

Population density and structure of a breeding bird community in a suburban habitat in the Cuvelai drainage system, northern Namibia

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Abstract

Population density and structure of a breeding bird community in a suburban habitat in the Cuvelai drainage system, northern Namibia. In a suburb (c. 100 ha) of Ongwediva, a total of 30 breeding bird species were recorded in 2018. Shannon's Diversity Index was 2.01. *Passer domesticus* comprised almost half of all breeding pairs (36.4 pairs/10 ha). Granivores were by far the most numerous feeding guild, comprising 77.5% of all birds breeding. Birds nesting on/in buildings were represented by two species only, but they comprised almost half (49.9%) of all breeding birds. In comparison with other southern African towns, the number of bird species breeding in Ongwediva was low. This was compensated by high population densities of some species.

Key words: Community ecology, Urban ecology, *Streptopelia doves*, *Passer domesticus*

Resumen

Densidad de población y estructura de una comunidad de aves reproductoras en un hábitat suburbano del sistema de drenaje de Cuvelai, en el norte de Namibia. En un suburbio (100 ha aproximadamente) de Ongwediva se registraron un total de 30 especies de aves reproductoras en 2018. El índice de diversidad de Shannon fue de 2,01. El estudio reveló que *Passer domesticus* supone casi la mitad de todas las parejas reproductoras (36,4 parejas/10 ha). Los granívoros son, con gran diferencia, el grupo más numeroso según la alimentación, con el 77,5% de todas las aves reproductoras. Las aves que anidan en edificios están representadas únicamente por dos especies, pero constituyen casi la mitad (49,9%) de todas las aves reproductoras. En comparación con otras ciudades del sur de África, el número de especies de aves reproductoras de Ongwediva es bajo, aunque se compensa con altas densidades de población de algunas especies.

Palabras clave: Ecología comunitaria, Ecología urbana, *Streptopelia doves*, *Passer domesticus*

Resum

Densitat de població i estructura d'una comunitat d'ocells reproductors en un hàbitat suburbà del sistema de drenatge de Cuvelai, al nord de Namíbia. En un suburbi (100 ha approxi-

madament) d'Ongwediva es van registrar un total de 30 espècies d'ocells reproductors el 2018. L'índex de diversitat de Shannon va ser de 2,01. L'estudi va revelar que *Passer domesticus* suposa gairebé la meitat de totes les parelles reproductores (36,4 parelles/10 ha). Els granívors són, amb gran diferència, el grup més nombrós segons l'alimentació, amb el 77,5% de tots els ocells reproductors. Els ocells que nien en edificis només estan representats per dues espècies, però constitueixen gairebé la meitat (49,9%) de tots els ocells reproductors. En comparació amb altres ciutats del sud d'Àfrica, el nombre d'espècies d'ocells reproductors d'Ongwediva és baix, tot i que es compensa amb altes densitats de població d'algunes espècies.

Paraules clau: Ecologia comunitària, Ecologia urbana, *Streptopelia doves*, *Passer domesticus*

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Introduction

For the last few decades, birds breeding in towns and cities have become a subject of thorough investigation in some countries in the northern hemisphere (Chace and Walsh, 2006; Dunn and Weston, 2008; Magle et al., 2012; Luniak, 2017). Such research has contributed enormously to nature conservation, and contrary to expectations, some bird species may flourish in urbanized habitats (Kopij, 2001, 2014a, 2014c, 2015, 2016, 2018a, 2018b; Dunn and Weston, 2008). In such habitats they may find abundant food resources and suitable nesting sites, lack of predators, and also a sort of protection against adverse weather conditions.

In this study I used an accurate method to assess population densities and community structure of birds breeding in a suburban habitat in north-central Namibia. To date, no quantitative assessment of breeding avifauna has been conducted in this or any other towns in this region.

Material and methods

Study area

The study area (100 ha) was situated in a central part of the town Ongwediva, in north-central Namibia (17° 46' S, 15° 46' E). This is a densely built-up residential area with flat houses, with corrugated iron roofs. There are fruit trees around most of these houses and numerous indigenous trees such as the camel thorn *Acacia erioloba*, makalani palm *Hyphaena petersiana*, and marula *Sclerocarya birrea*, forming in some places clumps or rows. In a few places there are also exotic trees, such as gum trees *Eucalyptus camaldulensis*, or she oaks *Cassuarina* spp. (fig. 1).

The Greater Ongwediva, a heartland of Ovamboland, covers an area of 4,102 ha. The settlement was established in the 1960's and was proclaimed a town in 1992. The Cuvelai drainage system, where Ongwediva is situated, comprises a mixture of three major vegetation types: mopane savanna, acacia savanna and flooded grasslands (oshanas). It is located in



Fig. 1. Views of the study area in Ongwediva town.

Fig. 1. Vistas del área de estudio en la ciudad de Ongwediva.

a prime summer (November–March) rainfall zone, with an average annual temperature of 22.5 °C and mean annual precipitation of 400–500 mm (Mendelsohn et al., 2000).

Ongwediva has a semi-arid climate. The summers are sweltering and partly cloudy; the winters are short, comfortable, and clear. In the wet season 2017/18 the rainfall in Ongwediva was 420 mm, but in 2018/19 wet season it was only 192 mm. During the study period in 2018, the monthly rainfall was as follow: August, 0 mm; September, 0 mm; October 6.4 mm; November, 17.3 mm; December, 38.3 mm (<https://www.worldweatheronline.com/ongwediva-weather-averages/oshana/na.aspx>).

Methods

The territory mapping method was used (Bibby et al., 2012). Since the study area was too large for a single morning count, it was divided into two parts. Birds were counted in one part on one day and in the other part a few days later. Four surveys (each one consisting of two counts) were therefore conducted over the whole study area: I (12 and 19 August 2018); II (16 and 23 September 2018); III (21 and 28 October 2018); IV (25 November and 2 December 2018). All counts were conducted in the mornings.

Birds were counted while the researchers walked slowly along the streets. The routes were designed in such a way as to cover the whole study area. All birds showing breeding (e.g. transporting nesting material, constructing nests, feeding chicks, etc.) or territorial (e.g. singing males) behaviour were plotted on a map. Special attention was paid to simultaneously singing males as they were important in determining numbers of occupied territories. Special care was taken to avoid counting the same birds twice.

If a bird of the same species showed breeding or territorial behaviour at the same site on at least two such surveys, the area was assumed to be an occupied territory. Each occupied territory was considered as one breeding pair. In the case of polygamous species, specifically the southern masked weaver *Ploceus velatus*, each breeding site was considered an

occupied territory. Such a simplistic approach could, however, underestimate the number of breeding females. In the case of feral pigeons *Columba livia*, the number of breeding pairs was estimated by dividing the total number of recorded individuals by two.

The following indices were used to characterize the diversity and evenness of the communities:

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.

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 and N , the total number of breeding pairs of all species.

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 and S , the total number of species.

J' varies between 0 and 1. The less variation between species in a community, the higher J' is.

Dominance Index:

$$DI = (n_1 + n_2) / N$$

where n_1, n_2 are the number of pairs of two most abundant species and N , the total number of pairs of all species.

Dominance was calculated as the percentage of breeding pairs of a given species in relation to all breeding pairs of all species. Species that comprised 5–9.99% of all breeding pairs recorded were defined as dominant, those with 10% or more were defined as eudominant, and those with 2–4.99% as subdominant.

The nomenclature of English and Latin species names follows that in Hockey et al. (2005).

Results

A total of 30 bird species were recorded as breeding species in the inner part of Ongwediva town (table 1; annexes). The house sparrow *Passer domesticus* was by far the most numerous and eudominant species, comprising almost half of all breeding pairs. It nested at a density of 36.4 pairs/10 ha. It was strictly associated with small residential houses, where it nested mainly under the corrugated roofs. Two other dominant species, the laughing dove *Streptopelia senegalensis* and blue waxbill *Uraegnis angolensis* comprised 11.3% and 9.2%, respectively (table 1). Five subdominant species comprised 18.9% of all breeding birds. The remaining 22 species together comprised 11.8% of all breeding birds (table 1).

Granivores were by far the most numerous feeding guild, comprising 77.5% of all breeding birds, although they were represented by nine species only. Insectivores, on the other hand,

Table 1. Breeding bird community in the inner part of Ongwediva town in 2018: FG, foraging guild (G, granivores; I, insectivores; F, frugivores; N, nectarivores; O, omnivores; C, carnivores); NG, nesting guild (B, on/in buildings; G, on the ground; V, in herbaceous vegetation; T, in trees or shrubs; H, in tree holes); P, pairs; D, dominance.

Tabla 1. Comunidad de aves reproductoras en el interior de la ciudad de Ongwediva en 2018: FG, tipo de alimentación (G, granívoros; I, insectívoros; F, frugívoros; N, nectarívoros; O, omnívoros; C, carnívoros); NG, lugar de anidamiento (B, edificios; G, suelo; V, vegetación herbácea; T, árboles o arbustos; H, agujeros en árboles); P, pares; D, dominancia.

Species		FG	NG	P	P/10ha	D
House sparrow	<i>Passer domesticus</i>	G	B	364	36.4	48.8
Laughing dove	<i>Streptopelia senegalensis</i>	G	T	84	8.4	11.3
Blue waxbill	<i>Uraeginthus angolensis</i>	G	T	69	6.9	9.2
Red-faced mousebird	<i>Urocolius indicus</i>	F	T	36	3.6	4.8
Red-eyed bulbul	<i>Pyconotus nigricans</i>	F	T	35	3.5	4.7
Chestnut-vented warbler	<i>Sylvia subcoerulea</i>	I	T	32	3.2	4.3
Southern masked weaver	<i>Ploceus velatus</i>	G	T	21	2.1	2.8
Marico sunbird	<i>Cinnyris mariquensis</i>	N	T	17	1.7	2.3
Black-chested prinia	<i>Prinia flavicans</i>	I	V	13	1.3	1.7
African palm swift	<i>Cypsiurus parvus</i>	I	T	10	1	1.3
Scaly-feathered finch	<i>Sporopipes squamifrons</i>	G	T	8	0.8	1.1
Speckled pigeon	<i>Columba guinea</i>	G	B	8	0.8	1.1
Marico flycatcher	<i>Melaenornis mariquensis</i>	I	T	7	0.7	0.9
Black-throated canary	<i>Crithagra atrogularis</i>	G	T	6	0.6	0.8
Dark-capped bulbul	<i>Pycnonotus tricolor</i>	F	T	6	0.6	0.8
Pied crow	<i>Corvus albus</i>	O	T	5.5	0.55	0.7
African hoopoe	<i>Upupa africana</i>	I	H	3.5	0.35	0.5
Black-collared barbet	<i>Lybius torquatus</i>	F	H	3	0.3	0.4
Rattling cisticola	<i>Cisticola chiniana</i>	I	V	3	0.3	0.4
Namaqua dove	<i>Oena capensis</i>	G	T	3	0.3	0.4
Acacia pied barbet	<i>Tricholaema leucomelas</i>	F	H	2	0.2	0.3
Red-headed finch	<i>Amadina erythrocephala</i>	G	T	2	0.2	0.3
Long-billed crombec	<i>Sylvietta rufescens</i>	I	T	2	0.2	0.3
Little bee-eater	<i>Merops pusillus</i>	I	H	1.5	0.15	0.2
Scarlet-chested sunbird	<i>Chalcomitra senegalensis</i>	N	T	1	0.1	0.1
Yellow-bellied apalis	<i>Eremomela icteropygialis</i>	I	T	1	0.1	0.1
Brown-headed tchagra	<i>Tchagra australis</i>	I	T	1	0.1	0.1
Black-backed puffback	<i>Dryoscopus cubla</i>	I	T	1	0.1	0.1
Lilac-breasted roller	<i>Coracias caudata</i>	I	H	0.5	0.05	0.1
Greater honeyguide	<i>Indicator indicator</i>	I	T	0.5	0.05	0.1
Total				746.5	74.65	100.0

Table 2. Population densities (pairs/10 ha) of sparrows in selected southern African towns: HS, house sparrow; CS, cape sparrow; GhS, grey-headed sparrow.

Tabla 2. Densidades de población (parejas/10 ha) de gorriones en las ciudades seleccionadas del sur de África. HS, gorrion común; CS, gorrion de El Cabo; GhS, gorrion gris.

Town	Size of study area	Population density				Source
		HS	CS	GhS	Total	
Kasane, Botswana	160 ha	–	–	5.4	5.4	Kopij (2018b)
Katima Mulilo, Namibia	215 ha	–	–	5.9	5.9	Kopij (2019b)
Swakopmund, Namibia	415 ha	1.7	6.5	–	8.2	Kopij (2018)
Roma, Lesotho	180 ha	0.4	–	7.9	8.3	Kopij (2019a)
Walvis Bay, Namibia	260 ha	4.4	9.9	–	15.3	Kopij (unpub.)
Bloemfontein, South Africa	5,100 ha	2.3	14.7	–	17.0	Kopij (2015)
Outapi, Namibia	130 ha	19.2	–	–	19.2	Kopij (2019)
Ongwediva, Namibia	100 ha	36.4	–	–	36.4	This study

were represented by 13 species, but they comprised only 10.4% of all breeding birds. More numerous (11.2%) were the frugivores, represented by five species. Remaining feeding guilds comprised together only 0.9%.

Birds nesting on/in buildings were represented by only two species but they comprised almost half (49.9%) of all breeding birds. As many as 20 species were nesting on trees and/or shrubs, but they comprised only 48.7%. Hole-nesting birds were represented by six species, but they comprised 1.4%, and birds nesting on the ground were absent altogether.

The cumulative dominance (69.3) and community dominance index (0.60) were very high, but Shannon's (2.01) and Simpson's (0.73) diversity indices were rather low, as was also Pielou's Evenness Index (0.59).

Discussion

The number of breeding birds in Ongwediva ($n = 30$) is low compared to other towns in southern Africa. For example, 122 species were recorded in Katima Mulilo (Kopij, 2016), 76 in Kasane (Kopij, 2018b), 73 in Maseru (Kopij, 2000), and 51 in Bloemfontein (Kopij, 2001, 2015). Only in towns situated in the Namib Desert, such as Swakopmund, were numbers lower (Kopij, 2018b, unpub.). Ongwediva is well-endowed with trees, including numerous large marulas and camel thorns. In urbanised environments in Africa, birds are attracted to large trees as a source of shelter and food (Kopij, 2000, 2001, 2015, 2016, 2018a, 2019), so the low number of breeding birds was therefore rather unexpected.

In Outapi, a town situated in the Cuvelai Drainage System, all diversity indices were similar (Kopij, 2019) to those in Ongwediva, situated in the same ecozone. However, in Katima Mulilo, a town situated on the Zambezi River in NE Namibia, these indices were higher (Simpson's Diversity Index = 0.90; Shannon's Diversity Index = 2.76; Pielou Evenness Index = 0.70) (Kopij, 2020).

Nevertheless, population densities of many bird species were high in Ongwediva compared to densities in the above-mentioned southern African towns.

Another finding of note is that the speckled pigeon *Columba guinea* and rock dove *Columba livia*, which are usually numerous in southern African towns (Hockey et al., 2005; Kopij, 2006, 2015), were uncommon in Ongwediva. Besides, the rock dove was not recorded at all, although semi-domesticated feral pigeons were common in the town. On the other hand, the invasive house sparrow has reached such a high population density in the town of Ongwediva that it is suspected to displace other bird species, especially granivores. The house sparrow is currently the only sparrow species nesting in the town. This situation of only one sparrow species breeding in a town is atypical; 2–3 sparrow species are usually reported to be breeding in most towns in southern Africa (Kopij, 2000, 2001, 2014a, 2014c, 2015, 2018a, 2018b, 2019; Hockey et al., 2005; table 2). The house sparrow invaded north-central Namibia in the second half of the 20th century (Hockey et al., 2005; Kopij, 2014a) and appears to have virtually replaced the indigenous southern grey-headed sparrow *Passer diffusus* not only from Ongwediva but also from other towns in the Cuvelai Drainage System in the north-central regions of Namibia (Kopij, 2014a).

Swallows (Hirundidae) and swifts (Apodidae) were found to be rare breeders in the town of Ongwediva, probably due to a lack of suitable and safe nesting sites. The fork-tailed drongo *Dicrurus adsimilis*, hornbills (*Tockus* spp.), shrikes (Laniidae) and bush-shrikes (Malacontidae) breed in relatively high density in southern African towns (Kopij, 2000, 2001, 2014a, 2014b, 2015, 2016, 2019), but in Ongwediva only two breeding pairs were recorded. They are, however, common outside urbanised habitats in the Cuvelai drainage system.

It appears, therefore, that within the Cuvelai drainage system, only a few bird species have adapted to urbanised habitats. For example, while the house sparrow and laughing dove are city exploiters, canaries, tits, and shrikes appear to avoid urban habitats, while finches, weavers, mousebirds and bulbuls seem to be attracted to such habitats in the Cuvelai drainage system.

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Annex 1. Diagram of the study area and its vegetation distribution.

Anexo 1. Esquema del àrea de estudio y su distribución de la vegetación.



Annex 2. Distribution of occupied territories/ breeding pairs of particular bird species in Ongwediva in 2018.

Anexo 2. Distribución de territorios ocupados/ parejas reproductoras de determinadas especies de aves en Ongwediva en 2018.



