

**Research article**

urn:lsid:zoobank.org:pub: D8C8DAAF-4F7A-4BB4-97A1-384C6E3D889D

**Terrestrial small mammal assemblage from pellets of three sympatric owl species in the Mount Oku area (Northwest Cameroon), with implications for conservation****Guy Martial Ntougwa Ebague<sup>1</sup>, Alain Didier Missoup<sup>2,\*</sup>, Ernest Keming Chung<sup>3</sup>, Maurice Tindo<sup>4</sup> & Christiane Denys<sup>5</sup>**<sup>1,2,4</sup>*Zoology Unit, Laboratory of Biology and Physiology of Animal Organisms, Faculty of Science, University of Douala, POBox 24157 Douala, Cameroon*<sup>3</sup>*Kilum-Ijim Forest Project, PO Box: 119, Kumbo, Cameroon*<sup>5</sup>*Institut de Systématique, Evolution, Biodiversité, ISYEB – UMR 7205 – CNRS, MNHN, UPMC, EPHE, Muséum National d'Histoire Naturelle, Sorbonne Universités, F-Paris, France**\*Corresponding author: Email: [admissoup@ymail.com](mailto:admissoup@ymail.com); ORCID: <http://orcid.org/0000-0002-3018-9188>*<sup>1</sup>urn:lsid:zoobank.org:author:80FE07CD-3F95-47C7-8B4B-AA7C5D03AC64<sup>2</sup>urn:lsid:zoobank.org:author:946A07D5-4AF2-453A-A579-7D22D0092E3B<sup>3</sup>urn:lsid:zoobank.org:author:27FD377D-34EC-4634-A510-DF279254191C<sup>4</sup>urn:lsid:zoobank.org:author:4BF18523-4634-4A8D-A8CF-2A4AA85DBD33<sup>5</sup>urn:lsid:zoobank.org:author:FCD37439-1E9D-4FD2-A845-E311603D45EF

**Abstract.** Mount Oku is well known for its exceptional species diversity for both animals and plants. A total number of 27 species of rodents and six species of shrews are reported from the area. Ten of these species are endemic at local or regional level and are considered as endangered or vulnerable, with a decreasing population trend. They are thus considered as having a high conservation importance. We sampled terrestrial small mammals from owl pellets during a period of 22 months in different areas near the village Oku, in order to assess the importance of these taxa in the diet of owl species present in the area. The 236 pellets attributed to three sympatric owl species (Barn owl, *Tyto alba*, the African wood owl, *Strix woodfordii*, Northern white-faced owl, *Ptilopsis leucotis*), yielded a total number of 543 specimens of rodents and shrews, belonging to 22 species (16 species of rodents and six species of shrews). They represented respectively 69.06% and 30.94% of the total assemblage, the species *Dasymys* sp., with a final score of 18.23%, having the highest relative abundance. Of the ten species with a high conservation importance, only *Lemniscomys mittendorfi* was missing. All constituted about 27.62% of all specimens collected, with a relative abundance of 4.23% for species strictly restricted to Mount Oku. This study confirms the position of Mount Oku as an important conservation area for rodents and shrews, and highlights the evidence that terrestrial small mammal predation by owls cannot be considered a threat to species of conservation concern at Mount Oku.

**Key words.** Mount Oku, owl pellets, rodents, shrews, owls, conservation.

**INTRODUCTION**

The montane forests of the Cameroon Highlands' region are considered as priority conservation areas at a global scale (Oates et al. 2004) and are one of the most important centres of endemism on the African continent (Zimkus & Gvoždik 2013). The Kilum-Ijim forest in the massif of Mount Oku (3100 m asl), the second highest mountain after Mount Cameroon, is relatively well-studied for many taxa including animals and plants (Cheek et al. 2000; Doherty-Bones & Gvozdik 2017; Ineich et al. 2015; Momo 2017). It represents the largest remaining part of afro-montane forest in West Africa (Cheek et al. 2000). Several studies have been carried out on small mammals of Mount Oku, most of them using trapping

methods, which enabled the publication of an updated list of 27 species of rodents (24 terrestrial and three arboreal) and six species of shrews (Maisels et al. 2001; Denys et al. 2014).

It has been recently demonstrated that the use of owl pellets is a more effective alternative to conventional trapping for broad-scale studies of small mammals' communities (Heisler et al. 2016). However, very little attention has been focussed on the study of small mammal communities using owl pellets in tropical Africa. Indeed, most of data available are from the northern part of the continent, mainly from the country Algeria (Baziz et al. 2002, 2005; Sekour et al. 2010, 2011, 2014; Alia et al. 2012; Hadjoudj et al. 2012; Iduhar-Saadi et al. 2014; Tergou et al. 2014; Souttou et al. 2015; Bounaceur et al. 2016;

Djilali et al. 2016; Ouarab & Doumandji 2017); few are from Morocco (Rihane et al. 2015), Tunisia (Leonardi & Del-Arte 2006) and Egypt (Sándor & Moldován 2012). For tropical Africa, some studies were made in the South African region, including the countries Malawi (Happold & Happold 1986; Ngonda 1991; Denys et al. 1999), Botswana (Denys 1985) and South Africa (Grindley et al. 1973; Dean & Dowsett 1986; Mendelsohn 1989; Avery 1992; Avery et al. 2005). The few data available for West Africa are mainly from Senegal (Bâ et al. 2000; Thiam et al. 2008), Mauritania (Bruderer & Denys 1999) and Nigeria (Lekunze et al. 2001). Previous works in the East African region include the two countries Ethiopia (Demeter 1982) and Tanzania (Andrews 1990). In Central Africa, only one study from the area of Bambilli (NW Cameroon), based on the diet of the African grass owl (*Tyto capensis*) and the spotted eagle owl (*Bubo africanus*) is known from the literature (Riegert et al. 2007). However, Denys et al. (2014) used owl pellets collected by O. Fülling in 1990 and 1991 in the lake Oku cave and for the first time verified the presence of *Myiomys dybowski* at Oku.

Of the 27 species of rodents reported from Mount Oku (Denys et al. 2014), four are known as strictly endemic (*Lamottemys okuensis*, *Hylomyscus grandis*, *Lophuromys dieterleni* and *Lemniscomys mittendorfi*) to the mountain, and three others (*Praomys hartwigi*, *Hybomys eisentrauti* and *Otomys occidentalis*) have a distribution range that is limited to the Bansa-Bamenda Highlands. Two of the six species of shrews reported from Oku (*Myosorex okuensis* and *Sylvisorex camerunensis*)

are restricted to the Bansa-Bamenda Highlands and one (*Sylvisorex isabella*) extends to the southern part of Cameroon Highlands in Bioko. All these species are considered as endangered or vulnerable on the IUCN Red List, with a decreasing population trend (IUCN 2016). Mount Oku is thus an important area for the conservation of terrestrial small mammals. The effect of owl predation on small mammal populations' abundance has already been reported and their importance in rodent pest species management has been repeatedly highlighted (Baleiauskiene 2005; Previtali et al. 2009; Sekour et al. 2014), suggesting a possible influence on rodent population dynamics at the local level. From 2015 to 2016 we conducted opportunistic sampling of pellets in areas near the village Oku, from 2000 up to 2900 m asl, in order to assess the importance of species with high conservation value in the diet of owl species present in the area. This paper reports data on small mammal assemblages sampled from three owl species (Barn owl, *Tyto alba*, the African wood owl, *Strix woodfordii*, and the Northern white-faced owl, *Ptilopsis leucotis*), with an emphasis on the conservation of rodent species endemic to Mount Oku or to the whole Bansa-Bamenda Highland region.

## MATERIAL & METHODS

### Study area

Belonging to Bansa-Bamenda Highlands within the Cameroon Highlands' region, Mount Oku (Fig. 1) is

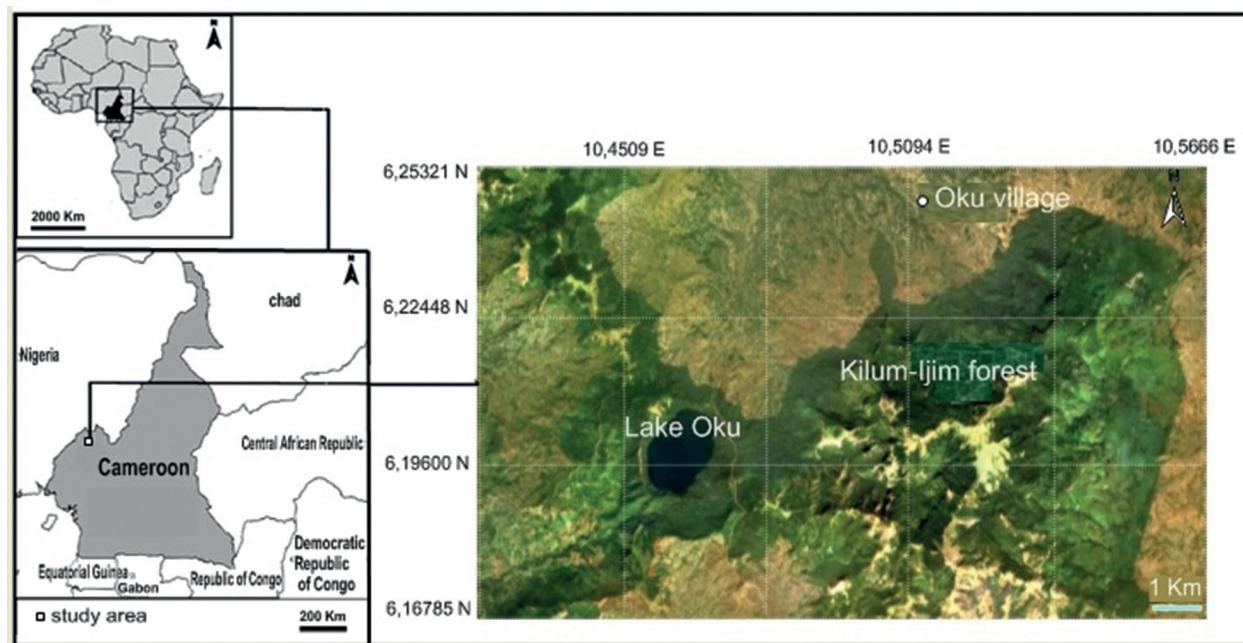


Fig. 1. Map showing the location of the study area.

covered by a small montane forest, the Kilum Ijim forest massif which extends from 2200 m to 2800 m asl (Maisels et al. 2001). It is dominated by *Carapa grandiflora* (Meliaceae), *Nuxia congesta* (Loganiaceae), *Syzygium staudtii* (Myrtaceae) and *Arundinaria alpina* (Poaceae). An afroalpine vegetation is found from 2800 m up to the summit (3011 m), and mostly constitutes of the grass species *Gnidia glauca*, *Hypericum revolutum* and *Erica mannii* (Momo 2017). Lower altitudes (below 2200 m asl) are widely used for agriculture. The Oku village is situated at about 2000 m asl in Mount Oku, close to the Kilum forest. Mount Oku is dominated by equatorial climate, characterised by a wet season of seven to eight months and a dry season of four to five months; months of August and March being respectively the most wet and dry. The average annual rainfall is about 2427 mm and the temperature ranges between about 10 °C and 25–28 °C (Forbosh & Ikfuingei 2001).

### Owl pellet sampling

From March 2015 to December 2016, opportunistic sampling of pellets (97 complete and about 139 damaged) was done in different habitats near the village Oku (6°24' N–10°50' E), including montane forests, montane grasslands and crop plantations. The sampling was done between 2000 m and 2900 m asl. On each occasion, the samples collected were kept together in a dry plastic bag. They were later attributed to three owl species known from the area, the Barn owl (*Tyto alba*), the African wood owl (*Strix woodfordii*), and the Northern white-faced owl (*Ptilopsis leucotis*), based on direct observations and feather remains, following the field guide by Borrow & Demey (2008).

### Owl pellet treatment and small mammal species identification

In the laboratory, each pellet was softened in hot water during five to ten minutes and disinfected later in a 10% diluted solution of chlorinated water. Pellets were then opened and the bones were cleaned using a pair of forceps. After rinsing with water and drying, skulls and other remaining bones were placed in separate tubes for further observations.

Species identifications of rodents and shrews were mostly based on the mandibles, the upper molar row and skull morphology, following the criteria provided in Denys et al. (2014) as well as reference collections housed at the MNHN. We also followed identification keys of Monadjem et al. (2015). For shrews, we also used cranio-dental characters, and followed character descriptions reported in Heim de Balsac (1968, 1975), Meester & Setzer (1971) and Hutterer & Happold (1983). In two cases (rodents and shrews), morphological characters of teeth were checked by using a Pierron® binocu-

lar magnifier at 10x. All specimens are currently housed at the Zoology Unit of the Laboratory of Biology and Physiology of Animal Organisms, Faculty of Science, University Douala.

### Small mammal relative abundance estimates

As skulls were not present in all pellets collected, the total number of small mammals was estimated in each pellet based on a tally of paired mandibles as proposed by Bueno & Motta-Junior (2008). After pairing, unpaired mandibles were counted as additional individuals. The same approach was also used to evaluate the total number of individuals in the whole sample, and finally for an estimation of the relative abundance.

## RESULTS

The entire sample examined yielded a total number of 543 specimens of rodents (Order Rodentia) and shrews (Order Soricomorpha), belonging to 22 species, 18 genera and three families (Table 1). Rodents were represented by 16 species from 14 genera and two families. Shrews included six species belonging to four genera and one family. Rodents represented 69.06% of the small mammal assemblage, while shrews constituted 30.94% of the entire sample. The Shaggy rat (*Dasymys* sp.) was the most abundant species found (18.23%), followed by the Hun shrew (*Crocidura attila* Dollman, 1915), with 12.34% of the total assemblage. The less represented species of our sample were the Mount Oku *Hylomyscus*, *Hylomyscus grandis* Eisentraut, 1969 (0.55%), the Roof rat, *Rattus rattus* (Linnaeus, 1758) and the Mount Oku rat, *Lamottemys okuensis* Petter, 1986 (each with 1.1 %). Of the ten species with a high conservation importance, only one species, *Lemniscomys mittendorfi*, was missing. The nine other species represented together a total number of 150 specimens, out of the 543 individuals counted, corresponding to a relative abundance of about 27.62%. From the whole sample, the relative abundance of each of these species varied from 0.55% (three specimens of *Hylomyscus grandis*) to 7.18% (33 individuals of *Otomys occidentalis*).

## DISCUSSION

With a total number of 236 pellets collected in the study area, our sample represents important material, which can help to complement our knowledge on small mammal diversity from the Oku area. Of the 543 specimens counted from the pellets, 22 species of terrestrial small mammals, including 16 species of rodents and six species of shrews were finally identified. All of these newly

**Table 1.** Relative abundance (RA) of rodent and shrew species found in owl pellets collected in Oku (N: Number of specimens).

Orders	Families	Subfamilies	Species	N	RA	
Rodentia	Nesomyidae	Dendromurinae	<i>Dendromys sp.</i>	13	2.39	
		Muridae	Deomyiinae	<i>Lophuromys dieterleni</i> Verheyen, Hulselmans, Colyn & Hutterer, 1997	14	2.58
	Murinae		<i>Dasymys sp.</i>	99	18.23	
			<i>Grammomys poensis</i> Eisentraut, 1965	8	1.47	
			<i>Hybomys rufocanus</i> (Tulberg, 1893)	7	1.29	
			<i>Hylomyscus grandis</i> Eisentraut, 1969	3	0.55	
			<i>Lamottemys okuensis</i> Petter, 1986	6	1.10	
			<i>Lemniscomys striatus</i> (Linnaeus, 1758)	29	5.34	
			<i>Mastomys sp.</i>	36	6.63	
			<i>Mus musculus</i> Linnaeus, 1758	11	2.03	
			<i>Mus setulosus</i> Peters, 1876	19	3.50	
			<i>Mus sp.</i>	22	4.05	
			<i>Oenomys hypoxanthus</i> Eisentraut, 1968	9	1.66	
			<i>Otomys occidentalis</i> Dieterlen & Van der Straeten, 1992	39	7.18	
			<i>Praomys hartwigi</i> Eisentraut, 1968	22	4.05	
			<i>Praomys jacksoni</i> (de Winton, 1897)	19	3.50	
			<i>Rattus rattus</i> Linnaeus, 1758	6	1.10	
			Undetermined murines	13	2.39	
			<b>Total Rodents</b>			
	Soricomorpha	Soricidae	Crociturinae	<i>Crocitura attila</i> Dollman, 1915	67	12.34
<i>Crocitura olivieri</i> Lesson, 1827				15	2.76	
<i>Suncus megalura</i> Jentink, 1888				16	2.95	
<i>Sylvisorex camerunensis</i> Heim de Balsac, 1968				14	2.58	
<i>Sylvisorex isabellae</i> Heim de Balsac, 1968				10	1.84	
Myosoricinae			<i>Myosorex okuensis</i> Heim de Balsac, 1968	35	6.45	
Undetermined shrews			11	2.03		
<b>Total Shrews</b>				<b>168</b>	<b>30.94</b>	
<b>Total general</b>				<b>543</b>	<b>100</b>	

collected species of rodents were previously sampled at Oku (Eisentraut 1968, 1969; Bowden 1986; Hutterer & Fülling 1994; Maisels et al. 2001; Denys et al. 2014), as well as the six species of shrews found in our sample (Maisels et al. 2001). Of the 24 species of terrestrial rodents reported by Denys et al. (2014), eight were missing from our sample. Some of these taxa are known by only a low number of specimens from Oku (*H. alleni* cf. *montis*, *H. walterverheyeni*, *Lemniscomys mittendorfi*, *Mylomys dybowski*, *Gerbilliscus kempi*). The others are members of genera currently under revision, in which the identification solely using morphology is not obvious (*Grammomys* sp., *L. sikapusi*). Moreover, species of the genus *Cricetomys*, with a mean weight of 500 grams (Monad-

jem et al. 2015) are likely not suitable prey in the diet of the three species of owls involved in this study.

The predominance of rodents, compared to shrews, in small mammal assemblages using owl pellets has been previously reported from different areas of the African continent (Demeter 1982; Dean & Dowsett 1986; Mendelsohn 1989; Ngonda 1991; Riegert et al. 2007; Sándor & Moldován 2010; Hadjoudj et al. 2011; Alia et al., 2012; Sekour et al. 2014; Ouarab & Doumandji 2017). However, some studies documented the abundance of birds (Hamani et al. 2011), amphibians (Tergou et al. 2014) or insects (Doumandji et al. 1997). With pellets of the African grass owl, Riegert et al. (2007) reported more shrew specimens (about 70.41% of the total prey items), compared to rodents. Data from other areas also suggest-

ed an abundance of shrew items in the diet of *Tyto alba* (Love et al. 2000; Mahmood-UI-Hassan et al. 2007). Many studies have highlighted the evidence of a seasonal variation in the diet composition of different owl species (Bosè & Guidali, 2000; Mahmood-UI-Hassan et al. 2007; Sekour et al. 2011). Other works suggested the existence of a shift in the trophic habits of these birds, depending on prey availability (Bueno & Motta-Junior 2008; Sandor & Moldovan, 2010). In this study, we used specimens collected from pellets from a period of 22 months, suggesting that we report here a general trend in the predation of small mammals by owls at Oku. In Bambili, less than 50 km from Oku, Riegert et al. (2007) reported a dominance of *Dasymys* (with about 27% of rodent and shrew samples), *Otomys occidentalis* (15%) and *Mastomys* sp. (12%) specimens in the diet of the Spotted eagle owl, which is very close to our findings.

Our study confirms the presence of nearly all the species with a high conservation importance at Oku, except *Lemniscomys mittendorfi*. All represented about 27.62% of the total small mammal assemblage. The three species *Lamottemys okuensis* (1.10%), *Hylomyscus grandis* (0.55%) and *Lophuromys dieterleni* (2.58%), that are restricted to Oku, together constituted only 4.23% of all the specimens identified. Using both Sherman, snap and traditional traps, specimens of *Lamottemys okuensis* represented about 18.66% of all the rodents trapped (Denys et al. 2014). Thus, the abundance of this species as revealed by owl pellets is not representative of its population size in the study area. Otherwise, from our final sample of species with high conservation importance, the three taxa having a high abundance, *Otomys occidentalis* (7.18%), *Myosorex okuensis* (6.45%), *Praomys hartwigi* (4.05%), are widely distributed in the whole area of the Bansa-Bamenda highlands. Riegert et al. (2007) obtained between 2.0% (*Myosorex okuensis*) and 11.4% (*Otomys occidentalis*) of total prey items in their study. All these findings together highlight the fact that (i) terrestrial small mammal species with high conservation importance do not constitute the main diet of owl species in the Oku area, (ii) those with a predation rate that can be considered as relatively high (eg. *Otomys occidentalis*: from 3.0 to 11.4% depending on the owl species) are widely distributed in Bansa-Bamenda Highlands, suggesting a lower pressure at the level of their entire area of distribution. In conclusion, terrestrial small mammal predation by owls cannot be considered a threat to their conservation at Mount Oku. Many other threats, mainly relating to high human pressure on natural environments of Mount Oku have been reported before, with a particular emphasis on local rodent trapping levels (Denys et al. 2014; Maisels et al. 2001). With nine of the ten small mammal species having a high conservation importance, this study confirms the place of Mount Oku as an important conservation area for rodents and shrews.

**Acknowledgments.** The authors would like to express their gratitude to local people of Oku that helped for pellets sampling during the study period. They are also grateful to authorities of the University of Douala for the deliverance of a research certificate to G.M. Ntougwa Ebage (Ref. LBPOA/05/2015), as part of its PhD project, and for the specimen transportation certificate delivered to A.D. Missoup (Ref. LBPOA/01/2018) that was used to export specimens at the MNHN in Paris in March 2018. The authors would finally like to thank the reviewers who improved the earlier draft of this manuscript.

## REFERENCES

- Alia Z, Sekour M, Ould El Hadj MD (2012) Importance des rongeurs dans le menu trophique de *Tyto alba* (Scopoli, 1759) dans la région de Souf (Algérie). *Revue des BioResources* 2 (2): 37–47
- Andrews P (1990) Owl, Caves and Fossils. Natural History Museum publications, London, 231 pp.
- Avery DM (1992) Ecological data on micromammals collected by Barn owls *Tyto alba* in the West Coast National Park, South Africa. *Israel Journal of Zoology* 38: 385–397
- Avery DM, Avery G, Palmer NG (2005) Micromammalian distribution and abundance in the Western Cape Province, South Africa, as evidenced by Barn owls *Tyto alba* (Scopoli). *Journal of Natural History* 39 (22): 2047–2071
- Bâ K, Granjon L, Hutterer R, Duplantier J-M (2000) Les micromammifères du Djoudj (delta du Sénégal) par l'analyse du régime alimentaire de la chouette effraie, *Tyto alba*. *Bonner Zoologische Beiträge* 49: 31–38
- Balčiauskienė L, Jovaišas A, Naruđevičius V, Petrađka A, Skuja S (2006) Diet of tawny owl (*Strix aluco*) and long-eared owl (*Asio otus*) in Lithuania as found from pellet. *Acta Zoologica Lituonica* 16 (1): 37–45
- Baziz B, Doumandji S, Denys C, Khemici M (2002) Répartition en Algérie du Pachyure étrusque *Suncus etruscus* (Insectivora, Soricidae). Première observation dans le Nord-Est du Sahara, à Biskra. *Mammalia* 66: 133–137
- Baziz B, Sekour M, Doumandji S, Denys C, Metref S, Bendjallah S, Nadji FZ (2005) Données sur le régime alimentaire de la Chouette chevêche (*Athene noctua*) en Algérie. *Aves* 42 (1–2): 149–157
- Bouaceur F, Bissaad FZ, Marniche F, Boutheldja H, Abaiter N, Khellil K, Saad A (2016) Écologie trophique du hibou grand-duc du désert *Bubo ascalaphus* (Savigny, 1809) dans la région de l'Ahaggar, sud algérien. *Revue Ivoirienne des Sciences Technologiques* 27: 175–189
- Borrow N, Demey R (2008) Guide des Oiseaux de l'Afrique de l'Ouest. Paris, France.
- Bose M, Guidali F (2001) Seasonal and geographic differences in the diet of the barn owl in an agro-ecosystem in northern Italy. *Journal of Raptor Research* 35 (3): 240–246
- Bowden, C. G. R. (1986) Small mammal research in western Cameroon. Pp 196–200 in Stuart S (ed.) Conservation of Cameroon Montane Forests. International Council for Bird Preservation, Cambridge.
- Bruderer C, Denys C (1999) Inventaire taxonomique et taphonomique d'un assemblage de pelotes d'un site de nidification de *T. alba* de Mauritanie. *Bonner Zoologische Beiträge* 48 (3–4): 245–257
- Bueno AA, Motta-Junior JC (2008) Small mammal prey selection by two owl species in southeastern Brazil. *Journal of Raptor Research* 42 (4): 248–255

- Cheek M, Onana JM, Pollard BJ (2000) The plants of Mount Oku and the Ijim Ridge, Cameroon: a conservation checklist. Royal Botanic Gardens, Kew
- Dean WRJ, Dowsett RJ (1986) A nest of the Grass-owl *Tyto capensis* in the Southern Cape. *Ostrich* 57: 187–188
- Demeter A (1982) Prey of the Spotted Eagle-Owl *Bubo africanus* in the Awash National Park, Ethiopia. *Bonner Zoologische Beiträge* 33: 283–292
- Denys C (1985) Nouveaux critères de reconnaissance des concentrations de microvertébrés d'après l'étude des pelotes de chouette du Botswana (Afrique australe). *Bulletin du Muséum National d'Histoire Naturelle de Paris, Section A (Zoologie)* 7 (4): 879–933
- Denys C, Chitaukali W, Mfuné JK, Combrexelle M, Cacciani F (1999) Diversity of small mammals in owl pellet assemblages of Karonga district, northern Malawi. *Acta Zoologica Cracoviensia* 42: 393–396
- Denys C, Missouf AD, Nicolas V, Fülling O, Delapré A, Bilong Bilong CF, Taylor JP, Hutterer R (2014) African highlands as mammal diversity hotspots: new records of *Lamottemys okuensis* (Rodentia: Muridae) and other endemic rodents from Mount Oku, Cameroon. *Zoosystema* 36 (3): 647–690
- Djilali K, Sekour M, Souttou K, Ababsa L, Guezoul O, Denys C, Doumandji S (2016) Diet of Short-eared Owl *Asio flammeus* (Pontoppidan, 1763) in desert area at Hassi El Gara (El Golea, Algeria). *Zoology and Ecology* 26 (3): 159–165
- Doumandji S, Doumandji-Mitiche B, Cisse O (1997) Régime alimentaire de la Chouette hulotte *Strix aluco* Linné, 1758 (Aves, Strigidae) en milieu suburbain près d'Alger. *Annales de l'Institut National Agronomique de El-Harrach* 18: 1–8
- Doherty-Bone TM, Gvoždík V (2017) The Amphibians of Mount Oku, Cameroon: an updated species inventory and conservation review. *ZooKeys* 643: 109–139
- Eisentraut M (1969) Die tiergeographische Bedeutung des Oku-Gebirges im Bamenda-Banso-Hochland (Westkamerun). *Bonner Zoologische Beiträge* 19: 170–175
- Eisentraut M (1969) Die Verbreitung der Muriden Gattung *Hylomyscus* auf Fernando Poo und in Westkamerun. *Zeitschrift für Säugetierkunde* 34: 296–307
- Forbeseh PK, Ikfuingei RN (2001) Estimating the population densities of *Tauraco bannermani* in the Kilum-Ijim Forests, North Western Cameroon. *Ostrich* 15: 114–118
- Grindley J, Siegfried WR, Vernon CJ (1973) Diet of the Barn owl in the Cape Province. *Ostrich* 44: 266–267
- Hadjoudj M, Manaa A, Merzouki Y, Sekour M, Doumandji S (2011) Place des rongeurs dans le régime trophique de la Chouette effraie *Tyto alba* dans la région de Touggourt. *Revue des BioRessources* 2 (1): 33–40
- Hamani A, Denys C, Doumandji S (2011) Nouvelles données sur le régime alimentaire de la Chouette effraie *Tyto alba* aux abords du barrage de Boughzoul. In: Séminaire international de protection végétale, Département de Zoologie agricole et forestière, Ecole Nationale Supérieure d'agronomie, El Harrach, Algerie
- Happold DCD, Happold M (1986) Small mammals of Zomba Plateau, Malawi, as assessed by their presence in pellets of the Grass-owl, *Tyto capensis*, and by live-trapping. *African Journal of Ecology* 24: 77–87
- Heim de Balsac H (1968) Contribution à l'étude des Soricidae de Fernando Po et du Cameroun. *Bonner Zoologische Beiträge* 19: 15–42
- Heim de Balsac H (1975) Nouvelles données sur la faune soricidienne du Cameroun. *Bonner Zoologische Beiträge* 26: 94–99
- Heisler LM, Somers CM, Poulin RG (2016) Owl pellets: a more effective alternative to conventional trapping for broad-scale studies of small mammal communities. *Methods in Ecology and Evolution* 7: 96–103
- Hutterer R, Fülling O (1994) Mammal diversity in the Oku Mountains, Cameroon. In: International Symposium on Biodiversity and Systematics in Tropical Ecosystems. Museum Koenig, Bonn, Germany.
- Hutterer R, Happold DCD (1983) The shrews of Nigeria (Mammalia: Soricidae). *Bonner Zoologische Monographien* 18: 1–79
- Idouhar-Saadi H, Moulai R, Souttou K, Baziz-Neffah F, Smai A, Zenia S, Doumandji S (2014) Diet comparison between fledgling and adult tawny owl *Strix aluco* Linné, 1758 (Aves; Strigidae) in suburban area of El Harrach (Algiers, Algeria). *International Journal of Zoology and Research* 4 (4): 59–66
- Ineich I, LeBreton M, Lhermitte-Vallarino N, Chirio L (2015) The reptiles of the summits of Mont Oku and the Bamenda Highlands, Cameroon. *Amphibian & Reptile Conservation* 9 (2): 15–38
- IUCN, 2016. IUCN Red List of threatened species 2018. [HTTP://www.iucnredlist.org](http://www.iucnredlist.org). Last access 22 Nov 2018
- Lekunze LM, Ezealor AU, Aken'Ova T (2001) Prey groups in the pellets of the barn owl *Tyto alba* (Scopoli) in the Nigerian savanna. *African Journal of Ecology* 39: 38–44
- Leonardi G, Dell'Arte GL (2006) Food habits of the Barn Owl (*Tyto alba*) in a steppe area of Tunisia. *Journal of Arid Environments* 65: 677–681
- Love RA, Webon C, Glue DE, Harris S, Harris S (2000) Changes in the food of British Barn Owls (*Tyto alba*) between 1974 and 1997. *Mammal Review* 30 (2): 107–129
- Mahmood-Ul-Hassan M, Beg MA, Ali H (2007) Seasonal variation in the diet of the barn owl *Tyto alba stertens* in central Punjab, Pakistan. *Current Zoology* 53 (3): 431–436
- Maisels FG, Keming E, Kemei M, Toh C (2001) The extirpation of large mammals and implications for mountain forest conservation: the case of Kilum-Ijim Forest, Northwest Province, Cameroon. *Oryx* 35 (4): 322–331
- Meester J, Setzer HW (1971) The Mammals of Africa. An Identification Manual. Smithsonian Institution Press, Washington.
- Mendelsohn JM (1989) Habitat preferences, population size, food and breeding of six owls species in the Springbok Flats, South Africa. *Ostrich* 60: 183–190
- Momo SMC (2017) Plant assemblages along an altitudinal gradient of Mount Oku forests (Cameroon). *Journal of Agriculture and Ecology Research International* 11 (2): 1–10
- Monadjem A, Taylor PJ, Denys C, Cotterill FPD (2015) Rodents of Sub-Saharan Africa: a biogeographic and taxonomic synthesis. De Gruyter, Berlin
- Ngonda JB (1991) Food Choice of the Spotted Eagle Owl (*Bubo africanus*) at Kachulu. Bachelors thesis, Chanco College University of Malawi
- Oates JF, Bergl RA, Linder JM (2004) Africa's Gulf of Guinea Forests: Biodiversity Patterns and Conservation Priorities. *Advances in Applied Biodiversity Science*. Conservation International, Washington D. C.
- Ouarab S, Doumandji S (2017) Ecologie trophique De la chouette effraie *Tyto alba* (Scopoli, 1769) Dans la réserve naturelle De la zone humide de Réghaïa. *Bulletin de la Société zoologique de France* 142(1): 13–28
- Previtali MA, Lima M, Meserve PL, Kelt DA, Gutierrez JR (2009) Population dynamics of two sympatric rodents in a variable environment: rainfall, resource availability, and predation. *Ecology* 90 (7): 1996–2006

- Riegert J, Sedláček O, Hutterer R (2007) Diet of sympatric African grass owl (*Tyto capensis*) and spotted eagle owl (*Bubo africanus*) in the Bamenda Highlands NW Cameroon. *African Journal of Ecology* 46: 428–431
- Rihane A, Lahrouz S, El Hamoumi R (2015) Étude du régime alimentaire de la Chouette effraie *Tyto alba* (Strigiforme, Tytonidae) dans la région de Lalla Mimouna dans la plaine du Gharb (plaine du Maroc atlantique). *Afrique Science* 11 (2): 116–126
- Sándor AD, Moldován I (2010) Heading to the city. Diet selection of urban breeding Desert Eagle Owls (*Bubo ascalaphus*) in Hurgada, Egypt. *Journal of Arid Environments* 74: 1146–1148
- Sekour M, Baziz B, Denys C, Doumandji S, Souttou K, Guezoul O (2010) Régime alimentaire de la Chevêche d'Athene *Athene noctua*, de l'Effraie des clochers *Tyto alba*, du Hibou moyen-duc *Asio otus* et du Grand-duc Ascalaphe *Bubo ascalaphus*: Réserve naturelle de Mergueb (Algérie). *Alauda* 78 (2): 103–117
- Sekour M, Beddiaf R, Souttou K, Guezoul O, Denys C, Doumandji S (2011) Variation saisonnière du régime alimentaire de la Chouette chevêche (*Athene noctua*) (Scopoli, 1769) dans l'extrême Sud-Est du Sahara algérien (Djanet, Algérie). *Revue Écologique (Terre Vie)* 66: 2011
- Sekour M, Guerzou A, Benbouzid N, Guezoul O, Ababsa L, Denys C, Doumandji S (2014). Importance de la Mérione de Shaw *Meriones shawii* au sein des composantes trophiques de la Chouette effraie *Tyto alba* en milieux steppiques de l'Algérie. *Comptes Rendus de Biologies* 337: 405–415
- Souttou K, Manaa A, Sekour M, Ababsa L, Guezoul O, Bakria M, Doumandji S, Denys C (2015) Sélection des proies par la chouette effraie *Tyto alba* et le hibou moyen-duc *Asio otus* dans un milieu agricole à El Mâalba (Djelfa, Algérie). *Lebanese Science Journal* 16 (2): 3–17
- Tergou S, Boukhemza M, Marniche F, Milla A, Doumandji S (2014) Dietary distinctive Features of Tawny Owl, *Strix aluco* (Linn 1758) and Barn Owl, *Tyto alba* (Scopoli 1759) in Gardens of Algerian Sahel, El Harrach, Jardin D'essai Du Hamma. *Pakistan Journal of Zoology* 46 (4): 1013–1022
- Thiam M, Bâ K, Duplantier J-M (2008) Impacts of climatic changes on small mammal communities in the Sahel (West Africa) as evidenced by owl pellet analysis. *African Zoology* 43 (2): 135–143
- Zimkus BM, Gvoždík V (2013) Sky Islands of the Cameroon Volcanic Line: a diversification hot spot for puddle frogs (Phrynobatrachidae: *Phrynobatrachus*). *Zoologica Scripta* 42: 591–611

# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Bonn zoological Bulletin - früher Bonner Zoologische Beiträge.](#)

Jahr/Year: 2019

Band/Volume: [68](#)

Autor(en)/Author(s): Ebage Guy Martial Ntougwa, Missoup Alain Didier, Chung Ernest Keming, Tindo Maurice, Denys Christiane

Artikel/Article: [Terrestrial small mammal assemblage from pellets of three sympatric owl species in the Mount Oku area \(Northwest Cameroon\), with implications for conservation 13-19](#)