Diet of Barn Owls (*Tyto alba*) in Katima Mulilo, Zambezi Region, Namibia

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Abstract

The diet of Barn Owls (*Tyto alba*) was studied at three active roosting sites in order to understand their feeding ecology throughout various phases of the annual cycle. We conducted weekly field trips between June and October 2016. During that period a total of 516 pellets were collected during the wet (353) and dry season (163). Furthermore, this study has resulted in the first-ever documentation on the diet of Barn Owl in Katima Mulilo in the Zambezi region of northeastern Namibia. Bones and skulls were extracted from dissected pellets and identified to taxonomic level based on cranial structure and bdirect comparison to reference specimens collected from Shamvura, Kavango East Region by Kopij (2013). Small mammals were the main prey in both seasons (86.3% in the wet season and 94% in the dry season) followed by arthropods in the wet season with 12.8% and 2% in the dry season, while birds contributed 0.5% in the wet season and 4% in the dry season. Results of this study point to the importance of basic field studies to understand the needs of a particular species as well as the community that supports it.

Keywords: Barn Owl, owl diet, *Tyto alba*, prey items, pellets analyses, frequency of occurrence, small mammals, and annual cycle

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1 Introduction

The Barn Owl (*Tyto alba*), is a nearly cosmopolitan bird that inhabits mostly open areas, including farms, grasslands, woods, and abandoned old structures (Kemp & Calburn, 1987). Barn Owls have shown considerable resilience to land use changes by adapting and persisting in landscapes which are becoming increasingly urbanized (Hager, 2009). Inhabiting urbanized landscapes comes with an increase in anthropogenic threats such as distress from collisions with vehicles and buildings (Hager, 2009).

Most owls are specialized predators that have adapted to hunting at night using large eyes to see and an acute hearing sense to search for prey (Venable, 1997). Although small mammals are the main food source of Barn Owls, they also feed on other vertebrates and invertebrates. Owls regurgitate prey remains in a form of pellets (Rocha et. 2017). This study focused on analyses of the Barn Owl's diet and understanding their feeding habits in Katima Mulilo, northeastern Namibia. Barn Owls produce pellets consisting of the less digested remains of their prey including bones, teeth, scales, hair, feathers, keratin, and chitin (Carl, 1974). Barn Owls are one of nature's biological pest controllers, and they keep the prey species population under control. But the Barn Owl can still have negative effects on the rodent's population if the rodents are not resilient to changes in their population. The results indicate that small mammals are the main prey species consumed by the Barn Owl. Therefore, that could then lead to prey species becoming threatened with extinction if the Barn Owls put more pressure on rodent's population.

The Barn Owls do feed on other species such as insects, bats, bird, lizards and solifuges apart from small mammals, and therefore, they have a diverse diet. The fact that Barn Owls do feed on other prey species as part of their diet in addition to small mammals tells us that they do select certain species relative to rodents. All that is because Barn Owls are able to hunt a different variety of species to balance their diet. That can also be attributed by the decrease of rodents' population needed to sustain the Barn Owls, and thus the owls then improvise with other prey available. Barn Owls have got other competitors that make use of the same resources, which means that there is an interspecific completion between them and other raptors present in the study area. These materials are compacted daily by the stomach and regurgitated. Pellet analysis offers advantages over other techniques because often a large sample may be acquired with relatively little expense, time, or disturbance of the raptors, and both seasonal and yearly trends in diet can be obtained, often from the same birds (Carl et al., 2007). Identification of remains in pellets can provide both qualitative and quantitative information about the diet of a barn owl or any other raptors that regurgitate pellets with the same characteristics (Marti et al.(nd); Yalden, 2009). Only fresh and compacted pellets were collected.

2 Methods and Materials

2.1 Study area

Katima Mulilo, is the largest town in Zambezi region located in the far north-eastern part of Namibia, in the Zambezi River Valley (Kopij, 2015). Katima Mulilo is one of the town in Southern Africa that have high bird diversity (Kopij, 2015). In a study on 'Birds of Katima Mulilo town, Zambezi region, Namibia', a total of 122 resident (breeding), 9 visitors and 9 Palearctic migrants were recorded (Kopij, 2015).

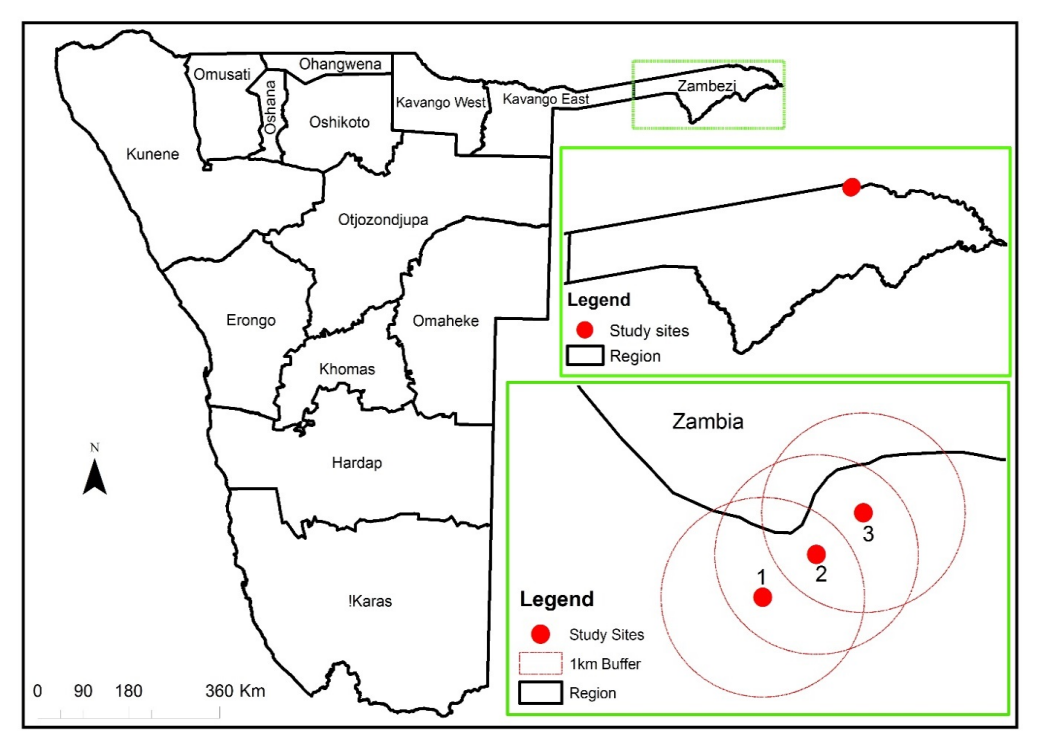


Figure 1: Study area with the three active roosting sites

2.2 Materials

Pellets were collected from three active sites, the Zambezi Waterfront Tourism Park; Department of Works and Total Service Station's abandoned warehouse from June-October 2016 (Fig. 1) Pellet analysis is a reliable method to study the diet of owls and is generally used

because owls swallow their prey (Marti, 1974). Materials used include: rulers, a dissecting kit, laboratory aprons and latex gloves. Depending on the details given by prey items from the pellets identification which range from order to species level.

All pellets were soaked for 2 hours in water (at 29°C) and sorted to isolate bones and other prey remains. The number of mammal species within each pellet was determined by coupling each skull with the correct number of ischia, left and right mandibles, tibiae/fibulae. Birds were counted by matching up each skull with sternum, gizzard sac and feet. The remains of smaller prey pieces were assumed to be contained within a single pellet as it is rare that bones from one prey item to be mixed into two successive pellets (Raczynski & Ruprecht, 1974; Hucks et al., 2015). Small mammals were identified based on cranial structures by direct comparison to voucher specimens collected at Shamvura in Kavango East region by Kopij (2013) and by skull and lower jaw characteristics using "Rodents of Southern Africa" guide book as a reference identification book. As for other species such as arthropods, their remains will be identified using Yalden (2009). The occurrence and quantity of birds found in each pellet was determined by the diagnostic characteristics of avian skulls, beaks, synsacrums, clavicles, crops, and feathers although Individuals were not identified to species level. To determine how often a particular prey item occurs in a given predators diet, we calculated frequency of occurrence (FO) index:

$$FO_i(\%) = \frac{(n_i}{N} \times 100.$$

The index measures the number of pellets (n_i) containing the remains from food category i with respect to the total sample size of pellets (N) (Nilsen, et al., 2012).

In addition, we used Pianka's (1973) index to compare owl diets across seasons:

$$O_{jk} = \frac{\sum p_{ij} p_{ik}}{\sqrt{\sum p_{ij}^2 \sum p_{ik}^2}},$$

where p_{ij} and p_{jk} are proportions of prey species (or other prey taxa) in wet season pellets j and dry season k, respectively. Mean prey weight for rodent species in each period will be estimated by multiplying the number of each prey item by its mean weight, adding the weights produced and dividing the sum by the total number of individual prey items in each sample.

3 Results

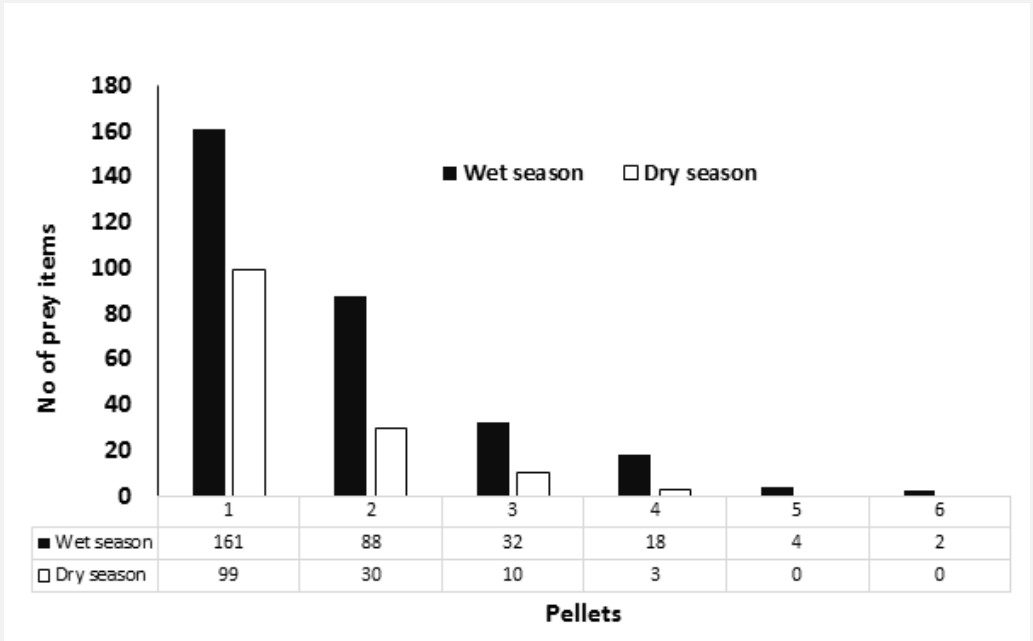
Barn Owls consumed 766 prey items from 516 pellets which gave an average of 1.5 prey items per pellet (Table 1). More than twice as many pellets were collected during the wet

Table 1: Prey items identified in Barn Owl pellets collected from Katima Mulilo, Namibia during the 2011 wet and dry season. FO indicates frequency of occurrence index.

	FO (%)		N prey		N Species	
Taxa	wet season	dry season	wet season	dry season	wet season	dry season
Mammals (Rodents & mice)						
Tatera brantsii	14	37	72	78	68	75
Tatera leucogaster	3	3	16	7	16	7
Tatera spp	11	14	54	28	51	28
Murinae	20	8.4	145	25	92	17
Muridae	5	1.4	23	3	22	3
Saccostomus campestris	2	3.4	8	8	8	7
Mastomys natalensis	8	12.8	54	32	37	26
Praomysn natalesis	3	0	24	0	14	0
Lemiscomys Griselda	0.2	0	1	0	1	0
Mus minutoides	-	-	-	-	7	3
(Shrews/sengi)	0.6	0.5	3	1	3	1
Crocidura hirta	7	1	62	2	35	2
Crocidura fuscomurina	1	0	5	0	5	0
Crocidura mariquensis	2	3	11	6	11	6
Crocidura spp	0.4	0	1	0	2	0
Microscelididae petrodromus (Mole rats)	0.2	0	1	0	1	0
Cryptomis hottentotus	0.2	0	1	0	1	0
(Chiroptera) spp						
Arthropoda						
Dorylus helvolus	-	0	-	-	9	0
Coleoptera spp	1.9	0	14	0	9	0
Acrididae spp	0.8	0	4	0	4	0
Grylidae spp	1.7	0	9	0	8	0
Scarabeidae spp	0.6	0	3	0	3	0
Orthoptera spp	3.4	1.5	16	3	16	3
Cicada spp	1	0	5	0	5	0
Solifuge	3.4	0	19	0	16	0
Aves	0.6	3	3	8	3	6
Reptilian	0.4	0	2	0	2	0
Unidentified	7	9.3	-	-	33	19

season than dry (353 vs 163). Small mammals were the main prey in both seasons (86% in the wet season and 94% in the dry season) followed by arthropods (12.7% in the wet season and 2% in the dry season), while birds contributed the least to the diet (0.5% in the wet season and 4% in the dry season). We were unable to identify some remains to possible taxa due to limited diagnostic features, thus we treated them as unknown. Of 32 prey items identified, 14 were identified to species and the rest were identified to higher taxa. There were also seeds recovered from the pellets, but to our knowledge Barn Owls do not feed on seeds nor do they feed on fruits. Thus the seeds are probably from the stomach contents of the prey species consumed by a Barn Owl.

Only one prey item was a reptile and there were no amphibians recorded. Barn Owls consumed more insects during the wet season than dry season which could be attributed to seasonal variation in abundance of tropical insects. In the wet season, Murinae appeared in most ($n = 92$) of the pellets followed by *Tatera brantsii* ($n = 68$ pellets) and then the genus Tatera ($n = 51$ pellets). Whereas in the dry season, *Tatera brantsii* had the highest presence in pellets ($n = 75$) followed by the genus Tatera ($n = 28$ pellets), whereas *Mastomys natalensis* occurred in 26 pellets. Remains of unidentified insects and small mammals were recorded in 52 pellets across both seasons, but they were excluded from our analyses, because we could not estimate the number of individuals. Most pellets had only one prey item followed by the pellets that had two prey items (Fig. 2). The number of pellets decreased as the number of prey items per pellet increased. In the wet season only four pellets had five prey items and no pellet in the dry season had five prey items. Two pellets had six prey items in the wet season and again no pellet had six prey items in the dry season. The number of prey items per pellet depended on the size of prey consumed. Thus, large species such as *Tatera Brantsii* were likely to be alone in a pellet, while there was likely to be smaller prey items such as insects in a single pellet.



	1	2	3	4	5	6
Wet season	161	88	32	18	4	2
Dry season	99	30	10	3	0	0

Figure 2: Number of prey individuals per Barn Owl pellet for each season

Murinae spp were most frequently found as present in pellets with about 20% of FO followed by *Tatera brantsii* with 15% FO and then *Tatera* spp with 11% of FO in the wet season. During the dry season, *Tatera brantsii* was the most frequent prey item with about 37% of FO followed by *Tatera* spp 14% of FO, and *Mastomys natalensis* with 13%. All

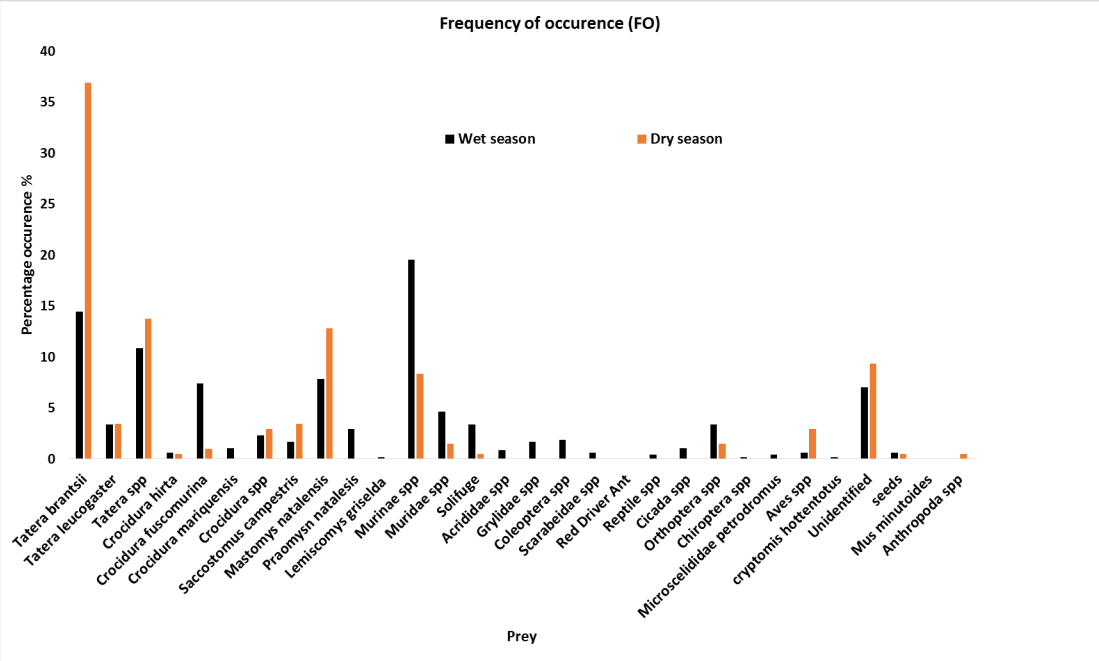


Figure 3: Frequency of occurrence of taxa in Barn Owl pellets in percentages for each recorded category of prey item across the wet and dry seasons.

the prey items that were more frequent across the two seasons were small mammals. The rest of the prey items consumed by a Barn Owl were in small proportions but still gave an important contribution to the species diet.

4 Discussion

Defining a species diet is essential to understanding its biology as well as its role in the ecosystem (Woolnough & Carthew, 1996) The present study investigated the dietary composition of the Barn Owl with attention given to the type of prey present in pellets obtained from three sites.The great diversity of species found in pellets suggested that ecological success of Barn Owls is due to the great plasticity of their feeding habits.Barn Owls showed a large seasonal overlap in diet ($< 71\%$). The remaining overlap of 21% is mainly a result of the absence of some insects' species in the dry season. Further studies are needed to focus on seasonal overlap of the Barn Owls' diet to support this evidence.

The percentage rate of small mammalian prey consumed is similar (usually greater than

90%) to other Barn Owl studies conducted in similar habitats and across continents (Marti, 1992). Seasonal overlaps in the diet was apparent in the population we studied,although it mainly took the form of a shift in use of thesame prey. Evenso, use of Murinae spp, shrews and insects declined during the dry season as compared to the wet season, while the use of *Tatera brantsii* remained the same. Whether the use of prey in the diet relate to seasonal changes in abundance of these species and whether these shifts are typical from the past is unknown.

Birds were not taken on a regular basis as some studies have reported (Myers et al., 2009) and they have made up 3.3% of the diet during the dry season and 0.7% during the wet season. Birds have often been documented in the Barn Owl's diet within a range of up to $< 5\%$ which is more or less the same as the what is reported in this study (Marti, 1973; 1988). Otteni et al. (1972) stressed that Barn Owls may opportunistically have a rise in the use of birds, especially in abundant colonially nesting or roosting birds, when the availability of small mammals is low. But in this study we assume that small mammals were availabile across all the seasons since they dominated the diet of the Barn Owl which complements with prevous studies.

Large invertebrates have been occasionally reported in the diet of some Barn Owl populations (Marti, 1992). Similarly, we have reported a small proportion of invetebrates in the dry season (2.2%) but a slighly larger propotion in the wet season of (12.7%). In a study by Kopij & Symes(2014), they indicated that pellets collected mainly in the dry season, the time of the year when insects are generally scarce in the grassland, could be the main factor leading to less use of insects by Barn Owls in the dry season.

Carl (1974) further emphasized that there are many reasons that lead to seasonal variation in prey in his study of four owl species. For example, seasonal vegetation changes may lead to some species being more available to owl predation for a time. Daily activity patterns of owls and certain prey may overlap at some times of the year and not at others which will the cause the differences in the diets of the predators. The efficient gastric acids on raptor digestion leaves little evidence to identify prey species extracted from pellets (Trierweiler & Hegemann, 2011) and numerous soft-bodied prey species, including some invertebrates and amphibians, may be absent or under-represented in pellets. Rosenberg & Cooper, (1990) made it clear that identification of prey species obtained from pellets alone is biased and therefore to account for that, it must be coupled with direct observations of Owls taking prey.

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