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ASSESSMENT OF MINERALS COMPOSITION OF NATURAL SALT LICKS, IN KAINJI LAKE NATIONAL PARK, NIGERIA

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ABSTRACT

The study was carried out to determine the quantities of essential elements composition of natural salt lick, at the three (3) different horizons in Oli range, Borgu sector of Kainji lake national park. Field survey and focus group discussion were used through the help of experienced park rangers to locate the commonly utilized saltlick spots. Nine (9) samples of soil were collected from three (3) different spots, two (2) saltlick spots and one (1) control spot each from three horizons (O, A, & E).Mineral element were determined for soil pH., potassium, sodium, calcium, magnesium, organic carbon, organic matter nitrogen were used respectively. Analysis of variance (ANOVA) and Duncan Multiple Range test was used to compare the means. Results indicated that calcium content of the saltlick at second horizon (A layer) was (15.13± 0.81^{b}) differs significantly ($p<0.05$) from calcium content of the saltlick at first and third horizon (O layer) (4.03±0.81^{a}) and E layers (1.53 ± 0.81^{a}) respectively. Magnesium content followed the same trend. Layer (A) was where high concentration of salt-licking was observed in all the spots sampled. The study also revealed that natural licks had higher level of essential elements than the control samples.

Keywords: Salt lick, Mineral elements, Horizon and Soil Profile

INTRODUCTION

Nigeria is blessed with remarkable wildlife resources both in diversity and abundance. Today the present Nigeria's network of protected area include a biosphere reserve,445 forest reserves, 7 National parks, 12 Strict nature reserves including 1 international Games reserve-former Yankari National park (Amusa, 2008). One of nutritional requirements needed for sustainability of these fauna species is the saltlick (natural mineral lick).Mineral elements occur in the living tissues or soil in either large or small quantities. Those that occur in large quantities are called macro/major elements are required in large amount and the micros are require in small amount (Lameed and Adetola, 2012). According to (Parker and Ayotte 2004) Geophagy or soil ingestion by animals has numerous benefits which include: mineral supplementation, detoxification of plant secondary metabolites and alleviation of digestive disorders. The causes of this behaviour vary with the soil type of the area, seasons and among group of animals' species (Blake, *et al.*, 2010). It is common in both wild and domestic species, and animals have been reported to travel long distances away from their natural habitats to consume the naturally occurring minerals in the natural lick sites (Poole, *et al.*, 2009). The combined long time activities of grazing, burning, and tree felling have significantly altered much of the natural vegetation (Ojo and Mbaya, 2010).These activities leads to habitat degradation which affect the quality of vegetation which form the plant resources animals depends on the range. This make them seek for supplementary source of minerals from the saltlick which are lacking in the natural plant resources.(Dudley, *et*

al., 2012) emphasized that natural licks are an important source of sodium since this mineral is not naturally accumulated in terrestrial plants to meet the animals demand especially in areas far from the ocean.(Mahaney and Krishnamani, 2003) discovered that animals use the taste of sodium chloride to detect the sites with greater quantities of minerals because of their inherent ability to explore chemicals in the environment by use of the tongue.

Natural licks are also important sources of other essential minerals such as magnesium, calcium and iodine (Elyau, *et al.,* 2012). Sodium plays a critical role of maintaining acid-base balance in the body and its deficiency in the diet leads to low osmotic pressure and consequently dehydration of the animal (McDonald, *et al.,* 1995). Magnesium is a major enzyme activator and an essential element for metabolism of carbohydrates and lipids in the body (McEliott, 2009).Calcium is important in nerve transmission and muscle contraction in animals and a deficiency of this minerals in the animals diet leads to low levels in blood serum which results in milk fever in female herbivores (Bezerra, *et al.*, 2014).

According to (Ajayi and Ogunjobi, 2015) the following species of wildlife were observed using licks in Oli range of Kainji Lake National Park, Nigeria: Western Hartebeest *Alcelaphus buselaphus*, Kob *Kobus kob*, and Bush buck *Tragelaphus scriptus*. Despite many studies conducted on the food and feeding ecology of most wild animals, little research efforts have been put in place to explore the mineral content of the natural licks from the different soil horizons in the study area. This study determine the essential mineral elements composition of the saltlick samples and there level of concentration in each horizons in the study area.

MATERIALS AND METHODS

Study Area

The study area was Kainji Lake National Park, one of the seven (7) National Parks in Nigeria. It is the premier National Park in the country. Kainji Lake National Park extends 80km in an East-west direction and about 60km North-south. This Park has two distinct sectors known as Borgu and Zugurma sectors. It lies between 90^0 4^1 to 10^0 30^1 N and 3^0 30^1 to 5^0 50^1 E, covering a total area of 5,340.82km (Ayeni, 2007). The study was conducted in Borgu sector of (KLNP). The Borgu sectors cover an area of 3,970.02km Southeast in Borgu Local Government Area of Niger State. The location of Borgu sector is between 10^0 50^1 N latitude and 4^0 19^1 E longitude (Amusa *et al.*, 2010).

Experimental Design

This study was conducted in three phases. In phase one focus group discussion with the Park Rangers stationed at Oli range, Borgu sector of Kainji Lake National Park was conducted. The aim was to obtain information on the location of salt lick sites commonly utilized by wild animals inside the Borgu sector of the park. In the second phase nine (9) samples of salt lick were collected at three different spots two saltlick spots and one control spot. The control spot was an area where the soil was not utilized by the animals. Samples were collected at each spot from three different horizons. Samples were collected using soil auger and trowel from three different horizons (O, A & E) from salt licks and store into polyethylene bags. The samples were labelled accordingly. It was homogenized and air dried, sieved via 2mm mesh and another portion through 0.5mm mesh according to (Kennedy *et al.*, 1995; Akinyemi, 2007) to remove stony or rocky fragment, surface plant litter and coarse root materials. The collected samples were taken to the laboratory in a cool box and kept under refrigeration to reduce chemical reaction in preparation for chemical analysis and maintain the temperature. Then, coning and quartering technique was used to come up with analyte samples (Matsi *et al,*. 2004). Third phase was the laboratory analysis conducted at Federal University of Technology, Akure (FUTA) central laboratory to test for element composition of samples which include pH, Potassium, sodium, calcium, magnesium using method describe by (Henderson *et.al*., 1993) phosphorus using method describe by (Agbenin, 1995), organic carbon and organic matters were tested using method describe by (Walkey and Black, 1934) and nitrogen were determined using the method describe by (AOAC, 1990).

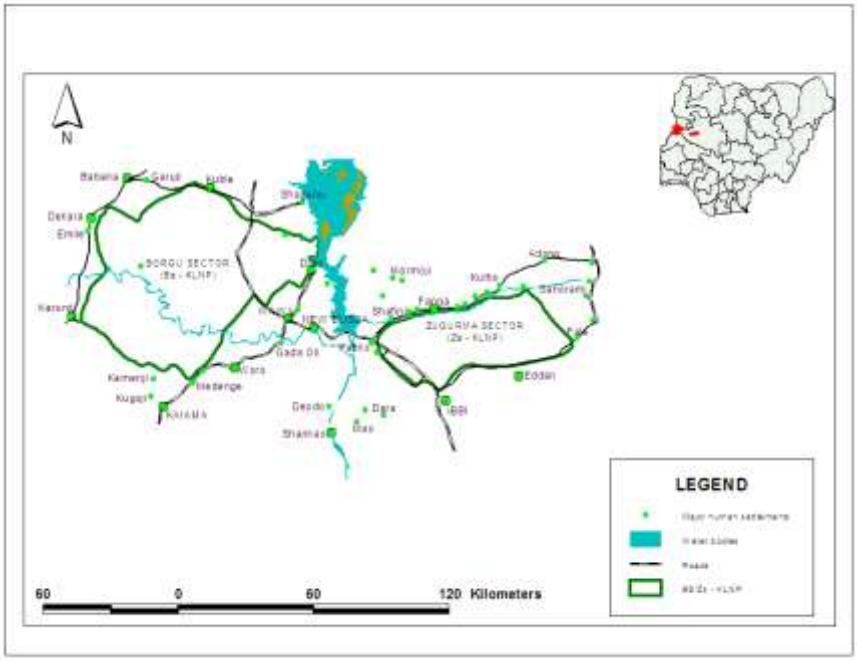

Figure 1 Map of Kainji Lake National Park

RESULTS

Table 1 revealed that the concentration of pH, potassium and Calcium were higher in the (E) Layer, Sodium and Magnesium were higher in (A) Layer and Organic carbon and matters, Nitrogen, Phosphorus were higher in (O) Layer. The sodium and calcium were both located in high concentration in the (A) Layer which is the spot mostly utilized by the herbivores on the saltlick spot.

Table 1: Element compositions of saltlick samples of Spot A in Oli range, Borgu sector of Kainji Lake National Park.

Samples	pH	OC	OM	N	P	K	Na	Ca	Mg
Surface horizon (O layer),	6.92	0.56	0.96	0.07	14.47	0.22	2.24	2.00	0.6
Second horizon (A layer),	6.32	0.33	0.56	0.06	6.69	0.18	2.30	4.90	2.00
Third horizon (E layer)	8.55	0.38	0.66	0.06	10.11	0.26	0.46	3.20	2.00

***Key: OC**= Organic carbon (mg/L)**; OM**=Organic matters (mg/kg); **N**=Nitrogen (mg); **P**=Phosphorus (mg/dL)*
***K**=Potassium (mmol/L); Na=Sodium (mmol/L); **Ca**=Calcium (mmol/L); **Mg**=Magnesium (mmol/L)*

Table 2 revealed that the concentration of Phosphorus, Sodium were higher in Layer (E), pH, potassium, Calcium and Magnesium were higher in the (A) Layer, Organic carbon and matters, Nitrogen, were higher in (O) Layer. Majority of essential elements where located in high concentration in (A) Layer of the saltlick spot.

Table 2: Element Compositions of Saltlick Samples of Spot B in Oli range, Borgu sector of Kainji Lake National Park.

Samples	pH	OC	OM	N	P	K	Na	Ca	Mg
Surface horizon (O layer),	7.68	1.09	1.88	0.12	5.06	0.30	0.59	13.50	4.00
Second horizon (A layer),	7.82	0.61	1.06	0.08	10.50	0.35	1.87	16.00	6.80
Third horizon (E layer)	7.18	0.65	1.12	0.08	11.04	0.28	1.91	15.90	5.00

KEY: OC= Organic carbon (mg/L); **OM**=Organic matters (mg/kg); **N**=Nitrogen (mg); **P**=Phosphorus (mg/dL); **K**=Potassium (mmol/L); **Na**=Sodium (mmol/L); **Ca**=Calcium (mmol/L); **Mg**=Magnesium (mmol/L).

Table 3 revealed that the concentration of pH, was high in the (E) Layer, Sodium was high in (A) Layer and Organic carbon and matters, Nitrogen, Phosphorus, Potassium, Calcium and Magnesium were higher in (O) Layer. Majority of essential elements where concentrated in the (O) Layer in the control spot sample. There was no significant difference in all the three layers of the soil.

Table 3: Element Compositions of Soil on the Control Spot in Borgu sector of Kainji Lake National Park.

Samples	pH	OC	OM	N	P	K	Na	Ca	Mg
Surface horizon (O layer),	6.32	0.74	1.29	0.09	11.74	0.31	0.17	2.50	1.00
Second horizon (A layer),	6.94	0.54	0.92	0.06	6.69	0.14	0.35	1.00	0.40
Third horizon (E layer)	7.32	0.23	0.40	0.05	5.21	0.05	0.15	1.10	0.60

Key: *OC= Organic carbon (mg/L); OM=Organic matters (mg/kg); N=Nitrogen (mg); P=Phosphorus (mg/dL), K=Potassium (mmol/L); S=Sodium (mmol/L); Ca=Calcium (mmol/L); Mg=Magnesium (mmol/L)*

Table 4 revealed that there was a significant difference between the spots (A) and (B) with control spot in the elements concentration of Sodium and Calcium. Natural licks had higher levels of essential elements than control sample.

Table 5 revealed that there is a significant difference in the concentration of Calcium and Magnesium at Layer (2). Natural licks had higher levels of essential elements than control sample.

Table 4: Element Compositions of Saltlick and Control Spots in Oli Range.

Elements	Spot A	Spot B	Control spot	Sign. Level (0.05)
pH	6.97 ± 0.42^{a}	7.03 ± 0.42^{a}	7.68 ± 0.42^{a}	0.29^{ns}
Organic carbon	0.80 ± 0.12^{a}	0.49 ± 0.12^{a}	0.42 ± 0.12^{a}	0.08^{ns}
Organic matter	1.40 ± 0.22^{a}	0.85 ± 0.22^{a}	0.73 ± 0.22^{a}	0.08^{ns}
Nitrogen	0.09 ± 0.01^{a}	0.70 ± 0.01^{a}	0.06 ± 0.01^{a}	0.01^{ns}
Phosphorus	10.42 ± 2.06^{a}	7.96 ± 2.06^{a}	8.80 ± 2.06^{a}	0.44^{ns}
Potassium	0.30 ± 0.06^{a}	0.22 ± 0.06^{a}	0.20 ± 0.06^{a}	0.40^{ns}
Sodium	1.00 ± 0.62^{a}	0.93 ± 0.62^{a}	0.84 ± 0.62^{a}	0.90^{ns}
Calcium	6.00 ± 4.23^{a}	7.30 ± 4.23^{a}	7.40 ± 4.23^{a}	0.83^{ns}
Magnesium	1.90 ± 1.50^{a}	3.07 ± 1.05^{a}	2.53 ± 1.47^{a}	0.60^{ns}

Value (Mean +Standard error) with the same superscript signifies no significant difference (P > 0.05)

Table 5: Element Compositions of Saltlick spots in Oli Range at Different Soil Horizons.

Elements	Layer 1	Layer 2	Layer 3	Sign. Level (0.05)
pH	7.26 ± 0.44^{a}	7.56 ± 0.44^{a}	6.86 ± 0.44^{a}	0.31^{ns}
Organic Carbon	0.42 ± 0.13^{a}	0.78 ± 0.13^{a}	0.50 ± 0.13^{a}	0.11^{ns}
Organic Matter	1.35 ± 0.22^{a}	0.73 ± 0.22^{a}	0.87 ± 0.22^{a}	0.11^{ns}
Nitrogen	0.06 ± 0.11^{a}	0.93 ± 0.11^{a}	0.67 ± 0.11^{a}	0.10^{ns}
Phosphorus	10.42 ± 2.05^{a}	8.87 ± 2.05^{a}	7.88 ± 2.05^{a}	0.43^{ns}
Potassium	0.22 ± 0.05^{a}	0.31 ± 0.05^{a}	0.17 ± 0.05^{a}	0.85^{ns}
Sodium	1.67 ± 0.45^{a}	0.95 ± 0.45^{a}	0.15 ± 0.45^{a}	0.06^{ns}
Calcium	4.03 ± 0.81^{a}	15.13 ± 0.81^{b}	1.53 ± 0.81^{a}	0.00^{*}
Magnesium	1.53 ± 0.55^{a}	5.27 ± 0.55^{b}	0.67 ± 0.55^{a}	0.00^{*}

NOTE: Layer 1 is the same as (O) horizon, Layer 2 is the same as (A) horizon and Layer 3 is the same as (E) horizon

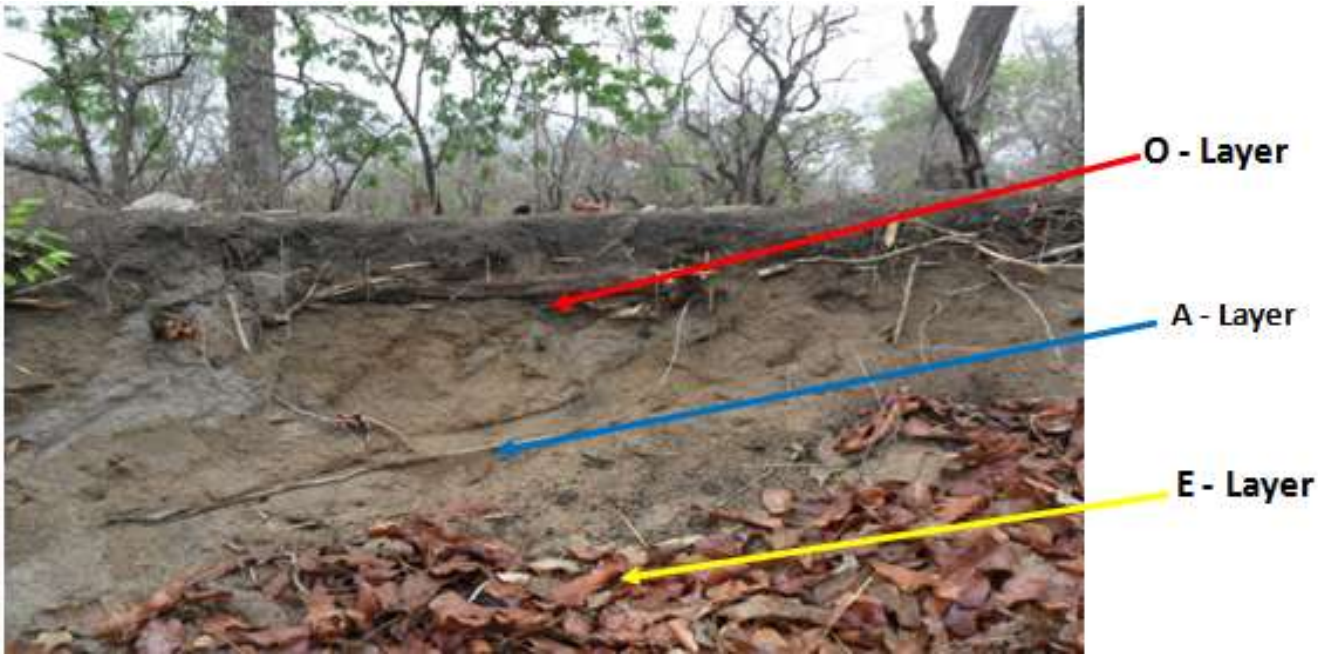

Plate 1: The Control Spot indicating the three (3) different Soil Profiles (O, A & E) in Kainji Lake National Park

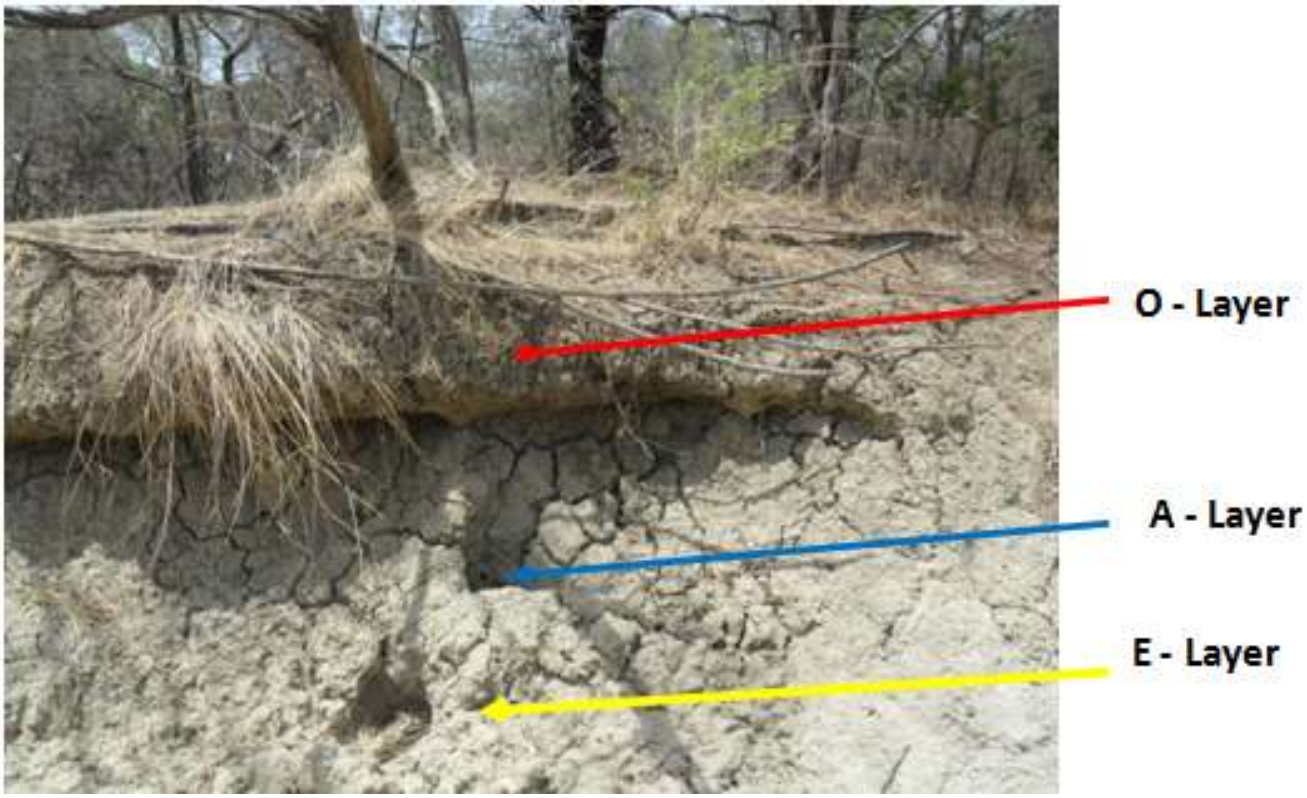

Plate 2: A Salt Lick Spot Showing the Soil Profiles (O, A and E) in Kainji Lake National Park

DISCUSSION

Mineral Element Composition in Kainji Lake National Park

Mineral elements play an important role in the nutrition of wild games. (Bowen, 1999) reported that an essential mineral element is necessary to proof that diet lacking in any wild animals can cause deficiency symptom in animals. From this study on saltlick, samples collected from three different horizons in Oli range (spot 1 and 2) and control spot (3). Element composition of major elements such as calcium, phosphorus, potassium, sodium, nitrogen and magnesium of the soil were analyzed. Three different soil profiles were observed. The study revealed that the concentration of major elements were more in the second horizon (A layer) which is the main layer observed that the wild herbivores lick in the study area, with significant difference in calcium and magnesium ($p<0.05$). This study corroborates the findings of (Ayeni, 1979, Justin and Michael, 2007; Lameed and Adetola, 2012). The study also revealed that natural licks had higher concentration levels of essential elements than control sample and there was no lick that contained high levels of all the minerals than in other licks. This is in agreement with the findings of (Onesmus, *et al.*, 2015). Chemical analysis showed that there were considerable variations in the levels of minerals and minimal variations in the pH (6.32-8.55). The pH was generally higher and it is consistent with the work of (Njoka *et al.*, 2015; Onesmus *et al.*, 2015). The higher pH value in almost all the saltlick spots explain why some of the basic elements like calcium which is also not mobile in alkaline soil to be generally high (Kelling and Schulte, 2004). Furthermore, the high pH could be the reason why poor or absence of plant growth on those particular sites or spots (Onesmus, *et al.*, 2015).Each of the three (3) soil horizons have vary quality and quantity of these essential mineral and animal can obtain all the essential minerals by mixing soil lick from the different horizons and was in agreement with the study of (Onesmus *et al.*, 2015. This revealed that natural licks had higher levels of essential elements than control samples this findings is also in agreement with the findings of (Onesmus *et al.*, 2015).

CONCLUSION

The study revealed that concentration of essential elements such as Sodium, Calcium and Magnesium which may be lacking in the plant materials utilized by the herbivores were higher in the (A) Layer spots of the saltlick which was the spots observed to be more utilized by the wild herbivores as mineral supplements in the park.

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