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Provisional atlas of breeding birds of Walvis Bay in the coastal Namib Desert

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In austral summer 2016/17, a provisional bird atlas project was conducted in the town of Walvis Bay (~260 ha), Namibia. In total, 18 breeding bird species were recorded. Four eudominant species (Cape Sparrow, Rock Dove, Laughing Dove, and Common Waxbill) comprised together 65.2% of all breeding birds. Three dominant species – House Sparrow, Southern Masked Weaver, and Speckled Pigeon – comprised additional 23.0%. The community dominance index (DI) was = 0.40, Shannon's Diversity Index H' = 2.21, Simpson's Diversity Index D = 0.87, and Pielou's Evenness Index J' = 0.76. By far the most numerous feeding guild were granivores (88.0% of all birds recorded) followed by insectivores (6.0%) and frugivores (5.3%). Tree and/or shrub nesting birds comprised 59.5%, while birds nesting in/on buildings the remaining 40.5%. There were neither ground-nesting nor hole-nesting birds. Structure-wise, the avian community in the town resembles avian communities in other parts of the world (strong dominance of granivores, such as sparrows and doves). In austral summer 2018/19, a total of 25 marine species were recorded in the lagoon, of which nine (36%) were Palearctic migrant and 16 (64%) African residents. In terms of the number of individuals, Palearctic migrants constituted 17% and African residents 83%. More than half of all marine birds were Greater Flamingos, while the most numerous Palearctic species was the Curlew Sandpiper.

Keywords: bird, breeding, community ecology, population density, urban ornithology

INTRODUCTION

In recent decades, the so-called urban bird atlas has become a popular way of presenting biodiversity in urbanised environment in cities and towns all over the world (Dunn, Weston, 2008; Magle et al., 2012; Luniak, 2013, 2017; Kopij, 2001, 2015). Such atlases aim to generate detailed maps of bird species distribution and their abundance across the whole city/town (usually within its administrative boundaries) or in a part of it (usually the centre). Urban bird atlas projects therefore play a vital role in engaging wide range of citizens in science, education, and nature conservation. They may also

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be a useful tool for urban planners, ecologists, tourists, and policy-makers.

The first urban bird atlas project was completed for Africa in 1997 for the city of Bloemfontein in South Africa (Kopij, 2001; Luniak, 2013, 2017). The urban atlas of birds is regarded as complete if it is based on at least four surveys of the entire study area (e.g., Bloemfontein in Kopij 2011, 2014). It is regarded as provisional if it based on 1–2 such surveys (e.g., Maseru, Lesotho in Kopij, 1999; Swakopmund, Namibia in Kopij, 2018a; Kasane, Botswana in Kopij, 2018b; Henties Bay, Namibia in Kopij, 2022). An urban bird atlas may include all breeding species (e.g., Swakopmund in Kopij, 2018a) or only selected ones (e.g., Ladybrand, South Africa in Kopij, 2009; Maseru, Lesotho in Kopij, 2000; Katima Mulilo, Namibia in Kopij, 2016). To date, three urban bird atlases have been produced in Namibia. The first one, for Katima Mulilo (Kopij, 2016), includes only less common species but is based on four surveys; the second one, for Swakopmund, includes all breeding species but was based on a single survey only (Kopij, 2018a); and the third one for Henties Bay, is based on two surveys (Kopij, 2022).

The atlas presented in the article deals with birds of yet another Namibian town. It includes all breeding species, but like the Swakopmund atlas, it is also based on a single survey. It is, therefore, the third urban bird atlas in Namibia and the second for the coastal Namib Desert. In addition to atlas study, non-breeding breeding species (Kelp Gull and Flamingos) were also counted in the lagoon, but their distribution was not mapped.

MATERIALS AND METHODS

Study area. Walvis Bay is a coastal town on the Atlantic Ocean in Namibia, in the hyperarid Namib Desert. It is situated at 22°57'S and 14°30'E, almost on the Tropic of Capricorn, beside the Kuiseb River delta (Fig. 1). The town was founded in 1840 as a British port. For a long time, the town and its surroundings were a part of South Africa, but in 1993, the whole Walvis Bay enclave was finally incorporated into

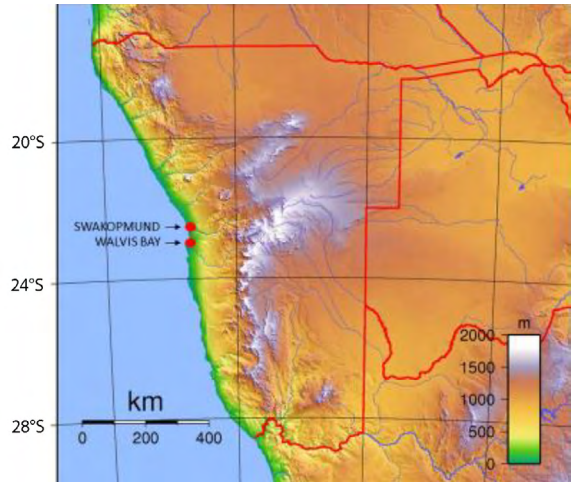


Fig. 1. Location of the study area

the Republic of Namibia. Today it is the largest port in the country. In 2016, it had 100,000 inhabitants and a total surface area of 29 km^2.

Walvis Bay is well-endowed with *Phoenix* and *Washingtonia* palms, *Araucaria* and *Casuarina* trees, and numerous exotic shrubs, such as tamarisk *Tamarix usneoides*, bottle-brush *Calistemon rigidus* and others (Figs 2 and 3). Sport fields are covered with mowed grass, while clumps of herbaceous and succulent plants (including *Aloe* spp.) are also cultivated in residential areas.

The study was limited to the oldest part of the town:

1. Walvis Bay Central, bordering on the port to the west, D1986 to the east, G. R. K. Hikkilwa to the north, and Nangolo Mbumba Drive

Fig. 2. Walvis Bay abounds in gardens with luxuriant vegetation

Fig. 3. Streets in Walvis Bay are often in the form of avenues with tall palm trees

to the east; this part developed between 1880 and 1950.

2. Walvis Bay East, between G. R. K. Hikkilwa Street and 9th Road, and between Nangolo Mbumba Drive and D1986; this part developed between 1950 and 1970.

3. Walvis Bay South, between 9th Road and The Esplanade; it developed between 1970 and 2000 (Billawer, Ekobo 2002).

4. Lagoon in the south-western part of the town.

The study area also includes Meersig, the most recent developed part (after 2000). It is an exclusive residential area. However, the proper port, Kuisebmond and Narraville settlements, were excluded from the study area. The total surface of such delimited study area was ~260 ha.

There are large open spaces in the study area, such as Town Hall and Museum, Municipal Indoor Centre, Carlo's Shuttle and Tours, State Hospital, Flamingo Primary School, Walvis Bay Private High School, J. C. Harries Park, Pelican Bay, Langholm, Lagoon Park, and Flamingo Cottage. Those areas are usually covered with mowed grass, with numerous shrubs and trees on the peripheries. Most (~60%) of the study area comprises, however, residential areas, ~15% are industrial, government or municipal areas, ~15% open green spaces, and ~10% business areas (shops, services; based on Billawer, Ekobo 2002).

Walvis Bay is located around a lagoon (Fig. 4), which constitutes one of the most important foraging areas for flamingos and other water birds in southern Africa. The Walvis Bay lagoon and the adjacent marshlands in the south-western part of the town are extremely important foraging grounds for waders and other water birds (Underhill, Whitelaw, 1977).

The town represents a mild variation of the desert climate. Annual precipitation is only 13.2 mm, but the average humidity is 80%, mainly due to frequent fogs which occur along the whole Namibian coast. The average temperature of the warmest month (February) is 17.9°C, and the coldest (August) 13.2°C (Billawer, Ekobo 2002).

The territory mapping method was employed (Bibby et al., 2012; Sutherland, 1996), with only one survey conducted. Counts were carried out in austral summer 2016/2017. To cover the whole study area (~260 ha), five counts were conducted in the mornings on the following days: 19 and 21 December 2016 and 2, 10 and 14 January 2017.

Birds occurring in Walvis Bay were divided into two groups: the breeding residents and non-breeding visitors (mostly marine species). Breeding birds came from a community the structure of which (population density, dominance) was the subject of this study. Non-breeding birds were also counted, but no attempt was undertaken to estimate their population densities and dominance as they did not form a definite community.

Fig. 4. The Walvis Bay lagoon

Birds were counted while walking slowly along streets. The routs were designed in such a way as to cover the whole study area. Each morning, different parts of the study area were surveyed. All birds showing breeding (e.g., transporting nesting material, constructing nests, feeding chicks, etc.) or territorial behaviour (e.g., singing males) were plotted on a map. Special attention was paid to simultaneously singing males as they were important in determining the number of occupied territories. Special attention was also paid to not count the same birds twice, as this may overestimate the number of territories. Each occupied territory was treated as one breeding pair. Such a simplistic approach could underestimate the number of breeding females of some polygamous species, specifically the Southern Masked Weaver *Ploceus velatus* and Common Waxbill *Estrilda astrild* and the co-operatively breeding Red-faced Mousebirds *Urocolius indicus*. In the case of pigeons, the number of breeding pairs could be estimated by dividing the total number of recorded individuals by two. However, the total number of individuals recorded is shown on maps as in summer these were probably mainly adult birds.

The study on marine birds was conducted in 2018/19 austral summer in the lagoon within Walvis Bay town. Counts were conducted on six days: 15 December 2018; 4 January 2019; 21 January 2019; 5 February 2019; 24 February 2019; 1 March 2019. Birds were counted from the shore up to about 500 m deep into wetlands, all the way of the Lagoon Promenade Rd (transect ~3.5 km long). Counting was conducted early in the morning, from 6:30 am to 10:00 am.

The following indices were used to characterise the diversity and evenness of the breeding bird communities (i.e., excluding the non-breeding marine birds):

• Shannon's diversity index:

$$H' = -\Sigma\, p_i \ln p_i$$

where p_i is the proportion of breeding pairs belonging to the *i*th species

• Simpson's diversity index:

$$D = ((\Sigma n(n\text{-}1))/N(N\text{-}1)$$

where n is the total number of breeding pairs belonging to a given species, N – the total number of breeding pairs of all species

• Pielou's evenness index:

$$J' = (-\Sigma\, p_i \ln p_i)/\ln S$$

where p_i is the proportion of breeding pairs belonging to the *i*th species, 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 – number of pairs of two most abundant species, N – the total number of pairs of all species.

The dominance was calculated as the percentage of breeding pairs of a given species in relation to all breeding pairs of all species. The eudominant species comprised at least 10% of all breeding pairs recorded, dominant species 5–9.99%, while subdominant 2–4.99%.

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

RESULTS

In total, 17 species were recorded as breeding in Walvis Bay, within boundaries as delimitated in Figures 8–27, in austral summer 2016/2017. Four eudominant species (Cape Sparrow *Passer melanurus*, Rock Dove *Columba livia* forma *domestica*, Laughing Dove *Streptopelia senegalensis* (Fig. 5), and Common Waxbill comprised together 65.2% of all breeding birds. Three dominant species, House Sparrow *Passer domesticus*, Southern Masked Weaver, and Speckled Pigeon *Columba guinea* (Fig. 6) comprised additional 23.0%. The remaining ten species comprised only 1.8%. The community dominance index was DI = 0.40. Non-breeding breeding species,

Fig. 5. Laughing Doves occur commonly all over the town

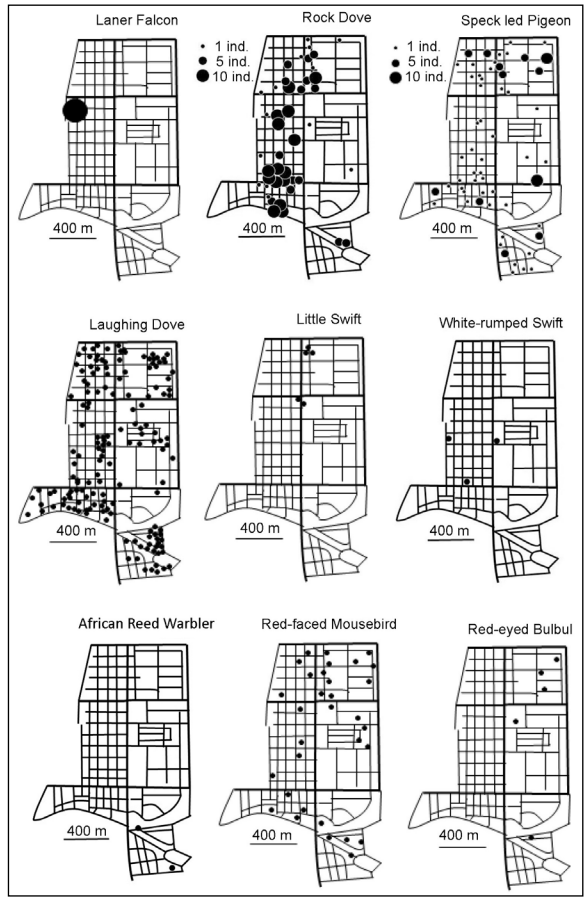
Fig. 6. The Speckled Pigeon is a dominant breeding species in Walvis Bay

Kelp Gulls *Larus dominicanus* and Flamingos *Phoenicopterus* spp., were also counted in the lagoon (Figs 7 and 4). The Kelp Gull is one of the most numerous birds on the Namibian coastline, including Walvis Bay, but, like many other marine birds, it does not nest in the town.

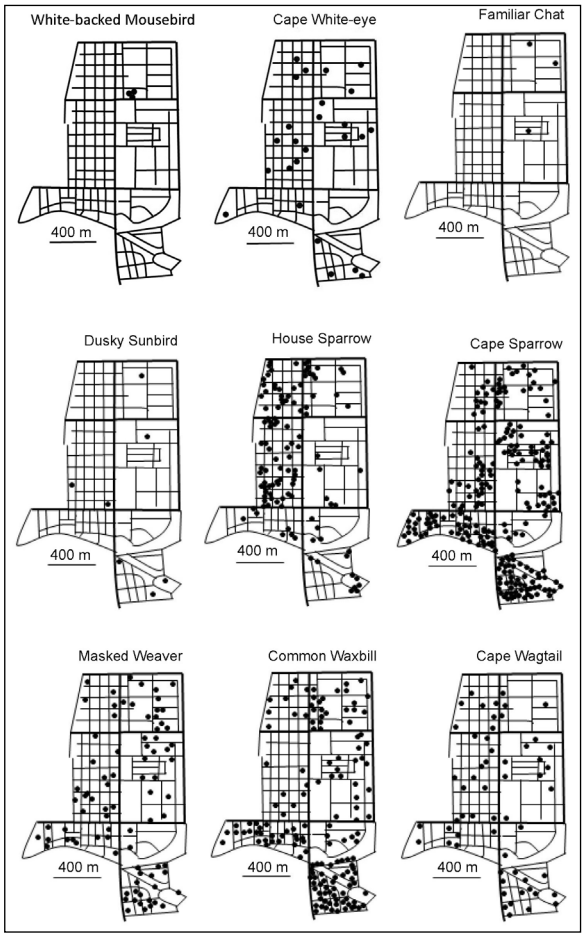
The House Sparrow was more numerous in the oldest part of the city centre, while the Southern Masked Weaver in the new expensive residential area. While the Rock Dove was the most numerous in the older part of the town centre, the Speckled Pigeon was found to be more equally distributed over the whole study area. The Common Waxbill and Cape Sparrow prefer the residential area over the town centre. Other species did not show a clear preference for any

Fig. 7. The Kelp Gull

parts of the town (Figs 8–19). Shannon's diversity index was H' = 2.17, Simson's diversity index D = 0.87, and Pielou's evenness index J' = 0.78.



Figs 8–17. Distribution of breeding pairs of particular bird species in Walvis Bay in austral summer 2016/2017. Numbers of individuals are given for the Rock Dove and the Speckled Pigeon



Figs 18–27. Distribution of breeding pairs of particular bird species in Walvis Bay in austral summer 2016/2017

Only two Palearctic migrants were recorded in the town (excluding waders on the beach): the Willow Warbler *Phylloscopus trochilus* (one record only) and the Barn Swallow *Hirundo rustica* (fairly common).

By far the most numerous feeding guild were granivores (88.0% of all birds recorded) followed by insectivores (6.0%) and frugivores (5.3%) (Table 1). Two remaining guilds, nectarivores and carnivores, comprised 0.6% and 0.1%, respectively. Tree and/or shrub nesting birds comprised 59.5%, while birds nesting in/on buildings made up the remaining 40.5%. There were neither ground-nesting nor hole-nesting birds.

The proportion between the number of breeding pairs of the Cape Sparrow and the House Sparrow was 0.69 : 0.31 (n = 370); that between the Rock Dove and the Speckled Pigeon 0.74 : 0. 26 (n = 304), and Red-faced Mousebird to the White-backed Mousebird *Colius colius* 0.97 : 0.03 (n = 34). The Laughing Dove was the only *Streptopelia*-dove recorded in the study area.

A total of 25 non-breeding water bird species were recorded in the lagoon, of which nine (36%) were Palaearctic migrant and 16 (64%) African residents. In terms of the number of individuals, Palearctic migrants constituted 17% and African residents 83%. More than half of all

Table 1. **Breeding bird community in Walvis Bay in austral summer 2016/2017 (~260 ha). Feeding guilds: G – granivorous, I – insectivorous, F – frugivorous, N – nectarivorous, C – carnivorous. Nesting guilds: T – trees and shrubs, B – on/in buildings**

Species	Feeding guild	Nesting guild	Pairs	Pairs/100 ha	Dominance
Cape Sparrow *Passer melanurus*	G	T	257	98.8	21.4
Rock Dove *Columba livia*	G	B	224	86.2	18.7
Laughing Dove *Streptopelia senegalensis*	G	T	155	59.6	12.9
Common Waxbill *Estrilda astrild*	G	T	146	56.2	12.2
House Sparrow *Passer domesticus*	G	B	113	43.5	9.4
Southern Masked Weaver *Ploceus velatus*	G	T	83	31.9	6.9
Speckled Pigeon *Columba guinea*	G	B	80	30.8	6.7
Cape Wagtail *Motacilla capensis*	I	B	58	22.3	4.8
Red-faced Mousebird *Urocolius indicus*	F	T	32	12.3	2.7
Cape White-eye *Zosterops pallidus*	F	T	25	9.6	2.1
Dusky Sunbird *Cinnyris fuscus*	N	T	7	2.7	0.6

Table 1. **(Continued)**

Species	Feeding guild	Nesting guild	Pairs	Pairs/100 ha	Dominance
Red-eyed Bulbul *Pycnonotus nigricans*	F	T	5	1.9	0.4
Little Swift *Apus affinis*	I	B	5	1.9	0.4
White-backed Mousebird *Colius colius*	F	T	4	1.6	0.4
Familiar Chat *Cercomela familiaris*	I	B	3	1.2	0.3
White-rumped Swift *Apus caffer*	I	B	3	1.2	0.3
African Reed Warbler *Acrocephalus baeticatus*	I	T	2	0.8	0.2
Lanner Falcon *Falco biarmicus*	C	B	1	0.4	0.1
Total			1203	462.7	100

water birds were Greater Flamingos *Pheonicopterus roseus*, while the most numerous Palearctic species was the Curlew Sandpiper *Calidris ferruginea* (Table 2).

Table 2. **Number of individuals of particular water bird species (non-breeding) foraging in the lagoon in the south-western part of the town in austral summer 2018/19. Palearctic migrants are indicated with an asterisk (*)**

Species	Dates						Total	
	15 Dec	04 Jan	21 Jan	05 Feb	24 Feb	01 Mar	N	%
Greater Flamingo *Phoenicopterus roseus*	110	500	1560	2030	110	500	4810	50.0
Hartlaub's Gull *Chroicocephalus hartlaubii*	255	228	153	98	51	110	895	9.3
Chestnut-banded Plover *Charadrius pallidus*			390	470			860	8.9
Lesser Flamingo *Phoenicoparrus minor*	340	350	15	70			775	8.1
Curlew Sandpiper *Calidris ferruginea**			480	155			635	6.6
Damara Tern *Sternula balaenarum*	315	13	29	12	106	25	500	5.2
Common Tern *Sterna hirundo**				93	29	265	387	4.0
Sanderling *Calidris alba**			312				312	3.2
Bar-tailed Godwit *Limosa lapponica**			74	62			136	1.4
Ruddy Turnstone *Arenaria interpres**		9	55	24			88	0.9
Grey Plover *Pluvialis squatarola**		7	19	35	2	6	69	0.7
Great White Pelican *Pelecanus onocrotalus*	6	30	2				38	0.4
Ringed Plover *Charadrius hiaticula**			11	9			20	0.2

Table 2. **(Continued)**

Species	Dates						Total	
	15 Dec	04 Jan	21 Jan	05 Feb	24 Feb	01 Mar	N	%
Cattle Egret *Bubulcus ibis*			1		9	8	18	0.2
Cape Cormorant *Phalacrocorax capensis*	13				1		14	0.15
Cape Wagtail *Motacilla capensis*	3		1	2	6	2	14	0.15
White-fronted Plover *Charadrius marginatus*			10				10	0.10
Swift Tern *Sterna bergii*	5						5	0.05
Common Greenshank *Tringa nebularia**			5				5	0.05
Grey Heron *Ardea cinerea*			3	1			4	0.04
Caspian Tern *Hydroprogne caspia*					2	2	4	0.04
Common Sandpiper *Actitis hypoleucos**		1		2			3	0.03
Pied Avocet *Recurvirostra avosetta*				2			2	0.02
Little Egret *Egretta garzetta*			1				1	0.01
Total number of individuals	110	500	1560	2030	110	500	9624	100.0

DISCUSSION

Walvis Bay, as one of the oldest towns in Namibia, has avian community structurally resembling avian communities in other parts of the world, i.e., it has a strong dominance of granivores and birds nesting in/on buildings, such as sparrows and doves (Dunn, Weston, 2008). However, the guild of aerial feeding insectivores (e.g., mostly swifts), usually well represented in cities all over the world, is poorly represented in Walvis Bay, probably because flying insects are uncommon in this desert environment. Suitable nesting sites for swifts are, however, abundant in this town.

In comparison with Swakopmund, the neighbouring town in the coastal Namib Desert (Kopij, 2018), the following species were recorded in Walvis Bay but not in Swakopmund: the Little Swift *Apus affinis*, the White-rumped Swift *Apus caffer*, and the African Reed Warbler *Acrocephalus baeticatus*. There was also one breeding pair of the Rock Kestrel *Falco rupicolus* in the port, outside the study area, and probably one breeding pair of the Lanner Falcon *Falco biarmicus*. The group of eudominants was composed of the same species in both towns compared. In addition to the Southern Masked Weaver and House Sparrow, the group of the dominant species comprised the Speckled Pigeon.

However, population densities of most species were higher in Walvis Bay than in Swakopmund. The overall density of all breeding birds in Walvis Bay almost doubled that in Swakopmund (Table 3). However, Shannon's diversity index was only slightly higher in Walvis Bay (2.17) than in Swakopmund (1.93). Also, Pielou's evenness index was similar in both towns (0.71 in Swakopmund and 0.78 in Walvis Bay). In Outapi town in northern Namibia, the number of breeding species almost doubled those in Walvis Bay and Swakopmund, but unexpectedly, Shannon's diversity index (2.13) was strikingly similar, at 0.63, Pielou's evenness index was even lower there (Kopij, 2019a). The Outapi town is situated in a transformed *Acacia* savannah with a large contributions of baobabs *Adansonia digitata*. Similarly, in Onguadiva in northern Namibia (Kopij, 2021).

Table 3. **Comparison of population densities (pairs/100 ha) and dominance of breeding bird species in Swakopmund (Kopij, 2018) and Walvis Bay (this study) during the same austral summer 2016/2017**

Species	Swakopmund		Walvis Bay	
	P./100 ha	Dom.%	P./100 ha	Dom.%
Cape Sparrow *Passer melanurus*	64.8	27.7	98.6	21.4
Laughing Dove *Streptopelia senegalensis*	47.0	20.1	59.6	12.9
Rock Dove *Columba livia*	32.3	13.8	86.2	18.7
Common Waxbill *Estlida astrild*	23.9	10.2	56.2	12.4
Southern Masked Weaver *Ploceus velatus*	17.3	7.4	31.9	6.9
House Sparrow *Passer domesticus*	16.6	7.1	43.5	9.4
Cape Wagtail *Motacilla capensis*	10.6	4.5	22.3	4.8
Red-faced Mousebird *Urocolius indicus*	1.4	0.6	22.3	4.8
Cape White-eye *Zosterops pallidus*	3.6	1.5	12.3	2.7
Dusky Sunbird *Cinnyris fuscus*	3.1	1.3	9.6	2.1
Red-eyed Bulbul *Pycnonotus nigricans*	2.2	0.9	2.7	0.6
Little Swift *Apus affinis*	0.0	0.0	1.9	0.4
White-backed Mousebird *Colius colius*	0.5	0.2	1.9	0.4
Familiar Chat *Cercomela familiaris*	0.2	0.1	1.6	0.4
African Reed Warbler *Acroceph. baeticatus*	0.0	0.0	1.2	0.3
White-rumped Swift *Apus caffer*	0.0	0.0	1.2	0.3
Lanner Falcon *Falco biarmicus*	0.0	0.0	0.8	0.2
Grey Go-away-bird *Corithaixoides concolor*	0.5	0.2	0.0	0.0
Southern Fiscal *Lanius collaris*	0.2	0.1	0.0	0.0
Peregrine Falcon *Falco peregrinus*	0.2	0.0	0.0	0.0
Total	234.2	100.0	462.7	100.0
Number of all pairs recorded	972		1203	

Even in the town of Katima Mulilo (Zambezi Region, Namibia), located in a transformed Kalahari Woodland, Pielou's evenness index was slightly lower than in Walvis Bay (0.78), although the number of breeding bird species (51) and Shannon's diversity index (2.76) were much higher (Kopij, 2019b).

A much higher proportion of granivores than insectivores recorded in Walvis Bay indicates that insects are relatively rare in this desert town. Since most hole-nesting birds are insectivores, there is also a lack of birds belonging to this nesting guild in the town. However, the low proportion of omnivores (e.g., crows) and carnivores (e.g., kestrels and falcons) was somewhat unexpected as the food resources and nesting sites are abundant for these birds in the town.

Species such as the Tractrac Chat *Cercomela tractrac*, the Red-capped Lark *Calandrella cinerea*, the Black-chested Prinia *Prinia flavicans*, the Fan-tailed Cisticola *Cisticola juncidis*, and the Cape Starling *Lamprotonis nitens* were recorded in close proximity to the study area. In some years, single pairs of those species may therefore breed in the town, but probably due to a scarcity of suitable nesting sites, they are unable to develop stable populations.

The lagoon within the town is only a small part of the greater Walvis Bay lagoon extending up to 20 km further south of the town; it is dominated by the Greater Flamingo. However,

more than 20 other water bird species were recorded there. It is an important stop-over and wintering place for a dozen or so of the Palearctic migrants.

It is important to point out that single counts usually underestimate the numbers of species (Bibby et al., 2012; Sutherland, 1996), especially those which are elusive, rare, or silent (e.g., the White-backed Mousebird, the Familiar Chat *Cercomela familiaris*, the Dusky Sunbird *Cinnyris fuscus*). The recorded numbers of these species should be treated as representing minimal values. On the other hand, some common species, such as the Cape Wagtail *Motacilla capensis*, the Common Waxbill, the Southern Masked Weaver, and the Laughing Dove, were very active during the counts and the estimated number of breeding pairs may well be close to the actual figures. More detailed studies by the standard territory mapping method (Bibby et al., 2012) may put more emphasis on the less common species. As a result, both dominance structure and population densities of these species may be higher than recorded in this study. Also, population densities of more common species may be higher than recorded in this study, but their dominance may remain similar. To evaluate the significance of the lagoon for foraging birds, more counts should be conducted throughout the year and over several years.

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PRELIMINARUS PAUKŠČIŲ, PERINČIŲ WALVIS BAY MIESTO PAKRANTĖSE (NAMIBIJA), ATLASAS

Santrauka

2016–2017 m. vasarą buvo atliktas preliminarus paukščių atlaso projektas Walvis Bay mieste (apie 260 ha) Namibijoje. Iš viso užregistruota 18 perinčių paukščių rūšių. Keturios rūšys (*Passer melanurus*, *Columba livia* forma *domestica*, *Streptopelia senegalensis*, *Estrilda astrild*) sudarė 65,2% visų perinčių paukščių. Trys dominuojančios rūšys – *Passer domesticus*, *Ploceus velatus* ir *Columba guinea* – sudarė 23,0 %. Bendruomenės dominavimo indeksas buvo DI = 0,40, Šenono įvairovės indeksas H' = 2,21, Simpsono įvairovės indeksas D = 0,87, o Pielou tolygumo indeksas J' = 0,76. Daugiausia užregistruota grūdaėdžių paukščių (88,0 % visų paukščių), toliau eina vabzdžiaėdžiai (6,0 %) ir vaisiaėdžiai (5,3 %). Medžiuose ir (ar) krūmuose lizdus sukančių paukščių nustatyta 59,5 %, pastatuose / ant jų – 40,5 %. Nenustatyta nei antžeminių, nei skylėse perinčių paukščių. Miesto paukščių bendruomenė savo struktūra primena paukščių bendruomenes kitose pasaulio vietose (dominuoja grūdaėdžiai, tokie kaip žvirbliai ir balandžiai). 2018–2019 m. vasarą įlankoje buvo užfiksuotos 25 jūrinės rūšys, iš kurių devynios (36 %) buvo palearkties migrantės ir 16 (64 %) iš Afrikos. Pagal individų skaičių, palearktiniai migrantai sudarė 17 %, o Afrikos paukščiai – 83 %. Daugiau nei pusė visų jūros paukščių buvo didieji flamingai (*Pheonicopterus roseus*); gausiausia palearktinė rūšis buvo lenktasnapis bėgikas (*Calidris ferruginea*).

Raktažodžiai: paukštis, veisimasis, bendruomenės ekologija, populiacijos tankis, miesto ornitologija