International Journal of Zoology and Applied Biosciences **ISSN: 2455-9571**
Volume 3, Issue 6, pp: 449-453, 2018
https://doi.org/10.5281/zenodo.2438752
http://www.ijzab.com

Research Article

A NON-INVASIVE APPROACH TO FAUNAL BIODIVERSITY SURVEY OF THE YALA SWAMP AND KAKAMEGA FOREST REGIONS OF KENYA

Meroka Ben Nyakundi* and Onduso Veronicah Nyanchera

Zoology Department, National Museums of Kenya, P.O Box 40658-00100, Nairobi, Kenya

Article History: Received 30th November 2018; Accepted 14th December 2018; Published 19th December 2018

ABSTRACT

Between 30th August and 14th September 2018, we did a survey of the fauna of one of the most important remnants of the guineo-congolian rain forest complex, the Kakamega forest, and the neighboring Yala swamp. The approach used was non-invasive so as to avoid death or possible injury to the study species. A scat and bone analysis was conducted on all samples collected so as to confirm the species representation in each study site. A total of 30 species belonging to 11 orders and 16 families were identified from the analysis of the skeletal remains collected from all the study sites. The order Rodentia was the most dominant species with a relative abundance of 93%. Our results indicate that the forest still harbors an appreciable number of species and these are in need of conservation. The study highlights the power and potential the non-invasive approach has in surveying biodiversity and points to the fact that the approach needs to be accepted and used more often in the place of or as a complement to the more traditional approaches of surveying biodiversity.

Keywords: Fauna, Distribution, Kakamega forest, Non-invasive.

INTRODUCTION

It has been noted that habitat loss especially to urbanization as well as land use change into agricultural use qualifies to be the chief driver of the biodiversity loss being witnessed today (Foley *et al.*, 2005). The problem is huge globally with the loss of terrestrial land estimated at approximately 43% (Barnosky *et al*., 2012). According to ISU (2015) approximately 14-21% of global emissions are attributed to wanton deforestation as well as habitat degradation. The situation in Kenya is worrying as encroachment into forested ecosystems continues and is becoming the norm. The sky rocketing continued dependence on forest resources, inequitable share and acquisition of forest resources by the political class, as well as spiralling population growth continue to clearly stand out as the key factors contributing to forest resource problems in Kenya (Wass, 2000).

Ongugo *et al*., (2008) estimate that approximately 12% of Kenyan population lives in the vicinity of forests and directly depend on these resources for their livelihood. As this population grows there will be a resultant increased pressure to clear land for agricultural purposes as well as other uses. Increase of anthropogenic pressures in Kenya and beyond is a cause for alarm given their negative knock-on effect on wildlife (Donald, 2004). These pressures are experienced most severely in pristine habitats which harbour unique and high diversity of fauna. Many of these places continue to be altered and will soon or later be affected by the intensification of climate change effects which will most likely be evidenced by species extirpation or extinction, especially those sensitive to habitat alteration and destruction. An understanding of species richness patterns in these regions is therefore very crucial since these areas act as centre's of endemism and species diversity in the tropics (Smith *et al*., 2007). Traditional methods of capturing and handling animals for study; examination and measurement have been noted to potentially cause harm, injury and alteration of the organism's normal behavior (Cattet *et al*., 2008; Proulx *et al*., 2012). In a bid to reduce these impacts on study species, techniques that are non-invasive in nature have been developed (Gompper *et al*., 2006; Proulx & San, 2016). The main goal of this research was to use non-invasive methods to assess the faunal biodiversity of Yala swamp and the Kakamega forest ecosystem.

*Corresponding Author: Meroka Ben Nyakundi, Zoology Department, National Museums of Kenya,
P.O Box 40658-00100, Nairobi, Kenya. Email: bnmeroka@gmail.com, Phone: +254721381687

The aim of this study was to document trends in distribution as well as diversity of fauna in Kakamega forest and Yala swamp using animal remains. The approach used in this survey included looking for bones (carcasses) and scats (faecal pellets) in the study sites.

MATERIALS AND METHODS

Study area

The study was conducted in Kakamega forest and Yala swamp which are found in Kakamega County. The County is approximately 352 kilometres from Kenya's capital, Nairobi. The forest lies in the Lake Victoria catchment, about 40 km north of Kisumu, and just east of the Nandi Escarpment that forms the edge of the central highlands.

Yala Swamp

Yala Swamp is a Ramsar *site*, a wetland of international importance and is Kenya's largest papyrus swamp and freshwater wetland habitat (Otieno, 2004). Yala wetland in Kenya, is located on the north-eastern shoreline of Lake Victoria in Siaya, Bondo and Busia districts in Kenya (between 00° 02'S and 34° 1E, 34° 7S) and at an altitude of 1150m above sea level. It covers an area of 17,500 ha and is comprised of three freshwater satellite lakes (Kanyaboli, Sare and Namboyo).The swamp is a filter for water flowing into Lake Victoria. Lake Kanyaboli covers (10.5 Km²) the largest and most ecologically important of the Yala swamp lakes. The swamp vegetation is mainly dominated by papyrus (*Cyperus papyrus*) and Phragmites reeds (Bennun & Njoroge, 1999). Lake Kanyaboli and the surrounding Yala swamp wetland in the western region have been recognized as important biodiversity hotspots.

Kakamega Forest

The Kakamega Forest in Western Kenya forms the easternmost relic of the Guinean-Congolian rainforest belt, which once spanned from East to West Africa. The forest comprises four blocks of rainforest in western Kenya with 12,562 ha of natural forest cover. The northern part of the forest is Kakamega Forest National Reserve (0°10′–0°21′N; 34°47′–34°58′E) with an altitude ranging from (1500–1700m a.s.l.) the northern part comprises of two forest blocks (Buyangu and Kisere) that cover a total area of 4377.3ha.Our sampling occurred in Buyangu main block that is protected as a national wildlife reserve which covers an area of (2,400 km^2). The average rainfall is about 2147mm; heavy rainfall occurs in two rainy seasons: March–May and July–October. January, February and June are dry season months (Tsingalia, 1988). The altitudinal range was between 1140m a.s.l. in Kakamega (lowest) and 2353m a.s.l. in Yala swamp (highest).

Stratified random sampling approach was adopted in all forest blocks to ensure inclusivity. Ad hoc surveys were conducted in all the forest blocks within the study sites by walking transects along roads, as well as paths and searching for animal signs in open plains, dens and hideouts such as caves where the animals are suspected to hide their prey. Local people were also interviewed so as to ascertain the location of birds of prey' roost sites as well as carnivore den/kill sites. The locals were very instrumental in providing information where carcasses of dead carnivals could be found as well as bone assemblages. GPS coordinates were taken wherever a sample (bone, scat, pellets, etc.) was encountered or collected. In the laboratory the single scats were placed in warm water for a full day and then washed using a continuous slow swirling action using forceps till the scat was all loose and disintegrated. The water was then drained and the scats dried in the air till all moisture was lost. The content of the scat was then separated into teeth, bone, bone fragments or hairs, which were then identified using literature (de Graaff, 1981) and comparative reference material available at the National Museums of Kenya collections.

Statistical Analyses

We estimated species richness as the number of species identified from skeletal remains collected from each studysite. Data was checked for normality and homogeneity (Zuur *et al*., 2010) and wherever necessary, log transformed to achieve normality (Axelsson *et al*., 2011). We collected data on number of skeletal remains collected in each study site and abundance of each species identified. Relative abundance of species was calculated as the number of individuals collected for a particular species divided by the total number of individuals of all species encountered. Analyses were performed using Paleontological Statistics PAST (version 3.1). Species diversity was determined using the Shannon-Weiner index given by the formula $H' = -\sum (Pi * \ln Pi)$ where H' is the diversity index; Pi is the proportion of representation by species i and ln is the natural logarithm.

RESULTS AND DISCUSSION

A total of 30 species (belonging to 11 orders and 16 families) were identified from the skeletal remains as well as scats/pellets collected from the two study sites (Table 1). Despite there being equal sampling effort, the number of species representation and bones varied from site to site. Yala swamp had 23 species in total whereas Kakamega forest had 13 (Table 2). Despite Kakamega forest having fewer species than Yala swamp, it was noted that the species present there had relatively higher abundances. This may be attributed to the greater availability of food items given that the forest is quite expansive and experiences a good distribution of rain almost all year round. Rodents were particularly noted to be of high abundance. Twelve out of all species belonged to the order Rodentia making up 93% of all the species encountered. Three bird species' skeletal material were also encountered, *viz*, the helmeted guinea fowl (*Numida meleagris*), singing bush lark (*Mirafra cantillans*) and the superb starling (*Lamprotornis superbus*). The diversity index of the study site was 1.929, whereas an evenness index of 0.2295 and a Simpson's dominance index of 0.8009 were realized. This means the

diversity is rather low given the fact that a few species (four out of thirty) tend to have all the high abundances, resulting also in the high dominance figure realized (0.8009). This may be attributed to the dominant species merely being generalist feeders and therefore having a wide array of food items to choose from, thus reducing intra and interspecific competition. Alternatively, the low abundance species could have been 'visitors' in the forest or swamp having come from other habitats.

Skeletal remains of sixteen species were encountered in both sites and these are *Praomys misonnei,Lemniscomys striatus,, Crocidura spp, Rattus rattus, Acomys percivalli, Mastomys natalensis, Bufo bufo, Buphagous africanus, Mirafra cantillans, Tragelaphus scriptus, Potamocherus lavartus, Hystrix cristata, Phacocherus africanus, Canis familiaris, Bos taurus* and *Lamprotornis superbus* (Table 2).

Table 1. Species composition and relative abundance (%) of faunal remains collected in the study area.

Order	Family	Species	Abundance	Rel. Abundance (%)
Rodentia	Muridae	*Praomys misonnei*	133	21.91
		Lemniscomys striatus	111	18.3
		Rhabdomys dilectus	175	28.83
		Rattus rattus	9	1.5
		Otomys angoniensis	5	0.82
		Lophuromys ansorgei	110	18
		Mus triton	2	0.33
		Acomys percivali	7	1.15
		Mastomys natalensis	7	1.15
		Oenomys hypoxanthus	2	0.33
	Hystricidae	*Hystrix cristata*	2	0.33
	Nesomyidae	*Cricetomys ansorgei*	2	0.33
Soricomorpha	Soricidae	*Crocidura spp*	19	3.13
Artiodactyla	Bovidae	*Tragelaphus spekei*	1	0.16
		Tragelaphus scriptus	1	0.16
		Potamochoerus lavartus	1	0.16
		Phacochoerus africanus	1	0.16
		Bos taurus	2	0.33
	Hippopotamidae	*Hippopotamus amphibious*	1	0.16
Eulipotyphla	Erinaceidae	*Erinaceus spp*	1	0.16
Lagomorpha	Leporidae	*Lepus capensis*	2	0.33
Ciconiformes	Ciconiidae	*Leptoptilos crumenifer*	1	0.16
Squamata	Pythonidae	*Python sebae*	1	0.16
Galliformes	Numididae	*Numida meleagris*	1	0.16
Carnivora	Canidae	*Canis familiaris*	1	0.16
		Canis mesomelas	1	0.16
Anura	Bufonidae	*Bufo bufo*	2	0.33
Passeriformes	Bufagidae	*Buphagus africanus*	2	0.33
	Sturnidae	*Lamprotornis superbus*	2	0.33
	Alaudidae	*Mirafra cantillans*	2	0.33
Shannon_H			1.929	
Evenness_e^H/S			0.2295	
Simpson_1-D			0.8009	

Table 2. Species distribution in the Yala swamp and Kakamega forest of Kenya.

No.	Species	Yala swamp	Kakamega forest
1	*Praomys misonnei*	√	√
2	*Lemniscomys striatus*	√	√
3	*Rhabdomys dilectus*		√
4	*Rattus rattus*	√	√
5	*Otomys angoniensis*		√
6	*Lophuromys ansorgei*		√
7	*Mus triton*		√
8	*Acomys percivali*	√	√
9	*Mastomys natalensis*	√	√
10	*Oenomys hypoxanthus*	√	
11	*Hystrix cristata*	√	
12	*Cricetomys ansorgei*		√
13	*Crocidura spp*	√	√
14	*Tragelaphus spekei*	√	
15	*Tragelaphus scriptus*	√	
16	*Potamochoerus lavartus*	√	
17	*Phacochoerus africanus*	√	
18	*Bos taurus*	√	
19	*Hippopotamus amphibious*	√	
20	*Erinaceus spp*		√
21	*Lepus capensis*		√
22	*Leptoptilos crumenifer*	√	
23	*Python sebae*	√	
24	*Numida meleagris*	√	
25	*Canis familiaris*	√	
26	*Canis mesomelas*	√	
27	*Bufo bufo*	√	√
28	*Buphagus africanus*	√	√
29	*Lamprotornis superbus*	√	√
30	*Mirafra cantillans*	√	√

Both study sites had a number of bones collected belonging to the domestic cow (*Bos taurus*) and dog (*Canis familiaris*).This suggests that habitat disturbance has had its toll on the forests in these sites. It alludes to the fact that there is encroachment by humans, or that human beings are living very close to the forest and swamp.

CONCLUSION

Findings of this survey give sufficient evidence that the non-invasive approach to biodiversity studies is an approach that bears great potential that complements the traditional approaches yet it remains underutilized. Investment into these approaches needs to be stepped up so that the approach can be used to a greater extent. Hair analysis is one area that calls for further research and development, since it has a great untapped potential. Yala swamp as well as the Kakamega forest still bears great potential to harbor different species of fauna. Its natural and minimally altered forests are exceptionally important in securing the threatened, vulnerable and any of the regions' endemics. The locals in these regions must of necessity therefore work with the Kenya Forest Service to ensure continued protection, sustainable utilisation as well as regeneration of this precious resource. Use of camera traps as well as hair analysis should be considered for future surveys as this will go a long way in complementing the methods used in this survey.

ACKNOWLEDGMENT

This study was supported financially by the Kunming Institute of Zoology (KIZ) through the Sino-African Joint Research Center, CAS grants (SAJC201612). We also acknowledge the immense guidance as well as the hospitality of Kenya Forest Service and Kenya Wildlife Service officers as well as the dedicated community scouts and guides. Their work was very critical and well

appreciated. We also salute all our museum research fieldwork team members and staff at the osteology section who aided in sample identification.

REFERENCES

Axelsson, E.P., Hjältén, J., LeRoy, C.J., Whitham, T.G., Julkunen-Tiitto, R., & Wennström, A. (2011). Leaf litter from insect-resistant transgenic trees causes changes in aquatic insect community composition. *Journal of Applied Ecology, 48*(6), 1472-1479.

Barnosky, A.D., Hadly, E.A., Bascompte, J., Berlow, E. L., Brown, J.H., Fortelius, M., Marquet, P.A. (2012). Approaching a state shift in Earth's biosphere. *Nature, 486*(7401), 52.

Bennun, L.A., & Njoroge, P. (1999). Important bird areas in Kenya: Nature Kenya, East Africa Natural History Society.1-332.

Cattet, M., Boulanger, J., Stenhouse, G., Powell, R. A., & Reynolds Hogland, M.J. (2008). An evaluation of long-term capture effects in ursids: implications for wildlife welfare and research. *Journal of Mammalogy, 89*(4), 973-990.

de Graaff, G. (1981). The Rodents of Southern Africa: Notes on their Identification, Distribution. *Ecology and Taxonomy. Butterworths, Pretoria*, 202-207.

Donald, P.F. (2004). Biodiversity impacts of some agricultural commodity production systems. *Conservation Biology, 18*(1), 17-38.

Foley, J.A., DeFries, R., Asner, G.P., Barford, C., Bonan, G., Carpenter, S.R., Gibbs, H. K. (2005). Global consequences of land use. *Science, 309*(5734), 570-574.

Gompper, M.E., Kays, R.W., Ray, J.C., Lapoint, S.D., Bogan, D.A., & Cryan, J.R. (2006). A comparison of noninvasive techniques to survey carnivore communities in northeastern North America. *Wildlife Society Bulletin, 34*(4), 1142-1151.

Ongugo, P.O., Obonyo, E., Mogoi, J., & Oeba, V. (2008). The effect of internal Human conflicts on Forest Conservation and sustainable development in Kenya.1-29.

Otieno, M. (2004). Mapping Landscape Characteristics of Yala Swamp, Kenya. MSc. Thesis, Moi University.

Proulx, G., Cattet, M.R., & Powell, R.A. (2012). Humane and efficient capture and handling methods for carnivores. Carnivore ecology and conservation: a handbook of techniques. Oxford University Press, London, 70-129.

Proulx, G., & San, E.D.L. (2016). Non-Invasive Methods to Study American and European Badgers A Review. Badgers: systematics, ecology, behaviour and conservation. *Alpha Wildlife Publications, Alberta, Canada*, 311-338.

Smith, S.A., De Oca, A.N.M., Reeder, T.W., & Wiens, J.J. (2007). A phylogenetic perspective on elevational species richness patterns in Middle American treefrogs: why so few species in lowland tropical rainforests? *Evolution: International Journal of Organic Evolution, 61*(5), 1188-1207.

Tsingalia, H. (1988). *Animals and the regeneration of a canopy tree in an African tropical forest.* Ph. D. Thesis. University of California, Berkeley.

Wass, P. (2000). Kenya's forest resource assessment.1-80.

Zuur, A.F., Ieno, E.N., & Elphick, C.S. (2010). A protocol for data exploration to avoid common statistical problems. *Methods in Ecology and Evolution, 1*(1), 3-14.