).

Sørensen's Coefficient: $S = 2c/a + b$ (where a – the number of bird species in 2014, b – the number of bird species in 2020, c – the number of bird species common for both years) was used to compare similarities between assemblages in 2014 and 2020. The chi-square test was used to test differences in population densities of selected species between 2014 and 2020.

RESULTS

In total, 36 breeding bird species were recorded in the study area in 2014 and 2020: 27 species in 2014 and 31 species in 2020 (Table 1).

Table 1. Breeding bird community in Olympia suburb (200 ha), Windhoek, in 2020.

Dominant species are in bold case. Rough estimates are in brackets

Common species name	Scientific species name	Number of pairs	Pairs per 100 ha	Dominance (%)
Acacia Pied Barbet	<i>Tricholaema leucomelas</i>	2	1.0	0.3
African Hoopoe	<i>Upupa africana</i>	1	0.5	0.2
African Palm Swift	<i>Cypsiurus parvus</i>	19	9.5	3.0
African Red-eyed Bulbul	<i>Pycnonotus nigricans</i>	(40–80)	30.0	9.4
African Reed Warbler	<i>Acrocephalus baeticatus</i>	5	2.5	0.8
Alpine Swift	<i>Tachymarptis melba</i>	1	0.5	0.2
Black-chested Prinia	<i>Prinia flavicans</i>	4	2.0	0.6
Black-faced Waxbill	<i>Estrilda erythronotos</i>	1	0.5	0.2

Table 1. (Continued)

Common species name	Scientific species name	Number of pairs	Pairs per 100 ha	Dominance (%)
Black-throated Canary	<i>Crithagra atrogularis</i>	24	12.0	3.8
Ring-necked Dove	<i>Streptopelia capicola</i>	1	0.5	0.2
Cape Wagtail	<i>Motacilla capensis</i>	4	2.0	0.6
Chestnut-vented Warbler	<i>Sylvia subcaerulea</i>	4	2.0	0.6
Dusky Sunbird	<i>Cynniris fuscus</i>	7	3.5	1.1
Fork-tailed Drongo	<i>Dicrurus adsimilis</i>	1	0.5	0.2
Grey Go-away-bird	<i>Corythaixoides concolor</i>	7	3.5	1.1
Helmeted Guineafowl	<i>Numida meleagris</i>	1	0.5	0.2
House Sparrow	<i>Passer domesticus</i>	(100–200)	75.0	23.5
Laughing Dove	<i>Streptopelia senegalensis</i>	125	62.5	19.6
Little Swift	<i>Apus affinis</i>	40	20.0	6.3
Long-billed Crombec	<i>Sylvietta rufescens</i>	1	0.5	0.2
Orange River Cape White-eye	<i>Zosterops pallidus</i>	1	0.5	0.2
Red-headed Finch	<i>Amadina erythrocephala</i>	32	16.0	5.0
Rock Martin	<i>Ptyonoprogne fuligula</i>	7	3.5	1.1
Rosy-faced Lovebird	<i>Agapornis roseicollis</i>	16	8.0	2.5
Scaly-feathered Finch	<i>Sporopipes squamifrons</i>	1	0.5	0.2
Scarlet-chested Sunbird	<i>Chalcomitra senegalensis</i>	4	2.0	0.6
Southern Masked Weaver	<i>Ploceus velatus</i>	51	25.5	8.0
Speckled Pigeon	<i>Columba guinea</i>	17	8.5	2.7
Swallow-tailed Bee-eater	<i>Merops hirundineus</i>	1	0.5	0.2
White-backed Mousebird	<i>Colius colius</i>	(25–50)	37.5	5.9
White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>	13	6.5	2.0
Total		638.5	319.0	100.0

Seventeen species were common in 2014 and 2020. The Sørensen's Similarity Index was therefore low (0.59).

In 2020, the following species were classified as dominants: House Sparrow, Laughing Dove, African Red-eyed Bulbul, Southern Masked Weaver, White-backed Mousebird (Fig. 19), and Little Swift. In 2020, relatively high population density was recorded for the Red-headed Finch (16.0 pairs/100 ha), Black-throated Canary (12.0 pairs/100 ha), Rosy-faced Lovebird (8.0 pairs/100 ha) and Southern Masked Weaver (25.5 pairs/100 ha).

In overall, population density of 25 selected bird species was much higher in 2020 than in



Fig. 19. Roosting flock of the White-backed Mousebird

2014 ($x^2 = 49.9$, $p < 0.01$). Population densities of the Laughing Dove, Southern Masked Weaver, and Red-chested Warbler differed in 2014 and 2020 ($x^2 = 57.8$; 47.5; 28.7 respectively; for all $p < 0.01$), whereas population densities of the Red-headed Finch were similar in both years compared ($x^2 = 0.02$; $p > 0.05$). The Rosy-

facéd Lovebird and Dusky Sunbird nested in 2020 at density higher than 3 pairs/100 ha, while in 2014 they were not recorded at all. On the other hand, the Pale-winged Starling, Pririt Batis, and Yellow Canary nested at density of 2 pairs/100 ha in 2014, while in 2020 they were not recorded at all (Table 2).

Table 2. Population densities of selected bird species in the northern part of Olympia suburb (165 ha) in 2014 and 2020

Species name		Number of pairs		Pairs/100 ha	
Common name	Scientific name	2020	2014	2020	2014
Laughing Dove	<i>Streptopelia senegalensis</i>	79	37	47.9	22.4
Southern Masked Weaver	<i>Ploceus velatus</i>	45	16	27.3	9.7
Chestnut-vented Warbler	<i>Sylvia subcaerulea</i>	3	18	1.8	10.9
Red-headed Finch	<i>Amadina erythrocephala</i>	19	16	11.5	9.7
Black-chested Prinia	<i>Prinia flavicans</i>	4	3	2.4	1.8
Grey Go-away-bird	<i>Corythaixoides concolor</i>	4	2	2.4	1.2
Cape Wagtail	<i>Motacilla capensis</i>	2	2	1.2	1.2
Scaly-feathered Finch	<i>Sporopipes squamifrons</i>	1	2	0.6	1.2
African Reed Warbler	<i>Acrocephalus baeticatus</i>	1	1	0.6	0.6
Long-billed Crombec	<i>Sylvietta rufescens</i>	1	1	0.6	0.6
Rosy-faced Lovebird	<i>Agapornis roseicollis</i>	9	0	5.5	0.0
Dusky Sunbird	<i>Cynniris fuscus</i>	5	0	3.0	0.0
Acacia Pied Barbet	<i>Tricholaema leucomelas</i>	2	0	1.2	0.0
Helmeted Guineafowl	<i>Numida meleagris</i>	1	0	0.6	0.0
African Hoopoe	<i>Upupa africana</i>	1	0	0.6	0.0
Swallow-tailed Bee-eater	<i>Merops hirundineus</i>	1	0	0.6	0.0
Alpine Swift	<i>Tachymarptis melba</i>	1	0	0.6	0.0
Fork-tailed Drongo	<i>Dicrurus adsimilis</i>	1	0	0.6	0.0
Orange River Cape White-eye	<i>Zosterops pallidus</i>	1	0	0.6	0.0
Black-faced Waxbill	<i>Estrilda erythronotos</i>	1	0	0.6	0.0
Pale-winged Starling	<i>Onychognathus nabouroup</i>	0	5	0.0	3.0
Pririt Batis	<i>Batis pririt</i>	0	5	0.0	3.0
Yellow Canary	<i>Crithagra flaviventris</i>	0	4	0.0	2.4
Familiar Chat	<i>Emarginata familiaris</i>	0	3	0.0	1.8
Cape Starling	<i>Lamprotornis nitens</i>	0	2	0.0	1.2
Total		182	117	110.3	70.9

DISCUSSION

The number of breeding species in Namibian towns may range from a dozen or so (e.g.,

Hentje's Bay, Swakopmund) to over 100 (Katima Mulilo). Sparrows and doves are the most common species everywhere. The Laughing Dove appears to be especially characteristic in the group

of dominants. It is consistently a dominant species in all towns where breeding bird communities have been quantified so far (Table 3). The other dove species, the Ring-necked Dove, is often absent in Namibian towns altogether, except for the towns in the north-east (Kopij, 2020; 2021c). In South African towns, the Ring-necked Dove is often in the group of dominant species (Kopij, 1996; 1997; 2000; 2001a; 2001b; 2011; 2015).

Also, the representatives of the genus *Columba*, the Speckled Pigeon and Rock Dove, are often dominant species in southern African towns (Kopij, 1996; 1997; 2000; 2001a; 2004; 2009), but either they were not recorded, or they nested in relatively low densities in Namibian towns (Table 3; also, Kopij, 2014; 2021c; 2021d). In Windhoek, the Speckled Pigeon is fairly common in suburbs, such as Olympia, but it has been replaced by the exotic Rock Dove in the centre.

The Southern Masked Weaver was found as a dominant species in all Namibian towns (Table 3). A similar situation was recorded in South African towns (Kopij, 1996; 1997; 2001a; 2004; 2015), Botswana (Kopij, 2018b), and Lesotho (Kopij, 2000; 2001b; 2011). This species may greatly benefit from the abundance of trees and

food in towns. Other weaver species are not so well adapted to urban habitats. In all towns surveyed, they either did not occur or they nested in low population densities.

Insectivorous swifts are often abundant in southern African towns (Kopij, 1996; 1997; 2000; 2001a; 2004). In Namibia, they are often represented by the African Palm Swift and Little Swift. In Windhoek, Alpine Swift, White-rumped Swift and Bradfield's Swift were also recorded (Kopij, own observation). Three of them – the Little, African Palm and Alpine – nested in Olympia at an overall density of 30 pairs/100 ha. It is interesting to note that swallows (Hirundinidae), a family so well represented in southern Africa, feeding on airborne insects like the swifts, are absent or rare in Namibian towns. A possible reason can be a competition with the swifts for both nesting sites and food.

In the towns of southern Africa, where breeding bird communities were quantified, the Red-headed Finch was recorded at low population densities or it was not recorded at all (Kopij, 1996; 1997; 2000; 2001a; 2001b; 2004; 2009; 2011). The Olympia suburb in Windhoek is exceptional in this regard. Both in 2014 and 2020, relatively high population

Table 3. Population densities (pairs/100 ha) of selected bird species in Namibian towns

Species \ Town	Windhoek	Swakopmund	Hantjes Bay	Outapi	Ongua-diva	Katima Mulilo
Laughing Dove	62.5	47.0	73.0	10.6	84.0	66.4
Ring-necked Dove	0.5	0.0	0.0	0.0	0.0	18.9
Speckled Pigeon	8.5	5.1	10.0	0.0	8.0	0.0
Acacia Pied Barbet	1.0	0.0	0.0	1.2	2.0	0.0
African Palm Swift	9.5	0.0	0.0	21.5	10.0	0.6
Rosy-faced Lovebird	8.0	0.0	17.0	2.3	0.0	0.0
Southern Masked Weaver	25.5	17.3	26.0	3.8	21.0	22.6
Black-throated Canary	12.0	0.0	0.0	7.7	6.0	1.1
African Reed Warbler	2.5	0.0	4.0	0.0	0.0	0.0
Cape Wagtail	2.0	10.6	11.0	0.0	0.0	0.0
Surface of study area	200 ha	415 ha	345 ha	130 ha	100 ha	177 ha
Source	This study	Kopij 2018	Kopij 2022	Kopij 2019a	Kopij 2021b	Kopij 2020

densities were recorded. The Red-headed Finch may be attracted to this suburb by numerous nests of the White-browed Sparrow-Weaver, which it readily adopts for breeding (Dean, 2005a). They may be much more common in arid savanna, which prevails it should read 'in and around' Windhoek, than in other vegetation types. Therefore, in most other towns investigated, the White-browed Sparrow-Weaver was not recorded (Kopij, 1996; 1997; 2000; 2001a; 2001b; 2004; 2011).

In southern Africa, canaries do not appear to be well-adapted to urbanized habitats (Hocky et al., 2005; Kopij, 1997; 2000; 2001a; 2011; 2015). The Black-throated Canary is an exception to this rule; its population density was relatively high in Olympia suburb (Table 3). In the arid environment surrounding Windhoek it may be attracted by water in the suburbs, which is its basic habitat requisite (Dean, 2005). It has been also evidenced that the Black-throated Canary has been replaced by other canary species in some places (Kopij, 2006). In Windhoek, it may be challenged only by the Yellow Canary, which is however, an uncommon species here (Kopij, own observation).

The breeding bird community in Olympia suburb does not appear to be stable over the years, both in regard to species composition and population densities of particular species. This instability may be linked to constant property development in this suburb and its surroundings. Olympia suburb borders on the city periphery, which is a savanna that is slowly transformed into suburbs. Under drought conditions, some species from these surroundings may be attracted to the suburbs by water and food, hence higher densities of some species in the suburb (Laughing Dove, Southern Masked Weaver, Dusky Sunbird, Rosy-faced Lovebird, Acacia Pied Barbet) in the dry onset of the breeding season (August-September) of 2020 than in more humid onset in 2014. On the other hand, there are species such as the Chestnut-vented Warbler, Pririt Batis, and Pale-winged Starling, which do not respond in such a way, being more common in the suburbs in humid than in dry years.

The main purpose of the study was to compare the numbers of particular bird species between two years with different rainfall. Since only single surveys were conducted in both years, population densities and dominance should be treated here rather as indices of relative abundance (or minimal values) and relative dominance (values from 2014 related to values from 2020) than absolute values.

In general, the avian community in the suburb appears to be not so much affected by rainfall as are avian communities in natural environment in southern Africa. This is probably because the availability of water for birds in suburbs (e.g., in swimming pools, watered gardens, and mown grassy areas) remain more independent of precipitation, as the water here originate also from tanks, dams, and underground.

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STRUKTŪRAI IR POPULIACIJOS TANKIUI**

Santrauka

Tyrimas atliktas Vindhuko miesto Olimpijos priemiestyje (200 ha). Perintys paukščiai buvo skaičiuojami 2014 ir 2020 metais. Bendras kritulių kiekis Vindhuke 2014 m. buvo daug didesnis nei 2020 metais (475 ir 275 mm). Iš viso 2014 ir 2020 m. tiriamoje teritorijoje buvo užregistruotos 36 perinčių paukščių rūšys: 2014 m. – 27 rūšys, 2020 m. – 31 rūšis. 2014 ir 2020 m. nustatyta 17 paplitusių rūšių, todėl Sörenseno panašumo indeksas buvo gana žemas (0,59). Apskritai 25 atrinktų paukščių rūšių populiacijos tankis 2020 m. buvo daug didesnis nei 2014 metais. Olimpijos priemiestyje perinčių paukščių bendruomenė nėra stabili tiek rūšinės sudėties, tiek tam tikrų rūšių populiacijos tankio atžvilgiu. Šis nestabilumas gali būti susijęs su nuolatine šio priemiesčio ir jo apylinkių gyvenviečių plėtra. Olimpijos priemiesčiai ribojasi su miesto periferija ir savana pamažu virsta kitu priemiesčiu. Sausros sąlygomis kai kurias rūšis iš šios aplinkos į priemiesčius gali pritraukti vanduo ir maistas. Taigi, priešingai nei tikėtasi, kai kurių rūšių tankis priemiesčiuose yra didesnis tais metais, kai iškrenta mažiau kritulių.

Raktažodžiai: miestų ornitologija, paukščių bendruomenė, populiacijų tankis, kritulių poveikis