Seasonal changes in avian assemblages in Kaokoland (Mopane) Savanna in the Ogongo Game Reserve, north-central Namibia

Grzegorz Kopij[1]*
[1]Department of Wildlife Management, University of Namibia
Katima Mulilo Campus, Private Bag 1096, Wenela Rd., Katima Mulilo, Namibia

Received: 20th June, 2013. Accepted: 15th October, 2013.

Abstract

Studies were conducted at UNAM Game Reserve (c. 1000 ha) in the BIOTA Observatory 'Ogongo', which is located c. 50 km NW of Oshakati, north-central Namibia (17°70′S, 15°31′E). The natural vegetation of this area is the Koakoland (Mopane) Savanna. In 2011-2012, the line transect method has been employed to assess the species composition, dominance structure, and relative abundance of all bird species, and their seasonal changes in the late rainy season (March), middle of dry season (July), and beginning of rainy season (November). In total, 66 resident (46 in late rainy season, only 35 in the middle of dry season and 39 at the beginning of rainy season) and 19 non-resident species were recorded. Only two resident species have been classified as dominants in all three seasons: *Plocepasser mahali* and *Uraeginthus angolensis*; five species were dominants in two, and four species in one season. The avian assemblage undergoes significant seasonal changes, mostly related to the water regime in oshanas. Although the number and proportion of dominant species changed only slightly from season to season (6-7 species; 58.8-62.4% of contribution), highly significant seasonal differences in abundance were recorded for 18 resident species. Clear seasonal changes were also found in the proportions of main feeding guilds, i.e. granivores and insectivores. In comparison with other habitats in Namibia, Ogongo Game Reserve has a rich and diverse avifauna. For many bird species the reserve constitutes a safe breeding habitat, and a rich feeding area. It is fully justified to retain its status as nature sanctuary in Cuvelai Drainage ecosystem.

Keywords: community ecology, avian assemblages, natural areas, Ogongo Game Reserve, Namibia

ISTJN 2013; 2(1):44-58.

*Corresponding author - E-mail: gkopij@unam.na

1 Introduction

Although Namibia has a rich and diverse avifauna (Barnard 1998), very few quantitative data on resident bird communities are available to date for most of the 31 distinguished vegetation types. Quantitative data refer to ecological parameters, such as species diversity, dominance structure, frequency of occurrence, relative abundance and density (Bibby et al. 1992). These parameters are indispensible for ornithologists, ecologists, environmentalists, conservationists and wildlife managers. Furthermore, they may constitute a basis for monitoring population changes for species regarded as rare, endangered or so called bio-indicators (Sutherland 1996). Such monitoring program can be easily conducted in areas located in a close proximity to proper scientific institutions. The Ogongo area is an ideal site for such program. The Department of Integrated Environmental Science of the University of Namibia is established there, and there is a game reserve stocked with large mammals in a close vicinity to the campus.

For these reasons Ogongo area has been designed in the early 2000's as a final observatory of the BIOTA Transect and Biodiversity Observatories in Southern Africa. This transect starts in Cape Town runs through Oranjemund, Karios, Nabaos, Windhoek, Okahandja, Sonop and Mutompo, and ends in Ogongo (Jürgens et al. 2010; Schmiedel& Jürgens 2010; Hoffmann et al. 2010). In each of these observatories, both plant and animal diversities are subject of a monitoring program. For some of these observatories, qualitative data (simple lists of species) on avian diversity have been provided. However, in the BIOTA Observatory 'Ogongo' (S42), no studies on birds have been projected (Jürgens et al. 2010; Schmiedel & Jürgens 2010; Hoffmann et al. 2010).

The aim of this study was to fulfill this gap by investigating species diversity and seasonal changes in avian assemblages in the natural vegetation in this important monitoring observatory.

2 Materials and Methods

2.1 Study Area

The study was conducted in UNAM Ogongo Game Reserve (Fig. 1). It is situated in the BIOTA Observatory 'Ogongo' within the Cuvelai Drainage System, c. 50 km NW of Oshakati, Outapi district, Omusati region, North-Central Namibia (17°70′S, 15°31′E). It is an extensive sandy plain, c. 1100 m a.s.l., partly flooded almost on annual basis (usually December-June). It is located in a prime summer rainfall zone, with mean annual precipitation of 400-500 mm (Mendesohn et al. 2000). A total of 411 vascular plant species, 3 vegetation classes, 7 associations and 7 sub-associations were described there (Kangombe 2007).

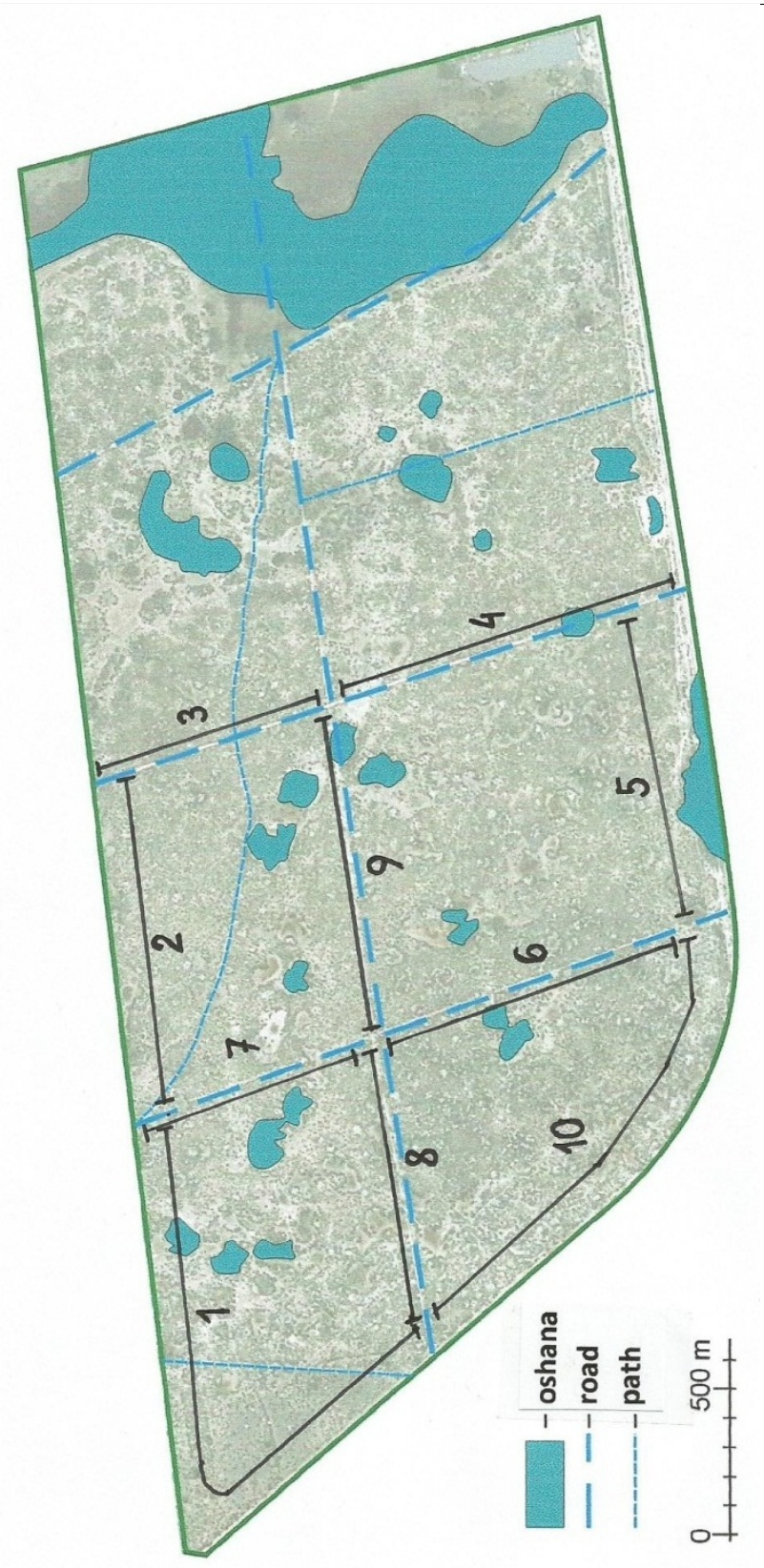

Figure 1: Map of Ogongo Game Reserve showing distribution of transects (1-10).

The UNAM Ogongo Game Reserve has been established in 1997. Its surface area is c. 1000 ha. The vegetation comprises mainly the Mopane Savanna *Colophospermum-Acacia nilotica*. Tree species diversity is relatively low (Shannon Diversity Index = 1.15) because of a strong domination of the Mopane *Colophospermum mopane* (69.8%) and *Acacia nilotica* (14.8%). Other common tree species include *Combretum collinum* (8.2%), *Terminalia sericea* (2.1%), *Comiphora africana* (1.8%), *Acacia siberiana* (1.5%) and *Acacia flecki* (0.6%). The stand density was estimated at c. 50 trees per ha. Most trees in the reserve are small, with a mean diameter 14.8 cm and mean height 7 m. Most trees (60%) are less than 10 cm in diameter (Ndeinoma, 2009). The most common grass species for grazing are *Schmidtia kalahariensis*, *Cynodon dactylon*, *Brachiria* spp., *Digitaria* spp., *Anthephora* spp., *Eragrostis* spp., *Enneapogon* spp. and *Panicum* spp (Fig. 2). The eastern part of the reserve comprises a large oshana mainly with *Eragrostis* grasses. It retains rain water for almost whole year (Ndeinoma, 2009).

Figure 2: Top left: Young stage of mopane savanna, which is predominant in the Ogongo Game Reserve; Top-right: A mixed flock of the Marabou Storks and Great Egrets; Bottom-left: A breeding colony of the Southern Masked Weaver; Bottom-right: Larger oshana surrounded by mature trees.

The carrying capacity of the Ogongo Game Reserve has been estimated at 33 LSU. In 2011 the approximate numbers of hoofed mammals were as follow: springbok *Antidorcas marsupialis* 350, gemsbok *Oryx gazella* 120, plain zebra *Equus quagga* 30, red hartebeest *Alcelaphus buselaphus* 35, and giraffe *Giraffa camelopardalis* 7. In addition there are 3-4 occupied territories of the aardvark *Orycteropus afer*, several scrub hares *Lepus saxatils*, yellow mongooses *Cynictis penicillata*, striped polecats *Ictonyx striatus*, black-backed jackals *Canis mesomelas* and yet unstudied number of small mammals (G. Kopij, own data).

2.2 Methods

Studies were carried out in late rainy season (dates of counts: 1, 2 March 2012) in the middle of dry season (19, 21, 23 July 2011) and at beginning of rainy season (1, 8 November 2011). The line transect method in American version (Bibby et al. 1992) has been employed to quantify avian assemblages (frequency of occurrence and relative abundance of each species). Ten transects were designed, each one was about 1 km long (Table 1; Fig. 1).

Table 1: Transects designed for counting resident bird species in the Ogongo Game Reserve.

Transect number	Co-ordinates for starting point		Co-ordinates for ending point	
1	S173953	E151789	S173906	E151835
2	S173906	E151835	S173896	E151898
3	S173896	E151898	S173935	E151914
4	S173935	E151914	S173996	E151931
5	S173996	E151931	S173998	E151868
6	S173998	E151868	S173943	E151849
7	S173943	E151849	S173906	E151835
8	S173953	E151789	S173943	E151849
9	S173943	E151849	S173935	E151914
10	S173953	E151789	S173998	E151868

Counts were conducted on each of the ten transect, once in each of the following months: March, July and November. Each transect was, therefore, covered three times in the whole study period. In a given day, birds were counted usually on 3-5 transects. Counts were conducted in the mornings by walking slowly from c. 7 a.m. till c. 11 a.m. and recording all seen and heard birds. For resident birds, a breeding pair was a census unit, while for non-resident species, the census unit was an individual.

Bird identification was based both on visual and auditory observations, and was aided by 10x50 binoculars. In the case of difficulties (poor light, weak features, aberrant plumage, etc.) identification was supported by field guide by Newman (1992) and Chinttenden (2007).

The following parameters were used to describe the avian assemblages: 1) species richness (number of species recorded); 2) $\%F$ frequency of occurrence of each species, defined as the

percentage of transects, where a given species was recorded to the total number ($N = 10$ transects) of transects surveyed; 3) $\%N$ dominance expressed as the proportion of resident pairs of a given species to the total number of all resident pairs of all species recorded, expressed as a percentage. Dominant species is defined here as comprising at least 5% of the total number of all resident pairs; while subdominant is that comprising 2-4.9% of that total.

Three indices were used to compare diversity of avian assemblages: Sorensen's Coefficient (I), Simpson's Diversity Index (D) and Shannon's Diversity Index (H) (Colinvaux 1973):

$$I = \frac{2C}{A+B}$$

such that
A the number of bird species in season A,
B the number of bird species in season B,
C the number of bird species common to both seasons.

$$D = 1 - \sum 2\frac{n}{N},$$

where:
n total number of pairs of particular bird species;
N total number of pairs of all bird species; and
if $D = 0$ there is no diversity, while there is infinite diversity if $D = 1$.

Alternatively, Shannon's Diversity Index (H) is used, defined as

$$H' = -\sum p_i \ln p_i$$

where p_i is the proportion of pairs belonging to ith-species.

Differences in the densities of particular species in various seasons were tested with χ^2-test (Fowler & Cohen 1986). The number of recorded resident pairs (for breeding species), individuals (for non-breeding species) or species (for species richness) was taken into account for this testing. All calculations were carried out in MS Excel 2007.

The nomenclature of bird species follows that of Hockey et al. (2005).

3 Results

In total, 66 resident (46 in late rainy season, only 35 in the middle of dry season and 39 at the beginning of rainy season; χ^2-test = 1.5, $df = 2$, $p > 0.05$) and 19 non-resident species were recorded: Sorensen Index was I=0.54 between March and July; I=0.49 between March and November, and I=0.78 between July and November.

Only two species have been classified as dominants in all three seasons: White-browed Sparrow Weaver *Plocepasser mahaliand* and Blue Waxbill *Uraeginthus angolensis*. Five species were dominant in two seasons: Laughing Dove *Streptopelia senegalensis*, Cape Turtle-Dove *Streptopelia capicola*, Red-billed Hornbill *Tocus erythrothynchus*, Helmeted Guineafowl *Numida meleagris* and African Palm Swift *Cypsirus parvus*. Four other species were recorded as dominant in one season only: Fork-tailed Drongo *Dicrurus adsimilis*, African Hoopoe *Upupa africana*, White-tailed Shrike *Lanioturdus torquatus*, and Red-billed Buffalo Weaver *Bubalornis niger* (Table 2). The numbers and proportions of dominant species changed only slightly from season to season (6-7 species; comprising altogether 58.8-62.4% of all resident birds).

Table 2: Seasonal changes in frequency and dominance of residential avian assemblage in mopane savanna. χ^2-test: * - significant difference ($P < 0.05$). ** - highly significant difference ($P < 0.01$).

Species	March		July		November		Total		$\chi^2 - test$
	%F	*%N*	*%F*	*%N*	*%F*	*%N*	*%F*	*%N*	
White-crowned Sparrow-Weaver	80	11. 0	70	9.1	90	9.0	80	9.9	10.1**
Cape Turtle-Dove	90	16.6	70	11.9	70	3.6	77	11.6	53.3**
Blue Waxbill	80	5.8	70	11.1	70	7.6	73	7.7	0.7
Red-billed Hornbill	70	4.2	60	5.3	80	6.1	70	5.1	0.9
Fork-tailed Drongo	90	5.1	40	1.6	50	4.0	60	3.9	13.3**
Laughing Dove	80	6.3	60	8.2	30	2.2	57	5.6	12.8**
White-tailed Shrike	70	3.7	10	0.4	90	6.5	57	3.7	14.8**
Helmeted Guinea Fowl	60	20.1	20	2.1	30	15.2	37	14.0	73.9**
African Palm Swift	10	0.2	30	6.6	70	6.1	37	3.6	14.5**
Black-throated Canary	60	4.0	0	0.0	507	2.9	37	2.67	17.5**
African Hoopoe	0	0.0	0	0.0	100	11.9	33	3.5	65.9**
Namaqua Dove	10	0.2	60	4.9	10	0.7	27	1.6	15.1**
Grey Lorie	30	1.2	30	2.1	20	1.4	27	1.5	0.2
White-crested Helmet-Shrike	10	1.2	20	6.6	40	1.8	23	2.7	9.2**
Acacia Pied Barbet	30	1.2	10	0.4	30	1.1	23	0.9	2.8
Common Scimitarbill	20	0.7	10	0.4	40	1.8	23	0.9	2.7
Southern Masked Weaver	40	1.9	0	0.0	20	1.4	20	1.3	8.3*
Golden-breasted Bunting	0	0.0	10	0.4	50	1.8	20	0.6	7.0*
Pied Crow	10	0.2	10	0.4	30	1.4	17	0.6	3.1
Brubru	20	0.5	0	0.0	30	1.1	17	0.5	2.8
Long-billed Crombec	20	0.5	0	0.0	30	1.1	17	0.5	2.8
Red-billed Buffalo Weaver	10	0.5	30	8.2	0	0.0	13	2.3	32.5**
Grey-headed Sparrow	40	2.1	0	0.0	0	0.0	13	0.9	18.0**
Red-faced Mousebird	20	0.5	0	0.0	20	1.8	13	0.7	5.3
Swainson's Spurfowl	30	1.4	0	0.0	10	0.4	13	0.7	8.6*
Groundscraper Thrush	20	0.7	0	0.0	20	1.1	13	0.6	3.0
Grey Hornbill	20	0.5	10	0.4	10	0.4	13	0.4	0.6
Zitting Cisticola	40	0.9	0	0.0	0	0.0	13	0.4	7.7
Ostrich	0	0.0	30	4.1	0	0.0	10	1.1	19.9**
Bateleur	0	0.0	30	2.5	0	0.0	10	0.6	12.2**
Southern Red Bishop	30	1.4	0	0.0	0	0.0	10	0.6	12.0**

Continued on next page

Table 2 – *Continued from previous page*

Species	March		July		November		Total		$\chi^2 - test$
	%F	*%N*	*%F*	*%N*	*%F*	*%N*	*%F*	*%N*	
Crimson-breasted Shrike	10	0.5	10	0.4	10	0.4	10	0.4	0.6
Black-chasted Prinia	10	0.5	10	0.4	10	0.4	10	0.4	0.6
Yellow-billed Kite	20	0.7	0	0.0	10	0.4	10	0.4	3.4
Spotted Thick-knee	0	0.0	20	0.8	10	0.4	10	0.3	1.9
Lilac-breasted Roller	0	0.0	30	1.2	0	0.0	10	0.3	5.8
Mourning Dove	10	0.2	20	0.8	0	0.0	10	0.3	2.0
Cattle Egret	0	0.0	20	3.3	0	0.0	7	0.8	16.0**
Greater Striped Swallow	10	0.2	10	2.1	0	0.0	7	0.6	7.5*
African Golden Oriole	20	0.9	0	0.0	0	0.0	7	0.4	7.7*
Dwarf Bittern	20	0.7	0	0.0	0	0.0	7	0.3	6.0*
African Cuckoo	20	0.5	0	0.0	0	0.0	7	0.2	4.3
Blacksmith Lapwing	0	0.0	20	0.8	0	0.0	7	0.2	3.9
Lesser Swamp Warbler	10	0.2	0	0.0	10	0.4	7	0.2	1.0
Glossy Starling	10	0.2	10	0.4	0	0.0	7	0.2	0.9
Hamerkop	20	0.5	0	0.0	0	0.0	7	0.2	4.3
Green Wood-Hoopoe	10	0.2	10	0.4	0	0.0	7	0.2	0.9
Black-crowned Tchagra	0	0.0	0	0.0	20	0.7	7	0.2	3.9
Violet-backed Starling	20	0.5	0	0.0	0	0.0	7	0.2	4.3
Southern White-crowned Shrike	0	0.0	10	0.4	10	0.4	7	0.2	1.1
Yellow-billed Oxpecker	10	0.2	0	0.0	10	0.4	7	0.2	1.0
Common Moorhen	0	0.0	0	0.0	10	2.5	3	0.7	13.9**
Yellow-crowned Bishop	10	0.5	0	0.0	0	0.0	3	0.2	4.3
Rosy-faced Parrot	0	0.0	10	0.8	0	0.0	3	0.2	3.9
Black-eyed Bulbul	0	0.0	0	0.0	10	0.4	3	0.1	2.2
Diederick Cuckoo	10	0.2	0	0.0	0	0.0	3	0.1	1.7
Familiar Chat	0	0.0	0	0.0	10	0.4	3	0.1	2.2
Lesser Moorhen	10	0.2	0	0.0	0	0.0	3	0.1	1.7
Marico Sunbird	0	0.0	0	0.0	10	0.4	3	0.1	2.2
Rufous-cheeked Nightjar	0	0.0	10	0.4	0	0.0	3	0.1	1.9
Pygmy Goose	0	0.0	0	0.0	10	0.4	3	0.1	2.2
Purple Heron	0	0.0	0	0.0	10	0.4	3	0.1	2.2
Southern Pochard	10	0.2	0	0.0	0	0.0	3	0.1	1.7
Tawny Eagle	10	0.2	0	0.0	0	0.0	3	0.1	1.7
Kurrichane Buttonquail	0	0.0	10	0.4	0	0.0	3	0.1	1.9
White-throated Swallow	0	0.0	10	0.4	0	0.0	3	0.1	1.9
Total number of pairs		428		243		277		948	
Simpson's Diversity Index		0.90		0.93		0.93		0.94	
Shannon's Diversity Index		1.24		1.28		1.32		1.39	

Among 19 non-resident species, there were three Palearctic migrants: Spotted Flycatcher *Muscicapa striata*, European Bee-eater *Merops apiaster* and Wood Sandpiper *Tringa glareola*. All other non-resident species, except for Red-billed Quelea *Quele quelea*, belonged to water

birds. The Red-billed Quelea was by far the most abundant non-breeding resident. Among water birds, a large foraging flock of ardeids, African Openbill *Anastomus lamelligerus* (100-200) and Marabou Stork *Leptoptilos crumeniferus* (up to 50) utilize the reserve as foraging ground throughout the wet season.

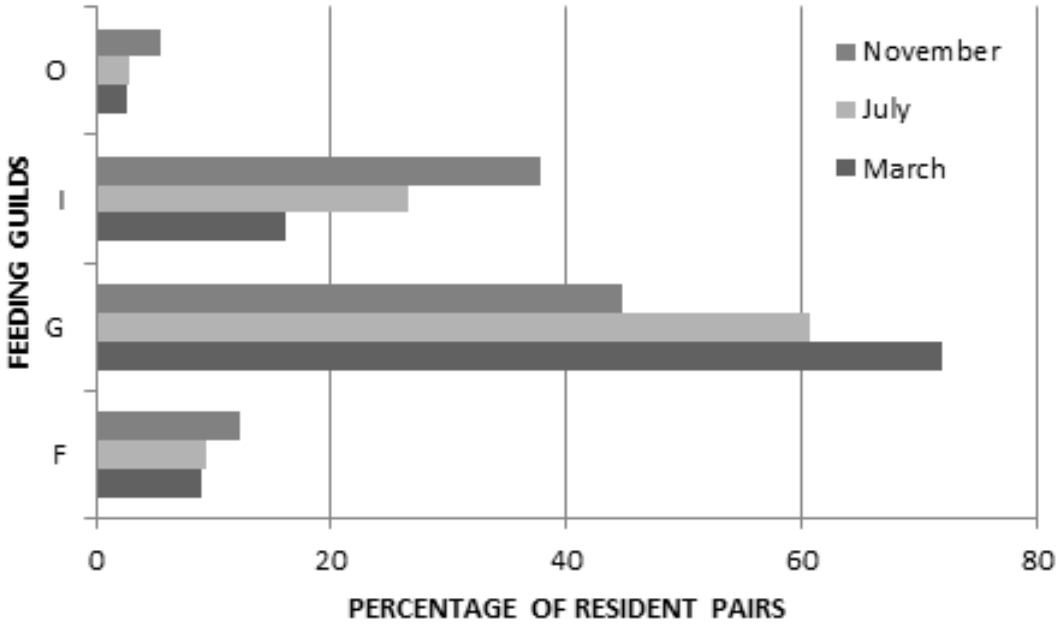

Figure 3: Seasonal changes in percentage contribution (calculated from all pairs) of main feeding guilds in resident avian assemblage in a mopane savanna (F frugivores, G granivores, I insectivores, O other guilds).

Highly significant seasonal differences in abundance were recorded for the following granivore species: Laughing Dove, Cape Turtle-Dove, Namaqua Dove *Oena capensis*, Grey-headed Sparrow *Passer diffusus*, Red-billed Buffalo Weaver, White-browed Sparrow-Weaver, Southern Red Bishop *Euplectes orix*, Black-throated Canary *Crithagra atrogularis*, Helmeted Guineafowl and the following insectivore species: African Hoopoe, Fork-tailed Drongo, White-tailed Shrike, and African Palm Swift. For additional six species, such as Southern Masked Weaver *Ploceus velatus*, White-crested Helmet-shrike *Prinops plumatus*, Golden-breasted Bunting *Emberiza flaviventris*, Swainson's Spurfowl *Pternistis swainsonii*, Greater Striped Swallow *Hirundo cucullata*, and African Golden Oriole *Oriolus larvatus*, statistically significant seasonal differences were recorded. However for 2/3 of all species no statistically significant differences in seasonal abundance have been shown (Fig. 4).

Figure 4: Top left: Red-billed Hornbill; Top-right: African Fish Eagle preying upon catfish; Bottom-left: Yellow-billed Kite roosting in a palm tree; Bottom-right: Juvenile Bateleur.

Table 3: Seasonal changes in frequency and dominance of non-residential avian assemblage in mopane savanna. χ^2-test: * - significant difference ($P < 0.05$). ** - highly significant difference ($P < 0.01$).

Species	March		July		November		Total		$\chi^2 - test$
	%F	%N	%F	%N	%F	%N	%F	%N	
Red-billed Quelea	0	0.0	50	77.6	20	51.3	23	69.5	269.5**
European Bee-eater	10	6.7	0	0.0	50	25.6	10	4.0	16.5**
Great Egret	10	6.7	20	0.9	0	0.0	10	1.1	1.9
Black-crowned Night Heron	0	0.0	10	9.2	10	7.7	7	8.5	30.3**
Little Egret	0	0.0	20	3.7	0	0.0	7	2.9	16.1**
Openbill Stork	10	6.7	10	2.8	0	0.0	7	2.6	9.0*
Rufous-bellied Heron	10	6.7	10	1.4	0	0.0	7	1.5	3.6
Green-backed Heron	20	20.0	0	0.0	0	0.0	7	1.1	6.0
Red-billed Teal	10	6.7	0	0.0	10	5.1	7	1.1	2.0
Black-headed Heron	20	13.3	0	0.0	0	0.0	7	0.7	4.0
Reed Cormorant	10	6.7	0	0.0	10	2.6	7	0.7	1.0
Spotted Flycatcher	10	6.7	0	0.0	10	2.6	7	0.7	1.0
Whistling Duck	10	6.7	10	0.5	0	0.0	7	0.7	1.0
Knob-billed Duck	0	0.0	10	1.8	0	0.0	3	1.5	7.8*
Wattled Starling	0	0.0	10	1.8	0	0.0	3	1.5	7.8*
Wooly-necked Stork	10	13.3	0	0.0	0	0.0	3	0.7	4.0
African Darter	0	0.0	0	0.0	10	2.6	3	0.4	2.0
Wood Sandpiper	0	0.0	0	0.0	10	2.6	3	0.4	2.0
Yellow-billed Egret	0	0.0	10	0.5	0	0.0	10	0.4	2.2
Total		15		217		39		272	

4 Discussion

The line transect method is suitable to assess species composition, dominance structure and relative abundance (Bibby et al. 1992). It can, however, produce only rough estimate of population density, as transect width are not clearly defined in this method (cf. Bibby et al. 1992). Data obtained by this method should be interpreted with certain precaution, as some species are less active (e.g. Black-faced Waxbill *Estrilda erythronotus*, Cape Penduline-Tit *Anthoscopus minutus*, Golden-breasted Bunting, Marico Flycatcher *Bradyornis mariquensis*) than others and therefore could pass undetected. Species, such as the White-tailed Shrike, Crimson-breasted Shrike, Long-billed Crombeck are more active in rainy that in dry season, and therefore could be underestimated in dry season. Doves, on the other hand, are more active in dry than in wet season, and could be, therefore, overestimated in dry season. Also habitat may play a role in that regard: in dense habitat, such as young mopane plantation, which predominates in the game reserve, bird detection is lower than in more open habitats. Further studies should be designed to elucidate these relationships.

Only in one (bushy vegetation on slopes of the Clarens Formation Sandstone Cave) of the 12 habitat types in South African Highveld, where avian assemblages were quantified by the means of line transect method, with a similar intensity (Kopij 2006), the number of resident bird species recorded ($N = 75$) was higher than that recorded in the Ogongo Game Reserve

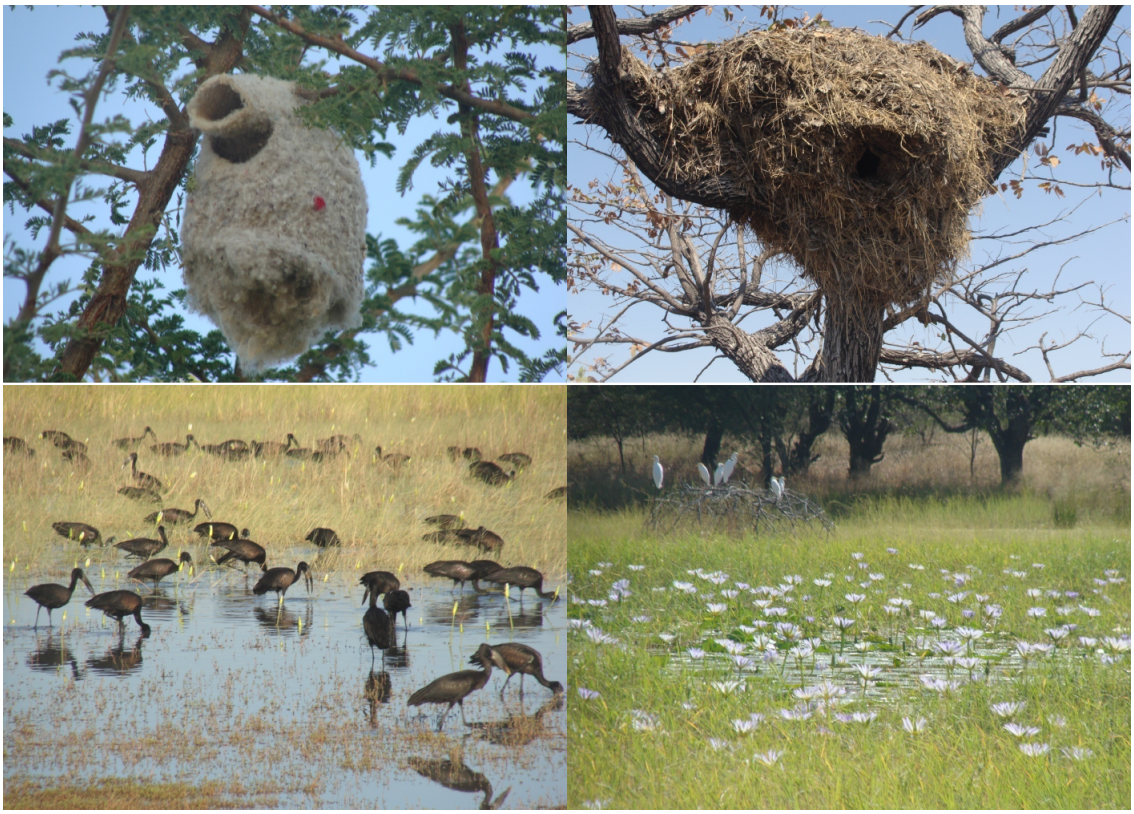

Figure 5: Top left: . A nest of the Cape Penduline-Tit; Top-right: A Hammerkop nest usurped by the Barn Owl; Bottom-left: A flock of the African Openbill Stork foraging on snails; Bottom-right: Small oshana with Cattle Egrets in the background.

($N = 66$) (χ^2-test 0.58; $p > 0.05$). In all other habitats in the Highveld the number falls below 60 (Kopij 2006). Also, nowhere in BIOTA Observatories, more than 65 bird species (including non-residents) were recorded. The highest numbers were recorded in the Woodland Savanna, 60 km SW of Rundu (56 species) and in Thornbush Savanna, Toggekry near Windhoek (65 species) (Jürgen et al. 2010). From this comparison it appears as if the species richness in Kaokoland (Mopane) Savanna, is one of the highest in Namibia. Precaution, however, should be taken, as a number of species in BIOTA Observatories was probably unrecorded. Unfortunately, Jürgen et al. (2010) have not provided any information on the days, time and intensity of their studies. If their studies on the richness of bird species were in fact, quick surveys, as they look like, the above comparison is not valid.

Even so, the recorded number of bird species in the Ogongo Game Reserve is by no means the definite number. It should also be regarded as the minimal value. The applied method,time and intensity of these counts (Table 1), have not allowed for recording some elusive and nocturnal species (studies were conducted in the night) resident in the reserve (e.g. Barn Owl *Tyto alba*, Pearl-spotted Owlet *Glaucidium perlatum*, Marsh Owl *Asio capensis*, Black-breasted Snake Eagle *Circaetus pectoralis*, goshawks *Accipiter* spp., nightjars *Caprimulgus* spp., cisticola *Cisticola* spp., pipits *Anthus* spp., and larks (Alaudidae) or visiting it on irregular basis (not every year), or so called vagrants (species with a few records per 10 years). Based on causual observations made on birds outside transects in the Ogongo Game Reserve in various seasons of the year the number of bird species resident there may actually exceed 80, while that of non-residents they are over 40 (Table 3).

In terms of diversity, there are almost no seasonal changes in the avian assemblages; both Simpson's and Shannon's diversity indices are almost identical for the resident birds (Table 2). Species composition differs, however, seasonally. The Sorensen's Index between particular seasons changes from 0.49 to 0.71. Differences are even more apparent if relative densities of particular species (number of breeding pairs recorded on transects) are compared; the seasonal differences were significant for 9.1%, and highly significant for 27.3% of them (Table 2). The seasonal differences are, however, most pronounced in the proportions of main feeding guilds, i.e. granivores and insectivores. In March, the granivores are three times more numerous than insectivores, in July they are twice more numerous than insectivores, while in November they are almost equal (Fig. 2). Granivores are most common in the time of the highest seed abundance, which is the end of wet season; while insectivores are most numerous at the beginning of wet season, when insects and other arthropods are most active.

From conservationist's point of view important is not only the level of species diversity, but also the presence of rare and endangered resident species (Barnes 2000) in an assemblage. In Ogongo Game Reserve, this group includes the Red-billed Hornbill and African Grey Hornbill *Tocus nasatus*, Common Scimitar *Rhinopomastus cyanomelas* and Green Wood-Hoopoe *Phoeniculus purpureus*, Red-faced Parrot *Agapornis roseicolis*, Acacia Pied Barbet *Tricholaema leucomelas*, Bateleur *Terathopius ecaudatus*, Tawny Eagle *Aquila rapax*, and Yellow-billed Kite *Milvus aegyptius*.

The Ogongo Game Reserve plays a particularly important role in the protection of a species endemic to Namibia, the White-tailed Shrike. It is common all over the area; in November being classified even as dominant. Two Red Data Book (Barnes 2000) species, the Yellow-billed Oxpecker *Buphagus africanus* and African Pygmy Goose *Nettapus auritus* are also resident in the reserve, although in much low numbers than the White-tailed Shrike.

The Ogongo Game Reserve plays also a role as feeding place for numerous non-resident (non-breeding) water birds. After heavy summer rains, all oshanas within this reserve harbor large amount of snails (Gastropoda), frogs (mainly *Rana* species) and fish (mainly catfish). They constitute staple food for large flocks of Openbill Storks, Marabou Storks, Little Egret *Egretta garzetta*, Rufous-bellied Heron *Ardeola rufiventris*, Great Egret *Egrett alba*, Yellow-billed Egret *Egretta intermedia* and other water birds (Fig. 5).

In conclusion, it should be stressed that Ogongo Game Reserve has a rich and diverse avifauna.It undergoes significant seasonal changes, mostly related to the water regime in oshanas. The areas surrounding the reserve are almost totally transformed into cultivated fields and are under heavy human disturbance. For many bird species the reserve constitutes a safe breeding habitat both in dry and wet season, and a rich feeding area in wet season (November/December-April/May). In the Cuvelai Drainage System, the Ogongo Game Reserve stands prominently as apparently the only nature reserve. It is, therefore, fully justified to retain its status as nature sanctuary in this unique ecosystem.

References

[1] Bibby, C. J., Burgess, N. D., Hill, D. A. 1992. *Bird censuses techniques*. Academic Press, London.

[2] Barnard, P. 1998 (ed.). *Biological diversity in Namibia: a country study*. Namibian National Biodiversity Tusk Force, Windhoek.

[3] Barnes, B. L. 2000. *The Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland*. Johannesburg: BirdLife South Africa.

[4] Chinttenden, H. 2007. *Roberts' bird guide*. Cape Town; John Voelcker Bird Book Fund.

[5] Colinvaux, P. A. 1973. *Introduction to ecology*. Wiley.

[6] Giess, W. 1971. A Preliminary Vegetation Map of South West Africa. *Dinteria* 4: 1-114.

[7] Fowler, J., Cohen, L. 1986. *Statistics for Ornithologists*. Tring: British Trust for Ornithology.

[8] Hockey, P. A. R., Dean, W. R. J., Ryan, P. G., Maree S. (eds.) (2005): *Roberts' birds of southern Africa*. Cape Town: John Voelcker Bird Book Fund.

[9] Hoffman, M. T., Schmiedel, U., Jürgens, N. 2010 (eds.) *Biodiversity in southern Africa*. Volume 3: Implications for land use and management. Klaus Hess Publishers, Göttingen & Windhoek.

[10] Jürgens, N., Haarmeyer, D. H., Luther-Mosebach, J., Dengler, J., Finckh, M., Schmiedel, U. 2010 (eds.). *Biodiversity in southern Africa*. Volume 1: Patterns at local scale the BIOTA Observatories, Klaus Hess Publishers, Göttingen & Windhoek.

[11] Kangombe, F. N. 2007. *Vegetation description and mapping of Ogongo Agricultural College and the surrounds with the aid of satellite imagery*. B.Sc. thesis. University of Pretoria, Pretoria.

[12] Kopij, G. 2006. *The Structure of Assemblages and Dietary Relationships in Birds in South African Grasslands*. Wydawnictwo Akademii Rolniczej we Wrocawiu, Wrocaw.

[13] Mendelsohn, J., Jarvis, A., Roberts, C., Robertson, T. 2009. *Atlas of Namibia. A Portrait of the Land and its People*. Sunbird Publishers, Cape Town.

[14] Mendelsohn, J, el Obeid, S., Roberts, C. 2000. *A profile of north-central Namibia.* Gamsberg Macmillan Publishers, Windhoek.

[15] Mendelsohn J, Weber, B. 2011. *The Cuvelai Basin, its water and people in Angola and Namibia*. Occasional Paper no. 8. Development Workshop, Luanda.

[16] Ndeinoma A. 2009. Vegetation of the Ogongo Game Reserve. NUL: Ogongo Campus.

[17] Newman, K. 1992. *Newmans' birds of southern Africa*. Halfway House: Southern Book Publishers.

[18] Schmiedel, U., Jürgens, N. 2010 (eds.). *Biodiversity in southern Africa*. Volume 2: Patterns and processes at regional scale. Klaus Hess Publishers, Göttingen & Windhoek.

[19] Sutherland, W. J. 1996. *Ecological Census Techniques: a handbook*. Cambridge University Press, Cambridge (U.K.).