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DISTRIBUTION AND POPULATION DENSITIES OF DIURNAL RAPTORS AND OWLS IN AN URBANIZED RIPARIAN FOREST, ZAMBEZI REGION, NE NAMIBIA

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Abstract. A territory mapping method has been employed in 2015 to assess the population density of all diurnal raptors and owls in a riparian forest on Zambezi River near Katima Mulilo, NE Namibia. The forest was c. 280 ha in surface area. The following densities (pairs/10 km^2) were recorded: *Haliaeetus vocifer* – 7.1, *Polyboroides typus*, *Milvus aegyptiacus*, and *Accipiter tachiro* – each species with 3.6; *Circaetus cinerascens*, *Kaupifalco monogrammicus* each species with 1.8; *Tyto alba* – 14.3, *Strix woodfordii* – 10.7, and *Glaucidium perlatum* – 3.6. In general, the raptor population density in southern Africa is much higher in woodlands and savanna than in grasslands.
Key words: Accipitiformes, Strigiformes, census, habitat, population ecology.

Распространение и плотность гнездования дневных хищников и сов в одном из прибрежных лесов на р. Замбези в Северо-Восточной Намибии. - Г. Копий. - Беркут. 27 (2). 2018. - Исследования проводились в 2015 г. в лесу возле г. Катима-Мулило. Площадь его около 280 га. Плотность населения изучалась путем картирования. Получены следующие данные (пар/10 км^2): *Haliaeetus vocifer* – 7,1, *Polyboroides typus*, *Milvus aegyptiacus* и *Accipiter tachiro* – по 3,6; *Circaetus cinerascens* и *Kaupifalco monogrammicus* – по 1,8; *Tyto alba* – 14,3, *Strix woodfordii* – 10,7, *Glaucidium perlatum* – 3,6. Плотность гнездования хищников на юге Африки намного выше в лесной местности и саванне, чем на лугах и пастбищах.
Ключевые слова: Accipitiformes, Strigiformes, учет, биотоп, популяционная экология.

Introduction

As top predators, raptors are good indicators of environmental quality (Petty, 1998; Kopij, 2018a). The group is well-represented in southern African region, with 72 diurnal raptor species and 12 owl species (Hockey et al., 2005). Some of these species may reach relatively high population densities in some localities, e.g. Black-shouldered Kite (*Elanus caeruleus*) in the central Free State (Kopij, in prep.), Jackal Buzzard (*Buteo rufofuscus*) in Maloloti/Drakensberg (Allan et al., 1996), or Yellow-billed Kite (*Milvus aegyptiacus*) in northern Namibia (G. Kopij, unpubl.), but most others are uncommon (Brown et al., 1982; Steyn, 1982).

In southern Africa, population densities of raptors were estimated so far only in some vegetation types, e.g. in Afromountain grasslands (Tarbotton et al., 1993; Allan et al., 1996), Highveld grassland (e.g. Kopij 2001a, 2001b), Mopane savanna (Kopij, 2018c) and in Kalahari woodlands (Kopij, 2017). There is still lack of such data from most remaining habitats. For example their densities were never estimated in riparian forests, which are regarded as rich in terms of bird diversity, and biodiversity at large (Smith, 1996; Seymour, Simmons, 2008; Kopij, Paxton, 2018). This paper aims to estimate population densities of raptors associated with riparian forest located in a central part of southern Africa on the largest river of this subcontinent.

Study area

The study area was located in the Zambezi Valley near Katima Mulilo in the Zambezi Region, NE Namibia. The study area comprised a forest stretching between the river and the international road from Zambia through Katima Mulilo to Botswana, laying on the left bank between the Wenela Bridge and the Zambezi River lodge. It is 7 km long and 300–700 m wide (on average c. 400 m). The approximate surface area of the studied territory is therefore c. 280 ha.

The natural vegetation is classified as Riparian Zambezi Forest (Mendelsohn et al., 2009). It is composed of large trees such as African Teak (*Pterocarpus angolensis*), Albizias (*Albizia* spp.), Apple Leaves (*Lonchocarpus nelsii*), Baobab (*Adansonia digitata*), Burkea (*Burkea africana*), Combretum (*Combretum* spp.), Camel-thorn (*Acacia erioloba*), Corkwoods (*Commiphora* spp.), False Mopane (*Guibourtia coleospermum*), Jackal Berry (*Diospyros mespiliformis*), Knob-thorn (*Accacia nigrescens*), Makalani Palm (*Hyphaene petersiana*), Manketti (*Schinziophyton rautanenii*), Marula (*Sclerocarya birrea*), Mopane (*Colophospermum mopane*), Pod Mahogany (*Afzelia quanzensis*), Silver Cluster-leaf (*Terminalia sericea*), Sausage Tree (*Kigelia africana*), Sycomore Fig (*Ficus sycomorus*), White Bauhinia (*Bauhinia petersiana*), Zambezi Teak (*Baikiaea plurijuga*).

The forest is interlaced with pans covered with grass and sedges flooded almost on yearly basis. About ¼ of the land is converted into arable grounds and built-up areas, but large trees usually remain even in these converted areas.

The annual temperature for Katima Mulilo is 21˚C. Average maximum temperature during the hottest month (September) is 35˚C; the average minimum temperature during the coldest month (July) is 3˚C. In the most humid month (February) the humidity is 80–90%, and only 10–20% in the least humid month (September). The average annual rainfall is c. 700 mm, the highest in Namibia. Median annual rainfall is 550–600 mm. Most of the rains fall between November and

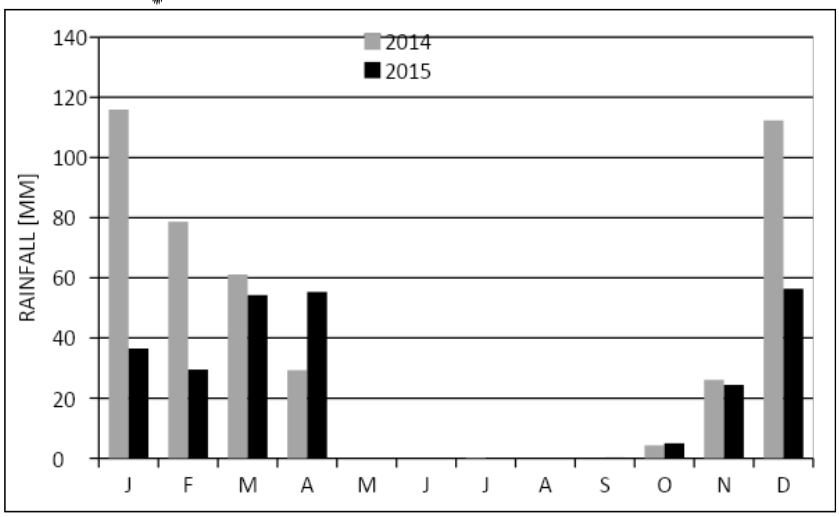

Fig. 1. Monthly rainfall in Katima Mulilo in 2014 and 2015.
Рис. 1. Количество осадков по месяцам в г. Катима-Мулило в 2014 и 2015 гг.

March. The mean monthly rainfall for the years 2015–2016 is shown in Fig. 1.

Methods

A territory mapping method (Sutherland, 1996; Bibby et al., 2002) has been employed to assess the population densities of all raptor species. The study area was divided into six sections. Birds were counted in each section in one morning. So, six mornings were devoted to cover the whole study area. Such complete coverage was achieved four times in 2015, one complete survey was achieved in each of the following months of 2015: August, September, October and November. During each count all raptors seen or heard were plotted on the map 1: 500. Special attention was paid to birds showing territorial behavior or breeding display. A bird or a pair of the same species recorded at the same site at least in two out of the four months was interpreted as occupied territory (following Bibby et al., 2002).

Results and discussion

In 2015, a total of six diurnal raptor and three owl species were recorded as breeding resident in the study area (Fig. 2–4). Two occupied territories of the African Fish Eagle (*Haliaeetus vocifer*) were identified. Other diurnal raptor, i.e. Gymnogyne (*Polyboroides typus*), Yellow-billed Kite (*Milvus aegyptiacus*) and African Goshawk (*Accipieter tachiro*), each established only one territory (i.e. 3.6 pairs/10 km^2). The Western Banded Snake Eagle (*Circaetus cinerascens*) and Lizard Buzzard (*Kaupifaco monogrammicus*) had only part of their territories within the study area (i.e. 1.8 pairs/10 km^2) (Table 1).

Among owls the most common was the Barn Owl (*Tyto alba*) nesting in a density of 14.3 pairs/10 km^2. Unexpectedly the Wood Owl (*Strix woodfordii*) was also relatively numerous, nesting in a density of 10.7 pairs/10 km^2. One occupied territory of the Pearl-spotted Owlet (*Glaucidium perlatum*) was also recorded.

The overall population density of all owls was 28.6 pairs/10 km^2. The difference with diurnal raptors (21.4 pairs/10 km^2) was, however, not statistically significant. The overall population density of all raptors (both diurnal and nocturnal) was 50.1 pairs/10 km^2.

The African Fish Eagle pairs had established territories along the river, one close to the bridge and the other about 2–3 km downstream (Fig. 3). The Yellow-billed Kite nest was located on a Jackalberry on the border of built-up area and riparian forest (Fig. 2). The Western Banded Snake Eagle occupied the riparian forest only, while the Gymnogyne territory covered both riparian forest, built up areas and arable ground (Fig. 2). The Lizard Buzzard territory included the riparian forest with grassy pans and a rural area (Fig. 3).

The Barn Owl was found either close to human settlements or arable grounds, but one pair was nested in the depth of riparian forest. The Wood Owl territories were established in riparian forest in a close proximity to built-up areas. The Pearl-spotted Owlet territory was established partly in the riparian, and partly in the Mopane forest (Fig. 4).

Unexpectedly, the Scops Owl (*Otus senegalensis*) and White-faced Owl (*Ptilopsus leucotis*) were not recorded in the study area. Few pairs of the Scops Owl were breeding in the neighbouring town of Katima Mulilo (own observ.), and the White-faced Owl had a territory c. 200 m away from the study area. The Pel's Fishing Owl (*Bubo peli*) was recorded few years ago in a riparian forest on the opposite (left) bank of the Zambezi River. The Barred Owl (*Glaucidium capense*) was recorded as breeding in the study area (in the vicinity of the fish farm) few years ago. In

Table 1

Population densities of raptors species in a Zambezi forest
Плотность популяций хищников в лесу на р. Замбези

Species	Number of pairs	Density (pairs/10 km^2)	Dominance (%)
Diurnal raptors			
Haliaeetus vocifer	2	7.1	14.3
Polyboroides typus	1	3.6	7.1
Milvus aegyptiacus	1	3.6	7.1
Accipieter tachiro	1	3.6	7.1
Circaetus cinerascens	0.5	1.8	3.6
Kaupifaco monogrammicus	0.5	1.8	3.6
Owls			
Tyto alba	4	14.3	28.6
Strix woodfordii	3	10.7	21.4
Glaucidium perlatum	1	3.6	7.1
Total	**15**	**53.6**	**100**

2015 its occurrence was, however, not confirmed.

The population density of raptors in the Zambezi riparian forest appears to be fairly high (Table 2). It is probably because human activities brought in to the natural riparian forest some new microhabitats suitable as hunting areas for some of the raptors. The Barn Owl may greatly benefit from the open spaces created by clearing forest for arable grounds, where rodents, its main prey, are common and easily available. Few other raptor species appear to benefit from the human-made ecotone zone (riparian forest/ built-up areas). On the other hand, some species (e.g. Shikra (*Accipiter badius*), Barred Owl, Spotted Eagle Owl (*Bubo africanus*)) could have withdraw from the area as a result of increasing human activities and habitat transformation.

Since the study area is located in a close proximity to the town of Katima Mulilo and the Wildlife Department of UNAM, it would be convenient to monitor the raptor community. Raptors are the apex consumers in ecosystems and can be therefore considered as good bioindicators of environmental quality. Some are sensitive to human activities and settlement encroachment and may decline or even totally withdraw from the area, but some other may benefit from it, adapt to the changes and, as result, they may even increase in numbers (cf. Petty, 1998; Kopij, 2018a).

While comparing across different habitats and geographical locations, the overall population densities of raptors should be taken into consideration rather than densities of particular species. But such studies on densities of all raptors in relatively large study area are limited in southern Africa, and in Africa at large. None has ever been conducted in riparian forests so far. In the neighbouring Baikiaea woodland, six diurnal raptor species nested in a density 75 pairs/ 10 km^2 (Table 2), while among the owls very high density of the African Scops Owl (*Otus senegalensis*) was recorded there (own observ.). However, in the

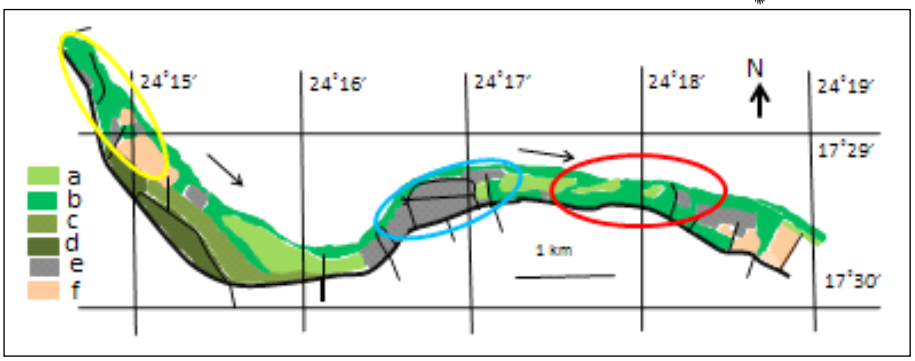

Fig. 2. Distribution of occupied territories of the Southern Banded Snake-Eagle (red circle), Gymnogene (yellow circle) and Yellow-billed Kite (blue circle) in Zambezi riparian forest.

Explanations (Fig. 2–4): a – grassland (flooded area), b – Zambezi riparian forest, c – *Colophospermum mopane* forest, d – Kalahari Woodland, e – built-up areas, f – arable grounds.

Рис. 2. Распространение занятых территорий *Circaetus cinerascens* (красный овал), *Polyboroides typus* (желтый овал) and *Milvus aegyptiacus* (голубой овал) в лесу на р. Замбези.

Условные обозначения (рис. 2–4): a – луга (затапливаемая территория), b – прибрежный лес на р. Замбези, c – лес из *Colophospermum mopane*, d – Калахарский лес, e – застройка, f – пашня.

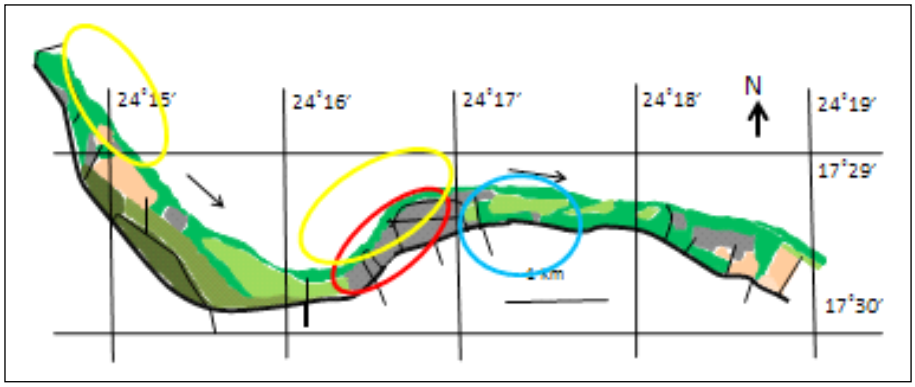

Fig. 3. Distribution of occupied territories of the Fish Eagle (yellow circles), African Goshawk (red circle) and Lizard Buzzard (blue circle) in Zambezi riparian forest.

Рис. 3. Распространение занятых территорий *Haliaeetus vocifer* (желтые овалы), *Accipieter tachiro* (красный овал) and *Kaupifaco monogrammicus* (голубой овал) в лесу на р. Замбези.

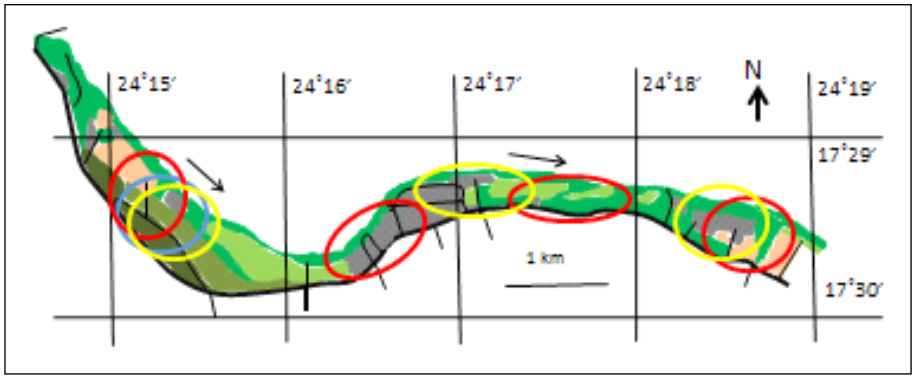

Fig. 4. Distribution of occupied territories of the Barn Owl (red circles), Wood Owl (yellow circles) and Pearle-spotted Owl (blue circle) in Zambezi riparian forest.

Рис. 4. Распространение занятых территорий *Tyto alba* (красные овалы), *Strix woodfordii* (желтые овалы) and *Glaucidium perlatum* (голубой овал) в лесу на р. Замбези.

Table 2

Overall density of diurnal birds of prey in different habitats of southern Africa
Общая плотность населения дневных хищных птиц в различных местообитаниях Южной Африки

Habitat	Area size	Number of species	Pairs/10 km²	Source
Savanna/Woodland habitats				
Riparian Forest Zambezi Region, NE Namibia	4 km²	6	21.4	This study
Urbanized woodland Katima Mulilo, NE Namibia	10 km²	6	9	Kopij, 2016
Urbanized riparian and Kalahari Woodland, Kasane, N Botswana	1.6 km²	4	31	Kopij, 2018a
Kalahari Woodland, Zambezi Region, NE Namibia	1.2 km²	6	75	Kopij, 2017
Mopane Savanna, Omusati Region, N Namibia	10 km²	6	12	Kopij, 2018b
Acacia Savanna Omusati Region, N Namibia	3 km²	6	33	Kopij, unpubl.
Grassland habitats				
Rural areas with farmlands Roma, Lesotho	70 km²	7	2	Kopij, 2001a
Mountain Grassland Mohale Dam catchment, Lesotho	1120 km²	4	0.6	Allan et al., 1996
Mountain Grassland Katse Dam catchment, Lesotho	1600 km²	5	0.4	Tarbotton et al., 1993
Cold Grassland E Free State, South Africa	1000 km²	10	0.6	Kopij, 1996
Dry Grassland SE Free State, South Africa	1000 km²	7	0.2	Kopij, 2001b

neighboring urbanized habitats of Katima Mulilo, six diurnal raptor species were recorded, which nested in a density of 9 pairs/10 km² (Table 2). It appears therefore that even in the same region, density of raptors may vary markedly depending on the vegetation type and its transformation by human activities. In general, the raptor population density in southern Africa is, however, much higher in woodlands and savannas than in grasslands (Table 2).

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