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Highlights

Potential of Acacia Gummifera

Assessment of Human Settlement

Discovering Thoughts, Inventing Future

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Nitrogen Fixing Potential of Acacia Gummifera at Different Ages Inoculated with Rhizobium Isolates

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Keywords: *acacia gummifera, nitrogen fixing, rhizobium.*

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Fatima Zahra Lahdachi [α], Laila Nassiri [σ] & Jamal Ibijbijen [ρ]

Abstract- ***Acacia gummifera*** is an important tree from the south-west of Morocco. It has been reported to increase the soil fertility as the other Acacia. The characterization of successful strains and the study of the potential for fixing atmospheric nitrogen was a necessary in order to succeed its establishment in the environment where it will be introduced. Growth in YMA, tolerance to stress factor (pH, salt and temperature) and resistance to metallic ions were used as phenotypic markers of isolates collected from root nodule of *A. gummifera*. Genotypic diversity was studied by amplification of polymorphic DNA and 16s RNA gene sequencing. The symbiosis effectiveness of 6 performed Rhizobium was evaluated using plant nodulation assay at two different ages in controlled condition.

The results of phenotypic characterization showed that the most of isolate are fast growing. All isolate tolerated high temperature (40°C),and a NaCl concentration that exceeds 800 mM and most of them increased under pH ranging from 7 to 10.

All six strains showed root nodules with variable number which varied between 2 and 25 nodules per plant and dry weight between 1.5 and 15mg.plant^{-1}. In addition, the statistical analysis showed that *Rhizobium* was more infective in 12-month-old Acacia. The symbiotic efficiency has shown considerable variability, the most effective symbiotic association was recorded in the strain A24 (*Rhizobium azibense* : MF769718) with 200% and an increase in the total nitrogen twice as much as control seedlings fertilized with nitrogen (KNO_3).

Keywords: *acacia gummifera, nitrogen fixing, rhizobium.*

I. Introduction

Nitrogen nutrition of legume plants is provided by two complementary ways: uptake of mineral nitrogen from the soil by the roots, as in all higher plants, and fixation of atmospheric nitrogen. Which is a process to these species, thanks to their symbiosis with soil bacteria. In most agricultural systems, the primary source of biologically fixed nitrogen occurs from the symbiotic interactions of legumes and soil bacteria of the genera *Rhizobium*, *Bradyrhizobium*, *Sinorhizobium*, *Allorhizobium*, *Mesorhizobium*, and *Azorhizobium* (Alberton et al., 2006).

The use of this symbiotic interactions in agricultural and agro forestry ecosystems makes it possible to limit the use of nitrogen fertilizer to a lesser extent (Ganry & Dommergues, 1995). In soils that are deficient or low nitrogen, nitrogen-fixing woody species such as Acacia, are expected to play an important role thanks to their adaptation to hostile environmental conditions and for their positive effect on soil fertility and ecosystem productivity (Fikri Benbrahim et al., 2014). The fixing power of these trees is related to their association with nitrogen fixing bacteria of the genera Rhizobium. In fact, the efficiency of a strain is closely related to the host plant and its environment. It is for this reason that research has focused on the characterization of successful indigenous strains and a potential for fixing atmospheric nitrogen. The nitrogen-fixing potential translates a plant's ability to fix nitrogen by integrating the effect of climatic, edaphic and biological factors (Bowen et al, 1990; Trotman & Weaver, 1995). In this work, we study the comportment (growth and nitrogen nutrition) of seedlings of *Acacia gummifera*at 6 and 12 months, in association with six strains of Rhizobium. This Moroccan gum is considered as the only endemic species of Acacia in Morocco, which has interest in reforestation and thus provides a plentiful gum used in traditional medicine. This study will be preceded by tolerance tests of isolates with edaphic factors: salinity, pH and temperature.

II. Material and Method

a) Bacterial strains

All strains were isolated from *Acacia gummifera*'s nodule. Which were obtained after trapping in rhizospheric soil from Skhour Rhamna region. The (solation and purification of the isolates were performed after several rounds of subculture on YMA medium Vincent 1970).

b) Effect of extrinsic factor

Different temperatures (4°C, 28°C, 37°C, 40°C at 50°C), pHs (3, 4, 5, 6, 7, 8, 9, 10 and 11) and salt (0, 172, 344, 517, 689, 862, 1190, 1200, 1360, 1500 mM)was studied in YMA medium.

c) Effect of heavy metals

This test was conducted to assess resistance of the isolates to the following heavy metals: $AlCl_3$ $6H_2O$, $ZnCl_2$, $CoCl_2$, $CdCl_2$, $HgCl_2$. The solution of different metals was filtered (milipore 0,22μm), sterilized and

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added to YMA agar medium in order to obtain the concentration in µg/mL. The results of each test were evaluated after one week of incubation.

d) Genotypic characterization

The genotypic characterization was based on 16sr RNA gene which was carried out within the laboratory of molecular biology and functional genomics of the National Center of Research Science and Technical Division UATRS Rabat-Morocco. PCR amplification of the isolated was performed by real time PCR using the universal primers Fd1 and RP2 (AGAGTTTGATCCTGGCTCAG,and,ACGGCTACCTTGTT ACGACTT, respectively) (Weisburg et al., 1991). The PCR reactions are carried out in a total volume of 25 µL containing the reaction buffer at 1/10 of the final volume, 0.125 µL of each primer (100 µM), 0.2 µL of the Taq polymerase (5 µL / L) and 5 µL of the DNA sample. In the negative control, the 5 µL of DNA is replaced by 5 µL of sterile H_2O. The amplifications were performed according to the following conditions: a first denaturation at95 ° C for 1 min and then cycle in each a denaturation at 95 ° C for 15 seconds, hybridization at 52 ° C for 20 seconds and a 72 ° elongation C for 15 seconds finally a final elongation at 72 ° C for 3min.

e) Sequencing

The amplicons were sequenced using the Big Dye v3.1 kit (Applied Bio systems) of the ABI 3130xl Genetic Analyzer Sequencer. The reaction consists of an introduction into a final volume of 10 µL, 0.75 to 1.5 µL of template DNA and 3.2 to 5 pmol / µL of each primer 515F (GTGCCAGCMGCCGCGGTAA) and 907R (CCGTCAATTCCTTTRAGTTT) (Weisburg et al., 1991). The optimal conditions of the sequencer are as follows: for 25 cycles 96 °C for 1 min, 96 °C for 10 seconds, 50 °C for 5 seconds and 60 °C for 4 min.

f) Sequence analysis

The sequences obtained were analyzed with the program DNA Baser v 4.36.0 (http://www. dnabaser.com) corrected manually. The sequences were then compared to those available in the NCBI database using the BLAST program (Basic Local Alignment and Search Tool, NCBI) to determine their phylogenetic affiliation. The identification of the genus and the species was carried out as described by Drancourt et al., 2014, where > 99% similarity a strain to a species already described, between 97% and 99 similarity a strain to a genus and > 97% represents a new species. The 16S rRNA gene sequences of the selected isolates were deposited in the Gen Bank database under accession numbers (Table 3).

g) Study of the symbiotic effectiveness of different rhizobial isolates

Six rhizobial isolates were compared for their symbiotic effectiveness. For that *A. gummifera* seedlings were inoculated with 5 ml of a freshly bacterial suspension (108 bacteria / ml).The inoculation was performed after each week for 20 days andthe pots were arranged in randomized random blocks with four repetitions for each strain. The watering was done daily, once a week 30 ml of a nutrient solution of nitrogen-free was added to each plant, except for the control seedlings which receive nitrogen in the form of $KN0_3$ (0.5 g / 1) (Munns., 1968).

The experience was maintained in green houseat 28°C day/25°C night, 16hours light/8 hours dark photoperiod (Beck et al.,1993; Soma segaran and Hoben, 1994). The following parameters were measured after 6 and 12 months of culture: dry weight of the aerial part (DRW) and the root part (PSR) which was obtained after drying the sample at 70 ° C for 48 hours, number of nodules per plant (NN) and their dry weight (DRW n).

The amount of total nitrogen (N) in the whole plant was measured using the Kjeldahl method and the symbiotic efficiency (SE) was calculated by comparing each isolate with the positive control plant. (Chalk., 1998).

SE = (nitrogen content of inoculated plants / nitrogen content of non inoculated positive control plants) x 100.

h) Statistical analysis

All root and aerial dry weight, plant N concentration, and symbiotic efficiency data were subjected to analysis of variance (ANOVA) using the SPSS general linear model procedure. version 17.Averages were tested for significance using the difference of least significant means (LSD) at $p<0.05$.Pearson correlation coefficients were calculated to establish the associative relationships between isolate infection or efficacy characteristics of isolates and age of *Acacia gummifera* seedlings.

III. Results

The isolates produced translucent and transparent colonies and a high production of mucus was observed in most of them. Most colonies obtained in YMA added to bromothymol blue, have acidified the medium. According to their phenotypic identification shown in table 1. The better growth was recorded at 28 °C, although all isolates recorded average growth at 40 °C, no multiplication was recorded at temperatures exceeding 45 °C. Our isolates in their majority (83%) support concentrations in Na Cl up to 862mM and all the isolates can grow on an alkaline medium at pH between 9 to 10. However, no growth was observed at acid pH except for isolate A10 which was shown to be able to multiply at pH = 4 (Table 1).

Table 1: Phenotypic characteristic of isolatnodulating *A. gummifera*

Isolat	A24	A26	A32	A12	A10	A4
Ph 3	-	-	-	-	-	-
4	-	-	-	-	+	-
5	-	-	-	+	+	-
6	+	+	+	+	+	-
7	+	+	+	+	+	-
8	+	+	+	+	+	-
9	+	-	+	+	+	+
10	+	-	+	+	+	-
11	-	-	-	-	-	-
Temperature (°C) 4	-	+	+	-	+	-
28	+	+	+	+	+	+
37	+	+	+	+	+	+
40	+	+	+	+	+	+
45	-	+	+	-	+	+
50	-	-	-	-	-	-
Salinity (mM) 0	+	+	+	+	+	+
172	+	+	+	+	+	+
344	+	+	+	+	+	+
517	+	+	+	+	+	+
689	+	+	-	+	+	+
862	+	+	-	+	+	+
1190	-	+	-	+	+	-
1200	-	+	-	+	+	-
1360	-	-	-	+	-	-
1500	-	-	-	-	-	-

+: Growth, - : No growth

All strains tolerate different metal ions at varying concentration. From table 2and figure 1 we note a resistance to high concentrations for aluminum and zinc. However, at lower concentrations of mercury, cobalt and cadmium the bacteria were negatively affected. These metal ions are therefore the most in hibitory for the development of our isolates.

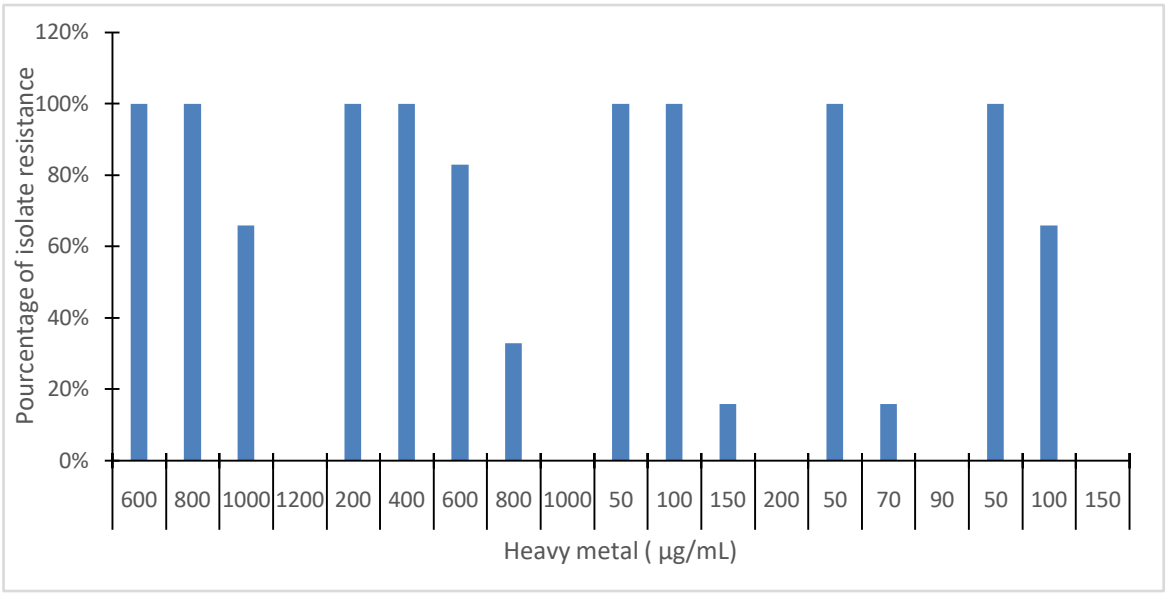

Figure 1: Effect of different concentration of heavy metals on the growth of isolates

Table 2: Resistance to heavy metals of isolates nodulating *A. gummifera*

Heavy metals	Concentration (µg/ml)	A4	A10	A12	A26	A32	A24
Al	**600**	+	+	+	+	+	+
	800	+	+	+	+	+	+
	1000	+	-	+	+	-	+
	1200	-	-	-	-	-	-
Zn	**200**	+	+	+	+	+	+
	400	+	+	+	+	+	+
	600	+	-	+	+	+	+
	800	-	-	-	+	-	+
	1000	-	-	-	-	-	-
Co	**50**	+	+	+	+	+	+
	100	+	+	+	+	+	+
	150	-	-	+	-	-	-
	200	-	-	-	-	-	-
Cd	**50**	+	+	+	+	+	+
	70	+	-	-	-	-	-
	90	-	-	-	-	-	-
Hg	**50**	+	+	+	+	+	+
	100	+	+	+	-	+	-
	150	-	-	-	-	-	-

Moreover, the comparison of the obtained sequences of the ribosomal RNA 16s gene of the most tolerant ones with those available in databases, using the BLASTn program, has indicated that the strains A10, A12 and A4 can be assigned respectively to *Rhizobium naphthalenivorans*, *Rhizobium pusense* and *Rhizobium nepotum* at 99% identity. Two strains A32 and A26 have a percentage of similarity 99% with *Rhizobium giardinii*, and A24 with 100% sequences identical to *Rhizobium azibense* (Table 3).

Table 3: Genotypic character of isolates nodulating A. gummifera

Isolates	Species	% similarity	Accession number
A24	*Rhizobium azibense*	100%	MF769718
A26	*Rhizobium giardinii*	99%	MF629731
A32	*Rhizobium giardinii*	99%	MF663789
A12	*Rhizobium pusense*	99%	MF774692
A10	*Rhizobium naphthalenivorans*	99%	MF629733
A4	*Rhizobium nepotum*	99%	MF972515

a) Evaluation of strain'sinfectivity

The examination of the root system of plants have shown a variability in the number of nodule. There is also a variability in the dry weight of the nodule formed during the two culture period tested (figure 2).In general, a wide significant variability in the infective capacity of the isolates adhering to plants which has 12-month old was highlighted. Furthermore the strain A4 is the most infective, with more than 25 nodule / plant and a dry weight of 15 mg. plant^{-1}. While the lowest infectivity was recorded in strain A32 with 2 nodule / plant and a dry weight of 2 mg. plant^{-1}. Also, at 6-month-old, A10 has recorded the highest dry weight and number of nodule (13mg. plant^{-1} and 8 nodules/plant).

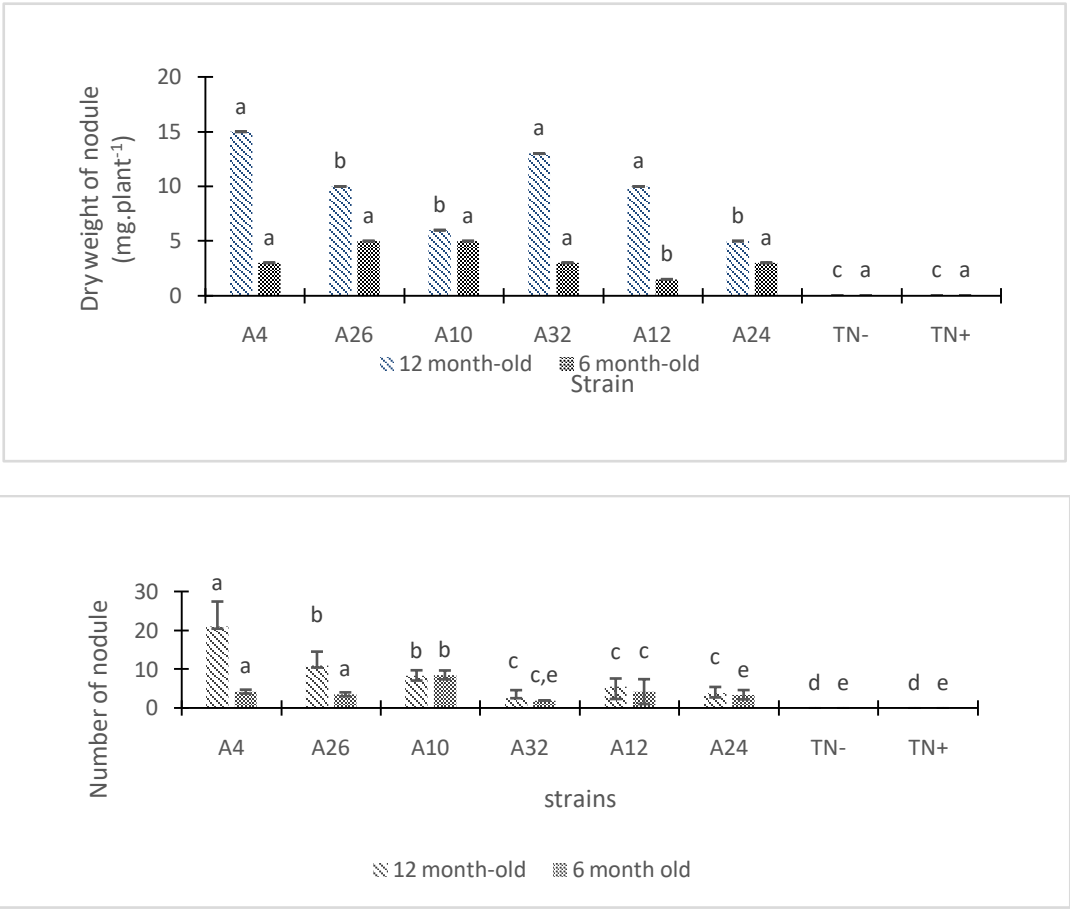

Figure 2: Number of nodule (A) and dry weight of nodule (B) collected from *Acacia gummifera* roots after 6 and 12 months of culture.

b) Evaluation of the strains'ssymbiotic efficiency

There is a large variation in the dry biomass among *A. gummifera* at 12 months-old inoculated with six different strains of Rhizobium (Table 3). The highest is recorded in those inoculated with the strain A24, which allowed to increase the aerial dry weight 3.5 times more than those obtained in positive control inoculated with KNO_3. While the strain A4 have given the lowest biomass.

For the 6-month Acacia, the statistical analysis of the variance showed that there is no significant difference between them. In addition, the 6-month-old plant's infection with the strain A10 caused the highest root biomass, while A26 had the lowest root dry matter content. The inoculation of the Acacia which have 12 months have given a higher nitrogen contents compared with those which have 6-month-old(Table 3). In particular, the total nitrogen content in the 12-month-old plants expressed in (g.plant^{-1}) shows that those inoculated with A24 have the highest content with 0.2 g / plant, which significantly exceeds that contained in Acacia fertilized with mineral nitrogen (0.1g / plant). While, the seedlings inoculated with A4 have the lowest nitrogen content. The association of *A. gummifera* of 6 months with strain A24 recorded the highest nitrogen content, which is significantly similar to that observed in plants fertilized with mineral nitrogen, while those associated with A32 have revealed the lowest nitrogen content similar to that found in uninoculated seedlings. In addition, it can be seen from the table 3 that, after 12 months of culture, fixed nitrogen is significantly higher than when they are combined with A. gummifera after 6 months of culture. Notably, 75% of strains that associate with 12-month-old acacias have been shown to be very effective with SE> 80%. However, it is important to point out that there are isolates that have shown a very low symbiotic efficiency, this is the case for example of isolate A4 which showed the least important value (SE 16%) despite the number of nodules observed. This shows that this isolate forms inefficientroot nodules.

Table 4: Effect of inoculation with six Rhizobium on dry weight of aerial and root part, total nitrogen

	Dry weight of aerial part(g.plant^{-1})		Dry weight of root part (g.plant^{-1})		Nt (g.plant^{-1})		Nf (g.plant^{-1})		ES (%)	
Age	**12 mois**	**6 mois**	**12 mois**	**6 mois**	**12 mois**	**6mois**	**12 mois**	**6mois**	**12 mois**	**6mois**
A4	$3,4 \pm 1^{b,c}$	$1,6\pm0,63^{A}$	$2\pm0,56^{b}$	$0,42\pm0,09^{A}$	$0,09\pm0,008^{a}$	$0,02\pm0,01^{A}$	$0,06\pm0,01^{a}$	$0,01\pm0,007^{A}$	$90\pm91,99^{a}$	24 ± 36^{A}
A24	$9,2\pm3,15^{a}$	$1,2\pm0,21^{A}$	$4,5\pm0,9^{a}$	$0,34\pm0,14^{A}$	$0,2\pm0,06^{b}$	$0,08\pm0,007^{B}$	$0,18\pm0,03^{b}$	$0,07\pm0,01^{B}$	$200\pm72,2^{c,b}$	114 ± 39^{B}
A10	$6,75 \pm 1,8^{a,b,c}$	$2\pm0,1^{A}$	$2,3\pm0,57^{b}$	$1,5\pm0,48^{A}$	$0,14\pm0,01^{a}$	$0,03\pm0,01^{A}$	$0,12\pm0,01^{a}$	$0,02\pm0,005^{A}$	$140\pm96,2^{b}$	42 ± 28^{A}
A26	$6,8 \pm 4,2^{b,c}$	$1\pm0,8^{A}$	$2,12\pm0,46^{b}$	$0,3\pm0,16^{A}$	$0,14\pm0,03^{a}$	$0,03\pm0,02^{A}$	$0,12\pm0,06^{a}$	$0,02\pm0,02^{A}$	$140\pm47,01^{b}$	42 ± 24^{A}
A12	$6,6 \pm 0,4^{a,b}$	$1,5\pm0,35^{A}$	$3,87 \pm 0,7^{a,c}$	$0,31\pm0,35^{A}$	$0,1\pm0,03^{a}$	$0,05\pm0,02^{B}$	$0,08\pm0,007^{a}$	$0,04\pm0,01^{B}$	$100\pm41,2^{a}$	$71\pm77,5^{B}$
A32	$4\pm1,5^{c}$	$1,8\pm0,2^{A}$	$2,3\pm0,5^{b}$	$0,5\pm0,1^{A}$	$0,11\pm0,03^{a}$	$0,017\pm0,001^{A}$	$0,09\pm0,01^{a}$	$0,007\pm0,002^{C}$	$110\pm50,1^{b}$	$28\pm8,7^{A}$
TN-	$2,4\pm1^{c}$	$1,2\pm0,6^{A}$	$0,5\pm0,22^{b}$	$0,26\pm0,12^{A}$	$0,02\pm0,008^{c}$	$0,01\pm0,008^{A}$				
TN+	$2,6\pm1,1^{c}$	$1\pm0,3^{A}$	$0,53\pm0,23^{b}$	$0,22\pm0,07^{A}$	$0,1\pm0,03^{a}$	$0,07\pm0,03^{B}$	$0,08\pm0,03^{a}$	$0,06\pm0,03^{B}$	100 ± 0^{a}	100 ± 0^{B}

content, fixed nitrogen and symbiotic efficiency of *Acacia gummifera* at 6 and 12 months-old

Table 5: Correlation between age, number of nodules, nodule dry weight, aerial and root dry biomass, total nitrogen, fixed nitrogen and symbiotic efficiency

Variables	Number of nodule	Dry weight of nodule	Dry weight of aerial part	Dry weight of root part	Total nitrogen	Fixednitrogen	SE
Age	0, 31**	0,536**	0,738**	0,589**	0,56**	0,587***	0,52**
Number of nodule		0,659**	0,56*	0,4*	0,2	-0,1	-0,73
Dry weight of nodule			0,681*	0,5*	0,4**	0,15	0,222
Dry weight of aerial part				0,853**	0,46**	0,3	0,313
Dry weight of root part					0,3*	0,1	0,105
Total nitrogen						0,326*	0,237
Fixednitrogen							0,786**

Total nitrogen, fixed nitrogen and symbiotic efficiency

*,** : The correlation is significant at p <0.05 and p <0.01 respectively.

IV. Discussion

It is established that the conservation of ecosystem biodiversity depends on the composition of microbial communities of the soil. Therefore, the knowledge of the distribution and abundance of beneficial bacteria is of crucial use. In this work, we studied the characteristics and symbiotic diversity of different strains nodulating *A. gummifera*. For that we have tested the growth of isolates on YMA medium at different temperatures, pHs and salinity (Table 1) in order to select those adapted to extreme edapho-climatic conditions. Because the exposureto high temperatures may cause the symbiotic plasmid loss (Zahran et al., 2012) and the soil acidity can affect nodulation and plant growth (Habish 1970), indeed the Rhizobia subjected to salt stress can have morphological alterations causing changes in the profile of polysaccharides and extracellular lipoplysaccharides (Ventorino et al., 2013)document).Therefore, the better growth of ourisolates was recorded at a temperature of 28 ° C. These results are in perfect agreement with those found by Fikri-Benbrahim et al., 2017, showing that Rhizobia are mesophilic bacteria that multiply between 10 and 37 ° C with an optimum of 28 ° C (Fikri-Benbra him et al., 2017).The growth of our strains in pH medium between 6 and 10 is in agreement with other studies (Lebbida, 2009 ; Jourand 2004 (Fikri 2017)). Furthermore, it has been found that at a pH 5 to 5.5 the nodulation is absent in Acacia (Brock well et al., 2005).We note that our isolates in their majority support concentrations of salt up to 862mM (Table 1), These results corroborate with those found in some isolates associated with other Acacia species (Sakrouhi et al., 2016). Other studies have shown that many woody legumes such as Acacia, Prosopis and Lucaena tolerate a Na Cl concentration of 5% (Abolhasani et al., 2010).Otherwise soil contamination by metal ions affect the processes of atmospheric nitrogen fixation and nodulation of legumes. That is why the effect of heavy metals on the development of strains associated with different Acacia has been evaluated in several studies (document) (Fterich et al., 2012; Sakrouhi et al., 2016). The results presented in table 2 show that some isolates are resistant to several metal ions (Al, Zn). However, low resistance is recorded for mercury, cobalt and cadmium. These metal ions are the most inhibitory for the development of our strains, this same result was also reported by Zerhari et al., 2000. Thereafter, the most tolerant onehas been selected for 16S rRNA gene sequencing. A26 (MF629731) and A32 (MF663789) isolated from *Acacia gummifera* were found to belong to the same species *Rhizobiumgiardinii*, while A24 (MF769718) was affiliated with *Rhizobium azibense*, A12 (MF 774692) and A10 (MF 629733) has 99% homology with 16s rRNA sequence with respectively to *Rhizobium pusence* and *Rhizobium naphthalenivorans*, A4 (MF 972515) is somewhat close to *Rhizobium neptum*. The nodulation and efficiency of the strains are essential for the establishment of *Acacia gummifera* after transplanting in the fields and for maximum use of their atmospheric nitrogen fixation potential. Through this work we have studied the nitrogen-fixing potential of *Acacia gummifera* at 2 different ages inoculated with six different strains of Rhizobium previously identified. The production of nodules is an essential factor for the achievement of an efficient symbiotic relationship, their insufficient number or their absence might cancel or reduce the process of biological fixation of nitrogen. Our Rhizobialstrains assessed in this study all showed a capacity to induce nodule formation on *Acacia gummifera*. The highest amplitudes of dry nodule

production were obtained in 12-month-old Acacia associated with strains A4 (*Rhizobium nepotum* MF 97515), A26 and A32 (*Rhizobium giardinii* MF663789).Gassamahas shown that Rhizobium strains become more infectious in *Acacia albida* trees that are more than 7 months old and in this case the formulation of nodules becomes continuous and increasing.Differences of nodule parameters suggest the existence of differences in efficiency between the sex strains of Rhizobium.Which is concordant with the dry matter yields results (table 3). The dry biomass of 12-month-old A.gummifera is significantly higher than that of 6 months withthe highest was produced by the strain A24(*Rhizobium azibense* MF769718).This strain recorded a number and a dry weight's nodule the least important, this indicates that *Acacia gummifera* is mobilizing less energy in the process of nodulation in favor of nitrogen fixation.The absence of correlationbetween the yield of the plant and the number of nodules (table 4) confirm that a good yield could be observed with a smaller number of nodules whereas a high number of nodules gives a low yield (ineffective nodules).These results are similar to those found by Chen et al 2004; El Akhal 2008 and Berrada, 2013. The 12-month-old seedlings accumulated more total nitrogen suggesting their better nitrogen fixation efficiency which was mostly recorded in seedlings inoculated with the A24 strain. The correlation existing between the different growth parameters comes from the accumulation of fixed biological nitrogen.

V. Conclusion

This study showed a diversity between bacteria belonging to the same generaof Rhizobium nodulating A. gummifera based on their phenotypical and genotypical characterizations. Also, it is clear from the results that inoculation with Rhizobia benefited especially plant 12 months growth and N fixation. Therefore, the introduction of native plant species such as A. gummifera associated with a managed microbial symbiont community is an effective biotechnological tool to support the recovery of desert ecosystems.

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Assessment of Human Settlement in Toungo Sector of Gashaka Gumti National Park-Nigeria

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Abstract- The study examined human settlements in protected areas in Toungo Sector of Gashaka Gumti National Park, Adamawa state. Six communities were selected for the study. Structured questionnaires were administered among the respondents to elicit information on the identified human settlements Data obtained were analysed using descriptive statistics (in form of frequency Tables and percentages). The results obtained indicates that majority of the respondents were males (63.64%) that are married (81.80%), falls within the age group of 21 to 30years(57.14%). Most of the respondents were settled in the park (50%) for the purpose of farming, grazing, collection of non-timber forest products and attributed participating in one threat or the other (90.91%).

Keywords: *human, settlement, influence, threats, wildlife.*

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Assessment of Human Settlement in Toungo Sector of Gashaka Gumti National Park- Nigeria

Kwaga B. T. [α], Shallangwa, A. A.[σ], Ringin M. I. G.[ρ] & Boni, P. G.[ω]

Abstract- The study examined human settlements in protected areas in Toungo Sector of Gashaka Gumti National Park, Adamawa state. Six communities were selected for the study. Structured questionnaires were administered among the respondents to elicit information on the identified human settlements Data obtained were analysed using descriptive statistics (in form of frequency Tables and percentages). The results obtained indicates that majority of the respondents were males (63.64%) that are married (81.80%), falls within the age group of 21 to 30years(57.14%). Most of the respondents were settled in the park (50%) for the purpose of farming, grazing, collection of non-timber forest products and attributed participating in one threat or the other (90.91%). Collection of non-timber forest products (41.18%) is the major anthropogenic activity by the respondents in the study area. Lack of farming land (42.86%) constituted the major reason for settling in the study area by the respondents. Awareness campaign in favour of protected area conservation, followed by enacting stiff penalty on defaulters of indiscriminate felling of trees, poaching and grazing should be encouraged in the study area.

Keywords: human, settlement, influence, threats, wildlife.

I. Introduction

Human settlement means the totality of the human community - whether city, town or village with all the social, material, organizational, spiritual and cultural elements that sustain it. The fabric of human settlements consists of physical elements and services to which these elements provide the material support (Oguntu, *et al.* 2012). The physical human settlement components comprise, shelter, the superstructures of different shapes, size, type and materials erected by mankind for security, privacy and protection from the elements and for his singularity within a community; infrastructure which is the complex networks designed to deliver to or remove from the shelter people, goods, energy or information; Services cover those required by a community for the fulfilment of its functions as a social body, such as education, health, culture, welfare, recreation and nutrition. Settlement is a permanent collection of buildings and inhabitants. They occupy a very small percentage of the earth's surface but exert a far greater influence on the world's economy and culture as well as places to find jobs and to obtain goods and services (Kumssa and Bekele, 2008; Martinuzzi, *et al*. 2015;)

The establishments of human settlements in protected areas are common and, on the increase, thereby endangering the future life of fauna and flora (Oguntu, *et al*., 2012). Such activities increase simultaneously with the increase in population growth and poverty (Kumssa and Bekele, 2008; Galanti, *et al*., 2006). Increased population pressure and its negative impact on habitat loss in African countries is a common phenomenon (Newmark, 1996; Kideghesho, *et al*., 2006).

Human settlements are highly increasing in national parks due to poverty and population pressures. However, the overall land coverage has been changing from time to time due to human settlements and activities within national parks (Tumusiime *et al.,* 2011). The threat factor trends have always been geared towards biodiversity loss which previous works addressed little or part of the study area, hence the need for this study to ''examine human settlements in Toungo Sector of Gashaka-Gumti National Park, Adamawa state, Nigeria

II. Methodology

a) Location of the study area

Gashaka-Gumti National Park is the largest and most diverse park in Nigeria, covering an area of approximately 6,671 Km^2. It's located in the northeast of Nigeria between Latitude $6^0.55'$ and $8^0.05'$ N, and between Longitudes $11^0.11'$ and $12^0.13'$ E and shares a boarder with the Republic of Cameroon in the east. (Figure 1) The parks name is derived from two of the oldest regions and most historic settlements: Gashaka village in Taraba State, and Gumti village in Adamawa State. Gashaka-Gumti National Park was created by Federal Decree (now Act) in 1991 by the merging of Gashaka Game reserve with Gumti Game Reserve (Gashaka-Gumti National Park- GGNP, 1998).

Annual rainfall within the park ranges from 1200mm in the north to 3000mm in the southern region. Wet season is normally experienced from April to November, and dry season from December to March. Lowland temperature nighttime lows in December of 10-15^0C, to daytime highs in March and April, of 40^0-43^0C. Temperature can be much cooler at higher altitudes and during the harmattan period that occurs from November to March (GGNP, 1998).

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Chapman and Chapman (2001) identified four main vegetation zones in the area as follows;.

Lowland Rainforest: occurs mainly as a gallery forest that is often found as blocks along many of the park's river valleys, gradually merging into montane forest at higher altitudes. Gallery forests are important reservoirs for biodiversity, providing both forest-edge habitats .Examples of plant species are *Terminalia superba* (afara),*Khaya grandifoliola* (savannah mahogany). *Ceiba pentandra* (silk cotton tree).(Chapman and Chapman, 2001).

Montane Rainforest: Much of this forest occurs as small gallery forest that is very fragile and susceptible to disturbance, especially by burning of the surrounding grasslands. Examples of some species include *Khaya grandifoliola*, *Lovo a*t richililiodes (Chapman and Chapman, 2001).

Montane Grassland: occurs at altitudes about 1,300m above sea level. This habitat has been created over time by the frequent burning of the Plateau areas. Examples of the species in this vegetation are *Albizia gummifera, Schefflera abyssinica* among others. (Chapman and Chapman, 2001).

Savanna Woodland: Savanna woodland dominates most of Gashaka-Gumti National Park. Two main Woodland Savanna types occur, namely Southern Guinea Savanna Woodland that occurs in the south and the Northern Guinea Savanna which dominates in the drier northern sector of the park. Such examples of savannah woodland includes *Brachystegia eurycoma*, *Berlinia grandiflora*, *Pandamus candelabrum* (Chapman and Chapman, 2001).

b) Study Design and Data collection

A preliminary investigation was carried out in the study area in order to assess communities, villages, population of the respondents, and occupation among others. The study design involved the assessment of the entire area based on communities and their populations in the study area. The community population was determined using information provided by National Population Commission (NPC, 2006). Cochran population allocation technique was adopted in the Households (HHs) survey from all selected village/communities as adopted by Dishan, *et al*. (2009). The formula is as follows:

$$n_h = N_h \times \frac{n}{N}$$

Where:

n_h= number of questionnaire administered in each community

N_h= estimated population of the people in each community

n = total number of questionnaires administered

N = total number of people in all the communities

One hundred and twenty (120) structured questionnaires were administered to the respondents while one hundred and eleven (111) was retrieved, focus group discussions were held to source information on the human settlement. In addition, direct observation of settlement and on the spot assessment of human activities in the study area was used to elicit information from the respondents in the study area. The household data was collected using a structured survey design, following a similar format to that used by Maddox (2003).

Some park management staff members and also district agricultural/natural resource management officers were consulted during the study design to facilitate the data collection on the laid down policies and the threat factor of the Park. Structured questionnaires were administered to residents and alternating male and female respondent's as much as possible and different age groups following Hill's guide (2000). In every household, the head of the household or other representatives were interviewed. The structured questionnaires were translated into local language using face to face interview on the family members.

c) Statistical Analysis of Data

The data collected was processed and analysed using descriptive statistics (Frequency Tables, means and percentages).

III. Results

a) Socio-economic characteristics of the respondents in the study area

The result of socio-economic characteristics of the respondents in the study area is shown in Table 1. The result shows that 63.64%, 57.14%, 60%, 62.50% and 60% of the respondents in Mayo Sangnare, Mayo Sunsun, Toungo (AgwanSoo) Dalasum, Mayo Bakari and Mayo Bagbag respectively are males, while 36.36%, 42.86%, 40%, 41.18%, 37.50% and 40% are females. Marital status indicated 9.1%, 21.43%, 88%, 68.75%, 75% and 100% of the respondents are single, 81.8%, 78.57%, 12%, 18.75%, 25% are married. Their ages randeg from 20 to above 41 years. 57.14% and 45.45% are within the ages o 21 to 30years and 31 to 40 years respectively, with only 29.41% above 41 years.

b) Identified Human Settlement of the respondents the study area

The results on some of identified human settlements of the respondents in the study area are presented in Table 2. The results showed that 11.83, 15.05, 26.88, 18.28, 17.26 and 10.75 of the respondents settled Mayo Sangnare, Mayo Sunsun, Toungo (Agwan Soo) Dalasum, Mayo Bakari and Mayo Bag bag respectively.

c) *Laid-down Policies on the respondents in the study area*

The result of the laid-down policies of the regarding respondents is shown in Table 3.

The results indicated that that; prohibition on tree felling, farming inside the park, poaching, collection of non-timber forest products, grazing, roads construction and settlements formed 16.66% of the laid-down policies, where 50% of the respondents indicated that all the afore-mentioned are prohibited in the park.

d) *Anthropogenic Threats/activities by the respondents in the study area*

The result of some Anthropogenic Threats/activities by the respondents in the study area is shown in Table 4. The results indicated that 90.91% to 100% of the respondents agreed that there exist anthropogenic activities in the study area, while 1% to 9.09% of the respondents did not agree. The types of anthropogenic activities in the study area indicated 21. 42%, 17. 64%, 23. 52%. 21. 42% and 41. 18% for poaching, grazing, family settlements, logging and collection of non-timber forest products respectively among the communities.

e) *Respondents reasons for settlement in the study area*

The results of respondents reasons for settlement in the study area is presented in Table 5. The result showed that 18.18% settled due to lack of forage for their livestock, 42.86% indicated lack of farming land and 30% indicate both lack of forage and farm land, while 31.25% settled for business or trading of non-timber forest products in the study area.

IV. Discussions

a) *Socio economic characteristics of the respondents in the study area*

The findings on the socio-economic characteristics of the respondents observed in the study period included gender as one of the important factor in determining settlement or expansion around protected area. There was low level of formal education in the area due to poverty and probably lack of basic social amenities which are not provided by the authority concern, and is partially complimented by the National Park potentials. This also indicates that most parents do not encourage their children to attend schools. Instead, they engage in occupations that their parents are involved in, like the care of the few livestock the family owns. The findings of this study conform to that of Kideghesho *et al*. (2006), Hansilo and Ti ki (2017) whom reported similar findings that many rural and semi-rural parents rarely encourage their children to go school.

b) *Identified Human Settlements in the study area*

The finding of this study indicated that there exists some human settlements in the study area. Collecting baseline information is a vital step in managing protected areas as observed by Kumssa and Bekele, (2008). Such information will go a long way to understand the timing, status and location of the challenges as well as the perceptions of local people towards protected areas. Like most African countries, humans also put pressure on protected areas in various ways and forms such as expansion of settlements, agricultural expansion, livestock grazing and collection of NTFPs.

c) *Laid down policy on the respondents in the study area*

Conservation of biodiversity in any protected area and or National Parks is done through two main approaches: one approach is the preservation approach, which aims at setting aside National Parks to exclude human activities except for tourism. Through this approach, direct use of natural resources in the park for commercial or subsistence purposes is prohibited (Adams, 2004). The finding of this study is in strong agreement with that of Adams (2004) who reported that in protecting any reserved area, there has to be an approach, often referred to as the "protectionism approach" or "the fines and fences" approach. The preservation approach aims at excluding human activities considered inimical to the objectives of conserving biodiversity in National Parks. There has to be community-based conservation approach that allows people (especially those that neighbour National Parks) to benefit socially or economically from parks (Stolton, *et al*., 2010). The community-based conservation approach was proposed to address the problems associated with excluding human activities from the park.

d) *Anthropogenic threats/ activities in the study area*

The finding of this study reveals that there are various anthropogenic activities ranging from poaching, grazing/livestock raring and NTFPs collection activities that can have a wide negative impact on protected area which would eventually leads to activities such as deforestation and loss of wildlife habitat. The setrend of land uses have occupied large space that led to destructions of natural vegetation and reduced area available for wild animals. This finding conforms to that of Kideghesho, *et al*. (2006); Hansilo and Ti ki (2017) who also mentioned similar problems of wildlife habitats for cultivation in other African countries. .Agriculture is still the backbone of Nigeria's economy as many people in the rural areas depend directly on agriculture to meet their daily demands. (Ogun tu, *et al.,* (2012) reported that, while wildlife doesn't provide incentives directly to these people, they can't see the importance of wildlife rather than just regarding it as threats to them or their farm crops.

The increased human settlement in the area has contributed greatly to lack of free space for animal

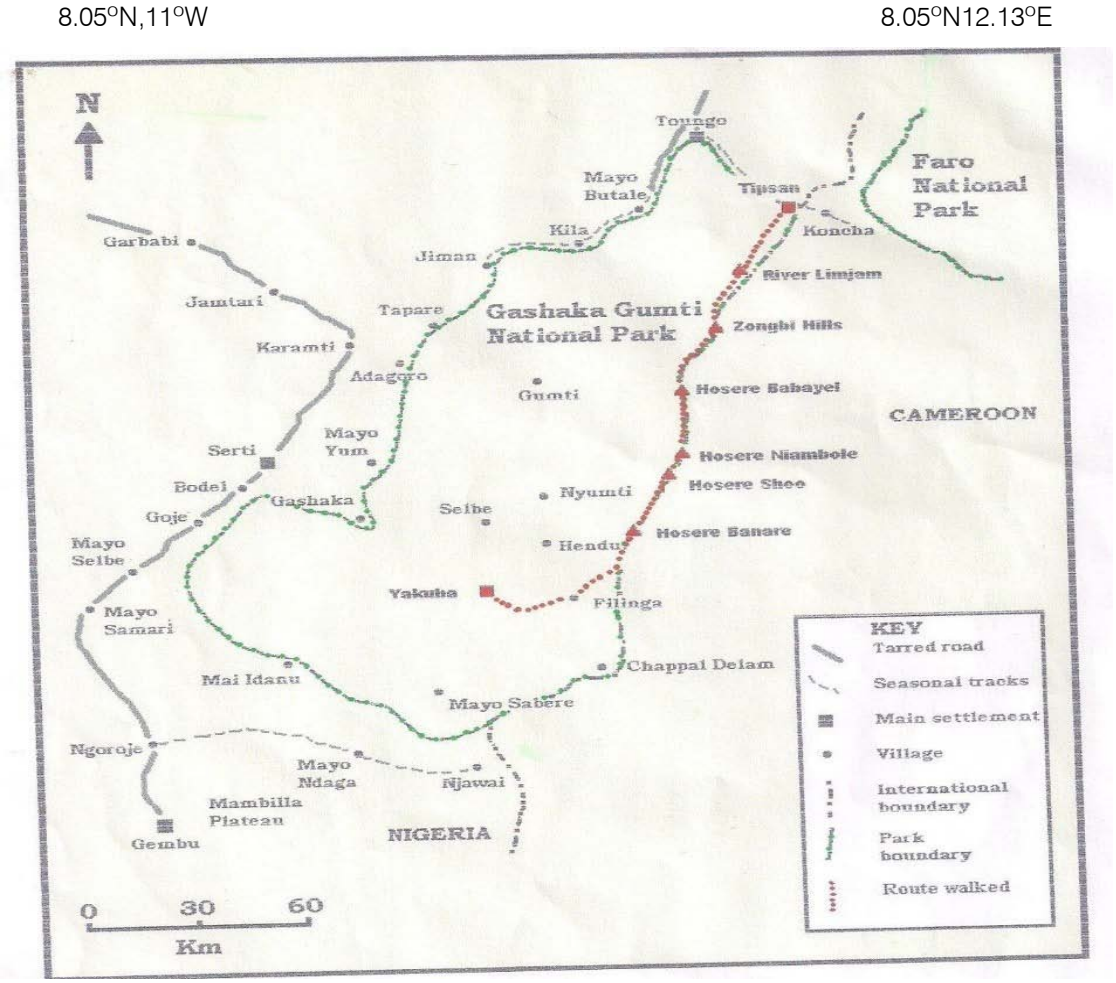
movements as it can be translated to increased human settlements as observed in the study area during this survey. This is not in contrast with that of Ndibalema (2010) who made similar report in Serengeti ecosystem. Hansilo and Tiki (2017) in Bale Mountains National Park (BMNP) also reported loss of habitats for birds due to agriculture expansions. This has also resulted in shrinkage of the buffer zone area of the park.

e) Reasons for Human Settlement in the study area

The findings on the human settlement in the study area reveals that majority of the settlers are either farmers or grazers, meaning that they have no alternative sites for such purposes. This finding is in close agreement with that of Tumusiime *et al.*,(2011), who reported the negative influence of settlers through Illegal livelihoods from a Protected Area in Uganda. Such activity if allowed unchecked, could have a detrimental effect on wildlife and the entire ecosystem.

V. Conclusion

The study viewed the influence of human settlement on wildlife conservation in Gashaka Gumti National park, Nigeria. Wildlife is under threat due to illegal human settlement, expansion of agricultural lands, poaching and livestock grazing in and around the protected area. The findings show that there are major land challenges which are associated with expansion of cropland cultivation and human settlements into areas that previously serves as wildlife habitats. These changes have negative impacts on the natural habitats of wildlife. Therefore, calls for involvement of not only conservationists, but also other stakeholders with different interests in the area and professional background, such as agriculturists, conservationists, demographers, policy makers, and land use planners to minimize the challenges. With this current trend of agriculture expansions and illegal human settlement which has already been put under cultivation of the park, the park will no longer act as a conservation area for wildlife as other protected area of the country.



Source: (GGNP Management Plan, 1998)

Figure 1: Map of Gashaka Gumti National Park showing the Villages (Enclaves) and Main Settlements within and around the Park

Table 1: Socio-Economic Characteristics of the Communities

Respondents	Mayo Sangnare		Mayo Sunsun		**Communities** Toungo (AgwanSoo)		Dalasum (Oaga)		Mayo Bakari		Mayo Bagbag	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Gender												
Male	7	63.64	8	57.14	15	60	10	58.82	10	62.5	6	60
Females	4	36.36	6	42.86	10	40	7	41.18	6	37.5	4	40
Total	11	100	14	100	25	100	17	100	16	100	10	100
Marital Status												
Single	1	9.1	3	21.43	22	88	11	68.75	12	75	10	100
Married	9	81.8	11	78.57	3	12	3	18.75	4	25	-	0
Others	1	9.1	-	0	-	0	2	12.5	-	0	-	0
Total	11	100	14	100	25	100	16	100	16	100	10	100
Age class												
20yrs	2	18.2	3	21.43	3	12	1	5.88	-		-	
21-30yrs	4	36.36	8	57.14	11	44	7	41.18	5	31.25	5	50
31-40yrs	5	45.45	1	7.14	8	32	4	23.53	8	50	5	50
41- above	-	0	2	14.29	3	12	5	29.41	3	18.75	-	0
Total	11	100	14	100	25	100	17	100	16	100	10	100
Number of children in Household												
1-10	9	81.82	7	50	23	92	11	64.71	11	68.75	5	50
11-20	2	18.18	7	50	2	8	5	29.41	5	31.25	5	50
21-30	-		-		-		1	5.88	-		-	
Total	11	100	14	100	25	100	17	100	16	100	10	100
Educational Status												
Non-Formal	5	45.45	7	50	8	32	5	29.41	4	25	4	40
Primary	-		4	28.57	11	44	4	23.53	8	50	3	30
Secondary	6	54.55	3	21.4	5	20	5	29.41	4	25	3	30
Tertiary	-		-		1	4	3	17.65	-		-	
Total	11	100	14	100	25	100	17	100	16	100	10	100

Source: Field Survey (2019)

Table 2: Identified Human Settlements of the respondents in the Study Area

Settlement	Respondents Frequency.	Percentage (%)
Mayo Sangnare	11	11.83
Mayo Sunsun	14	15.05
Toungo (AgwanSoo)	25	26.88
Dalasum (Daga)	17	18.28
Mayo Bakari	16	17.26
Mayo Bagbag	10	10.75
Total	93	100

Source: Field Survey (2019)

Table 3: Some Lay down Policies of the Park

Variables	Frequency	Percentage (%)
Laid Down Polices of the Park		
Prohibition on tree felling, farming, hunting, collection of non-timber products	3	16.66
Prohibition on grazing	3	16.66
Prohibition on settlements expansions, roads construction	3	16.66
All of the above	9	50.00
Total	18	99.98

Source: Field Survey (2019)

Table 4: Various Anthropogenic Activities/Threats in the Park

Variables	Mayo Sangnare		Mayo Sunsun		Toungo (AgwanSoo)		Dalasum (Oaga)		Mayo Bakari		Mayo Bagbag	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Respondents engagement in Anthropogenic Activities												
Yes	10	90.91	14	100	25	100	17	100	16	100	10	100
No	1	9.09	-	0	-	0	-	0	-	0	-	0
Total	11	100	14	100	25	100	17	100	16	100	10	100
Type of Anthropogenic Activities												
Poaching	2	10	3	21.42	2	8	1	5.88	1	6.25	2	20
Grazing	2	10	-	00.00	2	8	3	17.64	2	12.50	2	20
Farming	4	20	3	21.42	2	8	4	23.52	3	18.75	2	20
Logging	2	10	3	21.42	4	16	2	11.76	2	12.50	2	20
NTFPs	10	50	5	35.71	15	60	7	41.18	6	37.50	2	20
Total	20	100	14	100	25	100	17	100	16	100	10	100

Source: Field Survey, (2019)

Table 5: Reason for settlement near/inside the Park by the respondents

Villages	Number of Questionnaires Retrieved	Lack of land for forage %	Lack of land for farming %	Both (forage and farming) %	Business/Trader NTFP(s) %
Mayo Sangnare	11	18.18	36.36	18.18	27.28
Mayo Sunsun	14	14.29	42.86	14.29	28.56
Toungo (AgwanSoo)	25	12	48	16	24
Dalasum (Daga)	17	17.65	41.17	17.65	23.53
Mayo Bakari	16	6.25	50	12.5	31.25
Mayo Bagbag	10	30	30	30	10
Total/Average	93	16.40	41.40	18.10	24.10

Source Field survey, (2019)

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Evaluation of Camel Milk and Urine in the Management of Diabetes Mellitus in Alloxan Induced Albino Rats

By A Mustapha, A. A. Makinta, & A. Buba
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Abstract- There are many anecdotal reports on traditional use of camel milk and urine in the treatment of Diabetes Mellitus (DM). The need therefore arises to validate this claim. The objectives of the study is to; compare the effect of camel milk and urine on serum glucose of rats, compare the effect of camel milk and urine on serum lipids of rats and to Compare Different doses of the products on serum glucose and lipids. Thirty-six adult albino rats were used in 4 X 3 factorial experiment involving 4 product treatments and 3 doses. A significant decrease in the blood glucose level in the experimental groups fed camel milk when compared to diabetic untreated (control) group. In treatment group treated with camel urine singly and in combination there was a significant decrease in glucose compared to control. The result shows that there were significant decrease in TG, TC, LDL-C and VLDL-C compared with the control while the HDL was significantly increased.

Keywords: *diabetes mellitus, camel milk, urine, alloxan, rats.*

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Evaluation of Camel Milk and Urine in the Management of Diabetes Mellitus in Alloxan Induced Albino Rats

A. Mustapha [α], A. A. Makinta [σ] & A. Buba [ρ]

Abstract- There are many anecdotal reports on traditional use of camel milk and urine in the treatment of Diabetes Mellitus (DM). The need therefore arises to validate this claim. The objectives of the study is to; compare the effect of camel milk and urine on serum glucose of rats, compare the effect of camel milk and urine on serum lipids of rats and to Compare Different doses of the products on serum glucose and lipids. Thirty-six adult albino rats were used in 4 X 3 factorial experiment involving 4 product treatments and 3 doses. A significant decrease in the blood glucose level in the experimental groups fed camel milk when compared to diabetic untreated (control) group. In treatment group treated with camel urine singly and in combination there was a significant decrease in glucose compared to control. The result shows that there were significant decrease in TG, TC, LDL-C and VLDL-C compared with the control while the HDL was significantly increased. The results indicate that camel milk possess anti-diabetic effects on alloxan induced rats. This study recommended that awareness should be created on the therapeutic value of camel urine and its combination.

Keywords: diabetes mellitus, camel milk, urine, alloxan, rats.

I. Introduction

The camel belongs to the family camelidae and divided into two genera: genus camelus (the true or old world camels) and genus lama (the new world camels). The genus camelus includes two species, the Dromedary, (Camelus dromedarius) or one-humped camel and the Bactrian camel (Camelus bactrianus) the two humped camel. The Dromedary (C. dromedarius) is adapted to hot arid environments and contributes significantly to the food security of the nomadic camel pastoral households (Schwartz & Dioli, 1992). Camelids are ruminating animals and are in proximity to ruminants but are not part of the suborder Ruminantia. Differences such as foot anatomy, stomach system and the absence of horns confirm this fact. They belong to the suborder Tylopoda (Werney, 2003).

According to FAO (2013) the total population of camel in the world is 25.89 million, of which 89% are dromedary (C. dromedarius). The remaining 11% are C. bactrianus, which are generally found in the cold deserts of Asia. While more than 60% of the dromedary camel population is concentrated in the arid areas of North East African countries like Somalia, Sudan, Ethiopia and Kenya. Ethiopia ranks third in the world by the number of camel head after Somalia and Sudan (Simeneh et al., 2015). Nigeria has a population of more than Ninety-two thousand, four hundred and ninety-four (92,494) of one humped Camel (Felsner 2002).

Camel is a good source of various vitamins and minerals and is characterized for its low cholesterol and high concentration of insulin-like factor (Agrawal, et al., 2005). Camel milk and urine are used therapeutically against hepatitis, dropsy, problems of spleen, and asthma, (Mal et al., 2000).

DM is the fourth leading cause of death in most developed countries, and its prevalence is rising in Nigeria (IDF, 2013). The conventional medications for DM such as Biguanides, Sulfon'ylureas and Thiazolidinedione are associated with undesirable side effects such as allergic reactions, nausea and vomiting, diarrhea, sexual dysfunction, haemoglobin disorders and lipodystrophy (Oliver and Tellervo 1993). For this reasons cheaper alternatives such as medicinal plants and animal products are sought. Outstanding among these alternatives to the conventional drugs are camel milk and urine, for which there are many anecdotal reports and few scientific studies. The need therefore arises to validate this claim.

The aim of the study is to investigate the anti-diabetics effects of camel milk and urine in alloxan induced diabetic rats. The objectives of the study are to; compare the effect of camel milk and urine on serum glucose of rats, compare the effect of camel milk and urine on serum lipids of rats and to compare different doses of the products on serum glucose and lipid profiles.

II. Materials and Methods

The study was carried out at the Animal house, Department of Biochemistry, located in the Biological garden of Usmanu Danfodiyo University, Sokoto. Sokoto is located between Latitudes 12° and 13° N, and Longitudes 4° and 6° E in the Northern part of Nigeria and at an altitude of 350 m above the sea level (Mamman et al., 2000). The state falls within the Sudan savannah vegetation zone with alternating short and dry

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seasons. A hot dry spell extends from March to May and sometimes to June, in the extreme northern part of the state. A short, cool, dry period (harmattan) occurs between October and February (Mamman et al., 2000; SSMIYSC, 2007).

a) Experimental Animals and Their Management

Thirty Six adult albino rats of both sexes weighing between 150 -170 g, were obtained from National Veterinary Research Institute, (NVRI) Vom, and used for the study. The rats were housed in cages in a well-ventilated room with free access to feed (grower mash) and water. The rats were allowed to acclimatize under laboratory condition for a period of two weeks before the commencement of the experiment. Fresh Camel milk and urine were administered to the rats by oral intubation, in doses according to the experimental protocol.

b) Induction of Diabetes Mellitus

Diabetes mellitus was induced according to Szkudelski (2001), the rats were injected with a single dose of 120mg/kg bw of alloxan monohydrate, in dorsally recumbent position via penial vein. Food and water were given to the animals 30 minutes after the drug administration. A sample of the rat□s venous blood was collected 7 days after induction and DM was confirmed by measuring the serum glucose level with the aid of Accu Chek glucometer (mode: AE-350, BY ERMA INC). Rats that had serum glucose level >7.0 mmol/l were considered diabetic.

c) Experimental layout

The 36 diabetic albino rats were randomly allocated into four treatment groups of nine rats each. A 4 X 3 factorial design involving 4 product treatments (milk, urine and milk-urine combination) and 3 dose levels (0.5. 1.0 and 1.5 ml) were used.

d) Blood collection

Blood samples for monitoring of blood glucose level were taken from the tail. The tail of each of the rats was pricked with lancet and a drop of the blood was collected on the test strip and inserted into the glucometer to read glucose concentration on the screen in mg/dl. Readings were taken before, after the induction and at 28 days post treatment. The first blood collection (pre-induction) was for screening of the animals, while the second collection (post-induction) was for the confirmation of DM. The third collection was for the determination of the effect of treatments.

The serum lipids were measured 28 days after the commencement of the treatments where the animals were fasted overnight and sacrificed. The blood of the animals was collected in plain bottle, centrifuged and the serum separated and kept in labeled sample bottles at 4°C until required for lipid profile analysis.

e) Data collection

Serum glucose level was measured using glucometer, Total cholesterol (TC), Triglycerides (TG) and High Density Lipoprotein (HDL) were determined using Randox cholesterol kit (mode: CAT/TYP 05075548002, ROCHE INC). Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) were calculated using Friedewald formula (Friedewald et al., 1972).

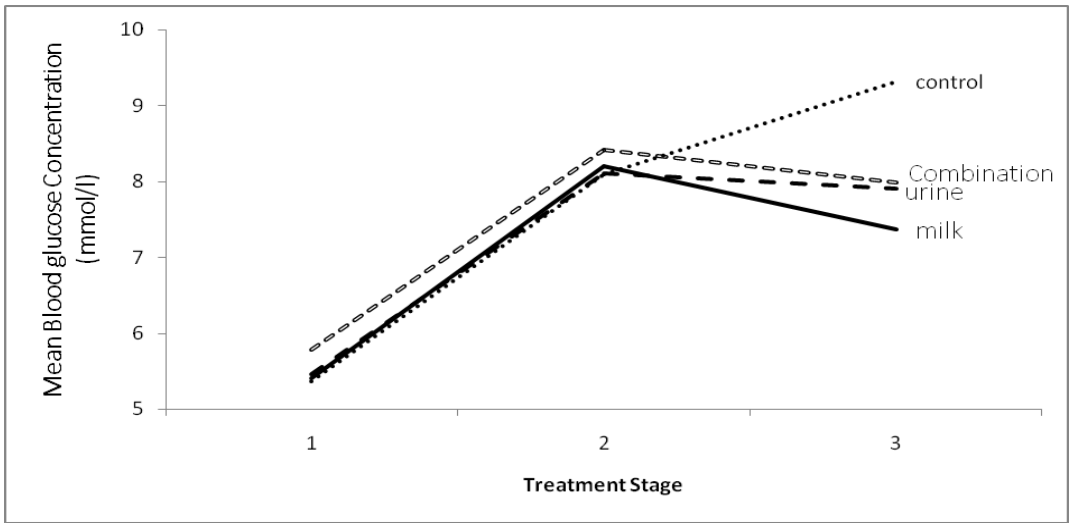
f) Data analyses

General Linear Model (GLM) univariate procedure was used to determine the effects of the product treatments and dose on serum glucose, TC, TG, HDL, LDL, and VLDL significant means were separated using tukey test.

III. Results and Discussions

a) Effect of Camel Milk and Urine on Serum Glucose

Before induction all the animals were in non-diabetic state, however, after successful induction there was a sharp increase in blood glucose levels in all the rat groups. With the commencement of treatment there was a steady decline in serum glucose in groups except the control groups. The groups administered camel milk had the lowest concentration of serum glucose, while there was no decline in serum glucose in the control groups (Figure 1).

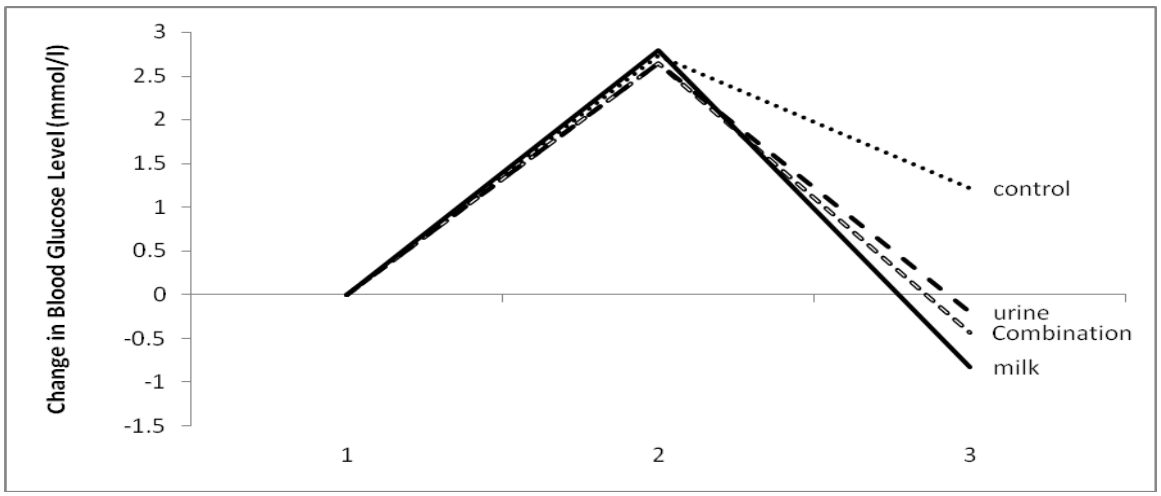


1= Pre- induction, 2= Post- induction before treatment 3= 28 days Post-treatment.

Figure 1: Change in blood glucose level among the various treatments groups

The trend indicated that the camel milk and urine had some hypoglycemic effects that might be due some hypoglycemic factors they contain.

The rate of decline in serum glucose of the control group (Figure 2) was greater in treated groups than in the control group. In all the treated groups, serum glucose fell below pre-induction stage. At the post-treatment stage, the order of decline in rate of serum glucose follow milk>combination>urine.



1= Pre- induction, 2= Post- induction before treatment 3= 28 days Post-treatment.

Figure 2: Rate of change in serum glucose across the treatment

The trend indicated that the drop in serum glucose in treated group is suggestive of the presence in the products of hypoglycemic factors, which was in fact reported for camel milk by Singh (2001). It is conceivable that this same factor might be present in the urine, in lower concentration. This may explain the greater decline in milk and milk-urine combination than urine.

There was significant difference in serum glucose between control group and groups administered with camel milk and urine. Significant differences also exist among treated groups (Table 1.). Milk recorded the lowest value followed by urine and milk-urine combination between which there was no difference (P>0.05). Furthermore, the treatments appear to be dose dependent, where significant reduction in serum glucose was recorded with increasing doses of the products.

Table 1: Blood glucose levels (mmol/l) of albino rats according to treatments and doses

Factor	Serum glucose
Treatment	
Milk	7.37[c]
Urine	7.91[b]
Combination	7.98[b]
Control	9.32[a]
SE	0.16
Dose (ml)	
1.5	7.44[c]
1.0	7.88[b]
0.5	7.96[b]
0.00	9.32[a]
SE	0.16
Interaction	NS

abc, means bearing different superscript along the same column within a subset differ (P<0.05);

NS not significant

The significant lower serum glucose level in rats administered with camel milk might be due to the high insulin-like protein concentration in camel milk. As reported by Singh (2001) who reported that the camel milk contains a high concentration about 52 units/l of insulin-like protein. This insulin-like protein was reported to have hypoglycemic effects (Sboui et al., 2010) by either increasing the release of insulin from the pancreatic beta-cells or by increasing its activity.

This insulin-like factor was reported (Wangoh, 1993) to be resistant to stomach acid degradation as it is encapsulated by casein micelles; this is evident in the fact that camel milk does not form coagulum in the stomach or in acidic medium.

Another possible explanation for the hypoglycemic effect of camel milk is the finding of Kamal (2012) that it has regenerative effects on damaged cells of the pancreas. All these factors may contribute to the observed hypoglycemic effect of camel milk in the study.

The low concentration of serum glucose in rats administered with camel urine, suggest the likely presence of the insulin-like protein, since it has been established to be present in milk (Singh, 2001), its presence in urine is therefore highly probable.

The lower concentration of serum glucose in treated rats may also be related to the report of Yadav et al. (2015) that some plants materials consumed by camel have anti-diabetic effects and the active ingredients are present in the body fluids such as urine and milk.

b) Effect of Camel milk and urine on Serum Lipids

Rats administered camel milk and urine separately and in combination had significantly lower TG, TC, LDL and VLDL than the control groups. HDL was however higher (P<0.05) in the treated groups. Dose had no effect (P>0.05) on all the lipid parameters among the treated groups. Treatment x Dose interaction was also not significant (Table 2).

Table 2: Serum lipids (mg/dl) in alloxan induced diabetic rats according to treatments and doses

Factor	Serum Lipids (mg/dl)				
Treatment	TC	TG	HDL	LDL	VLDL
Control	248.33[a]	237.11[a]	15.33[d]	296.11[a]	54.44[a]
Camel milk	164.44[b]	134.89[b]	43.44[a]	146.44[c]	27.67[b]
Camel urine	168.78[b]	133.0[b]	29.36[c]	168.79[bc]	27.22[b]
Milk- Urine combination	185.67[b]	143.44[b]	37.22[b]	191.78[b]	28.78[b]
S.E	6.68	10.22	2.04	10.50	2.00
Dose (ml)					
1.5	182.33[b]	141.22[b]	177.33[b]	33.67[a]	28.22[b]
1.0	163.89[b]	132.89[b]	160.67[b]	39.78[a]	27.44[b]
5.0	172.67[b]	137.22[b]	169.00[b]	36.78[a]	28.00[b]
0.0	248.33[a]	273.11[a]	296.11[a]	15.33[b]	54.44[a]
S.E	7.45	4.85	9.03	1.90	0.90
Treatment x Dose Interaction	NS	NS	NS	NS	NS

abcd, means bearing different superscripts along the same column within a subset differ (P<0.05)
NS = Not significant
Key: Total cholesterol (TC), Triglycerides (TG), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL)

Hyperlipidemia is a recognized consequence of diabetes mellitus (Sherma et al., 2003). Thus the higher TC, LDL, VLDL and TG in the control group than in treated groups. The higher lipid value of control group is due to DM, which led to abnormalities in lipid metabolism (Arkkila et al., 2001). The increase in lipids in the control group may be attributed to excess mobilization of fat from the adipose tissue due to the under utilization of the glucose (Krishna kumar et al., 2000). It appears that camel milk and urine have hypolipidaemic effects because the treated groups showed significantly lower levels of these lipids (Table 3).

Since insulin has been reported to activate lipoprotein lipase (Arkkila et al., 2001), an enzyme that hydrolyses triglyceride leading to low serum lipids. The presence of insulin-like protein (Singh, 2001) in camel milk will lower lipid components in camel milk treated rats. This supposition is supported by Hull, 2004 and Agrawal et al., (2007b) showing that a high insulin-like factor concentration of camel milk can cause the activation of lipoprotein lipase enzyme.

The HDL level in the treated groups is higher compared to the lower group. This may probably due the presence of some enzymes in camel milk and urine that enhance the reverse cholesterol transport system Al-Numair (2010). In addition the mechanisms by which HDL decreases in diabetes may be due to the impaired metabolism of triglycerides rich lipoprotein with decreased activity of lipoprotein lipase and impaired transfer of materials to the HDL components, in addition to the high level of hepatic lipase among diabetics (Balkis 2009). Finally, insulin resistance may be a direct cause of decrease of HDL concentration (Van Linthout et al., 2010).

A significant increase in LDL and VLDL levels may lead to a significant decrease in HDL levels. The inverse relationship between VLDL and HDL (Boizel 2000) might also explain lower levels of the HDL in the control groups.

The decrease in TC and TG in the treated groups and the increase in HDL in the present study are in agreement with Hassan and Emam (2012), who reported similar findings.

IV. Conclusions

The following conclusions were drawn from the study.

1. Camel milk and urine reduced serum glucose in rats
2. Rate and extent of serum glucose reduction was highest in milk
3. The hypoglycemic and hyperlipidemic effects of the products are not dose dependent.

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Avifauna Species Abundance and Diversity in Modibbo Adama University of Technology Yola, Adamawa State, Nigeria

By Kwaga, B. T., Gawaisa, S. G., Ali A. & Khobe, D.
Adamawa State University

Abstract- The study focused on the abundance and diversity of avifauna species at Modibbo Adama University of Technology (MAUTECH) Yola, in Girei local Government Area, Adamawa State. Information on species abundance and diversity is yet to be ascertained in the study area. Three habitat types (grassland, woodland and riparian) were selected for the study. Three transects of 1km length were established in each of the habitats. Data on avifauna species abundance was obtained through total count method. Diversity was determined using Simpson Diversity Index. Data on the avifauna species abundance was subjected to descriptive statistics (Frequency Tables and Percentages), while data on species diversity was analyzed using Simpson Diversity Index. The results obtained showed a list of 24 different avifauna species with their population distributed across the study sites (157and 164 for grassland, 200 and 140 for woodland and 272 and 164 for riparian areas) during morning and evening hours respectively.

Keywords: *avifauna, species, abundance, diversity.*

GJSFR-D Classification: *FOR Code: 300599*

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Avifauna Species Abundance and Diversity in Modibbo Adama University of Technology Yola, Adamawa State, Nigeria

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Keywords: avifauna, species, abundance, diversity.

I. Introduction

Birds are very visible and integral part of the ecosystem. They occupy many trophic levels in the food-chain, ranging from consumers to producers. Their occurrences have been helpful as environmental health indicators, plant/crop pollinators and seed dispersal as well as pest control (Ranchandria, 2013; Bideberi, 2013). Diversity is the biological assemblage of species in its entity, which is the complete representation of all possible measures of biological diversity across space and time (Kwaga *et al.* 2017). Species diversity is often measured as an index that incorporates the interplay between species richness and abundance (Lasorte and Boecklen, 2005).

Quantifying the avifauna species abundance and diversity in communities has gained increasing importance in environmental impact assessment especially in conservation planning and ecological research (Mohammed and Mohammed, 2011). Species inventories not only help in understanding species losses but also help determine the characteristics of species that are vulnerable to habitat perturbations (Koh *et al,.* 2004).Assessment of avifauna species is essential for sustainable development. The lack of it results in weak monitoring of bio-data, vegetation degradation and loss of ecosystem resources (Santhalakshmi *et al.,*, 2014). Wrong attitude towards achieving its goal has led to reduced variety of ecosystem potentials which could have negative impact on socio-economic development of varieties of goods and services derived from the ecosystem.

The species richness is simply the total number of species within a habitat or community. Species richness is the most commonly used measure of diversity because it is a straightforward measure and it is intuitive. Species diversity is a measure of both the number of species (species richness) and the relative contribution of each of these species to the total number of individuals in a community (evenness) (Stiling, 2002; Mukund *et al.,* 2012). Birds are warm blooded; they have been able to adapt themselves to living in climates varying from the ice snow of the Antarctic to the fringes of the hottest deserts.

Diversity has been referred to as the quantitative measure that reflects how many different species are in existence in a data set. A variety of objective measures have been created in order to measure of diversity. The basic idea is to obtain a quantitative estimate of biological variability that can be used to compare biological entities, composed of direct components, in space or time (Albert, 2012; Santha lakshmi *et al., 2014* Magurran, 2004).

Assessment of birds' species richness and abundance of an area makes it possible for any organization to plan for future conservation and sustainable utilization of avifauna resources (Anne and Brian, 2011; Khobe and Kwaga, 2017). Hence, the need for this study which is aimed at assessment of avifauna species richness and diversity in Modibbo Adama University of Technology (MAUTECH), Yola of Adamawa State, Nigeria.

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II. Methodology

a) The Study Area

The study area is Modibbo Adama University of Technology (MAUTECH), Yola. It is located at Sangere in Girei local Government area, Adamawa state in the North-Eastern part of Nigeria. Adamawa State covers a land mass of 39,742.12 sq km. This is about 4.4% of the land area of Nigeria. The study area lies between latitudes12^{0}30'N to 12^{0}42'N and longitudes 12^{0}30'E to 12043'E. (Figure1) (Department of Geography, MAUTECH, Yola, 2018). The study area is characterized by two well defined climatic seasons which starts from May and ends in October, while dry season commences from November through April. The average annual rainfall is about 972mm with average of 62 rainy days. The highest occurrence of rain in the study area is in August and September. (Adebayo, 1999). The dominant woody plant species incude: *Khaya senegalensis, Detarium microcarpum, Prosopis africana, Combretum species, tamarindus indica, Terminalia albida, Terminalia mantaly, Zizipus mauritiana, Balanites aegyptiaca* among others. Some of the existing fauna resources are; squirrel, monitor lizard, alligator lizard, hare and several species of birds (Akosim *et al.,* 2007).

b) Study Design and Data collection

The study design followed the method described by Sutherland (1999) and adopted by Kwaga *et al.,* (2017). Reconnaissance survey was carried out in order to ascertain the existing habitats, possible transects for bird identification in the area following Akosim *et al.* (2007) and Kwaga *et al.* (2017) methods. This was followed by the division of the entire area into three (3) basic habitats(A. Grassland/ Area under cultivation, B. Wood land/Partially disturbed area and C. Riparian/along the stream).Survey was carried out between 6.30am and 9.30am (morning hours) and 3.00pm and 6.00pm (afternoon hours). Nine (9) transects of 1km each (i.e. 3 transects per each habitat) were laid and assessed following Sutherland (1999) and adopted by Mukund *et al.,* (2012). The study lasted for a period of six (6) months (June – November, 2018). Each bird species identified and frequency noted with the aid of binoculars and related literatures as outlined by Baker (1993) and adopted by Nik and Ron(2008). The leaders of the community where the study was conducted served as source of information regarding the usage of the area under study as well as identification of the available avifauna species. Information on the micro-climatic factors (rainfall, temperature, relative humidity) was obtained from the Department of Geography of MAUTECH, Yola. The assessment was limited to avifauna species lists and diversity in each of the selected habitats following Rappole *et al.,* (1993), Ali (2015), Khobe and Kwaga (2017) and Kwaga *et al.,* (2017) guides.

c) Statistical Analysis of Data

i. Data on avifauna species list in the study area were assessed using descriptive statistics (Tables, frequencies, percentages).
ii. Simpson diversity index as described by Akosim *et al.,* (2007) as well as Kwaga *et al.,* (2017) was employed in the determination of avifauna species diversity in the study area.

The mathematical formula is as follows:

$$D = \sum_{i=1} p_i^2$$

Where,
D = Simpson diversity index,
P*i* = Proportion of species, that is = n_i / N
n*i* = individual of species in a sample N

D has a maximum value of 1 in a monoculture and becomes smaller as the community/species becomes more diverse.

III. Results and Discussion

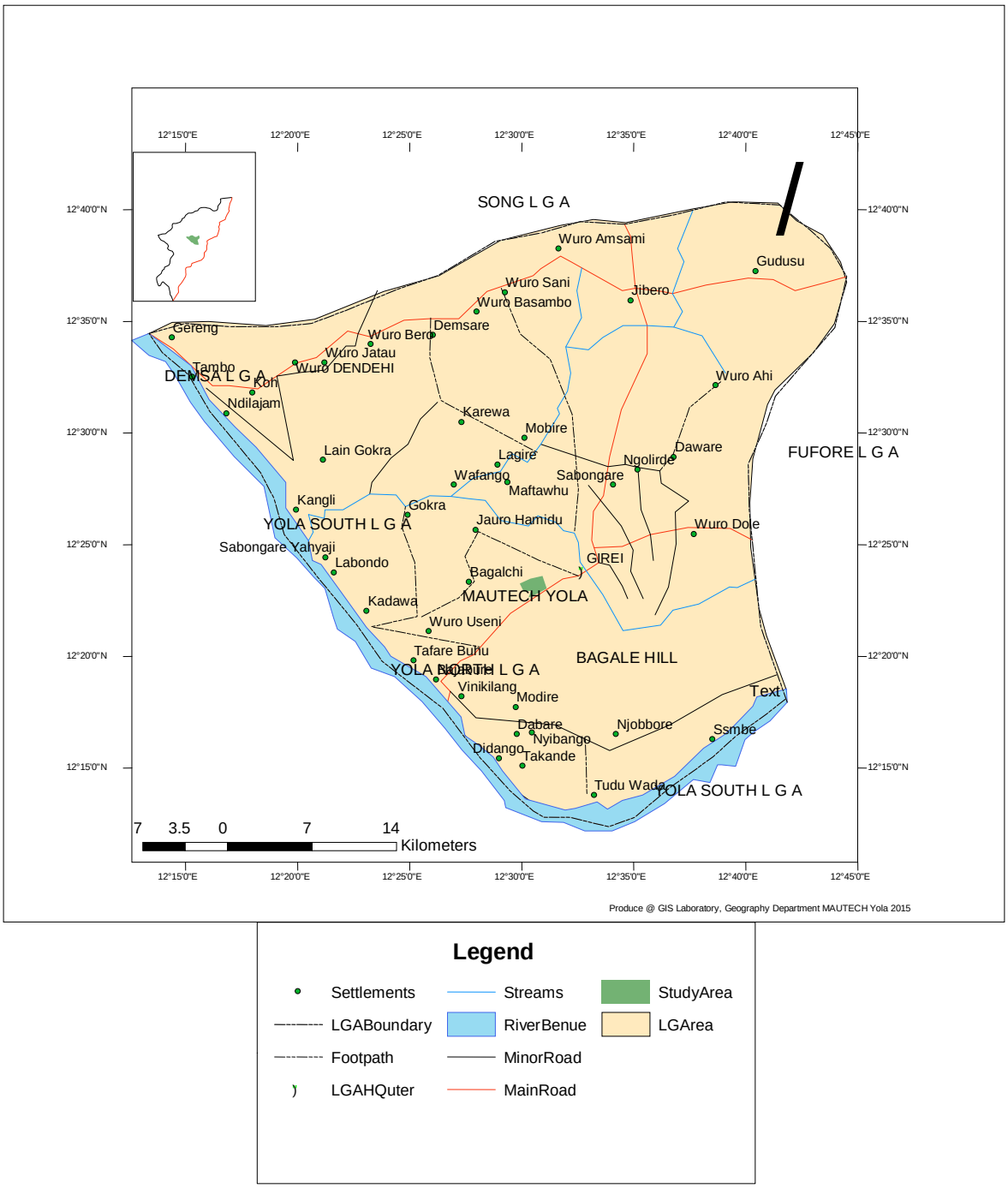
The results of avifauna species composition in the study area for morning hours are presented in Tables1, 2 and 3. A check-list of 24 different avifauna species was encountered. A total of 157, 200 and 272bird species were encountered. *Treron calvus* had the highest frequency 99.55%), while *Alethe peliocephala* had the least (0.64%) in grassland. *Ploceus vitellinus*(8.00%) and *Tockus nasutus*(1.00%) , while *Treron calvus*(8.82%)and *Oena capensis*(1.83)had the highest and lowest frequencies in woodland and riparian habitats respectively. Tables 4, 5 and 6 showed the result of avifauna species identified during evening session in the study area. From the results obtained, 164, 140 and 164 individuals were identified during evening session in grassland, woodland and riparian respectively. The results also indicated that *Chacomitra rubescens* (11.58%) and *Centropus senegalensis* (0.61%), *Tockus camerus* (11.42) and *Alethe castanea* (0.71) and *Pochycoccyx audeberti* (9.75%) and *Hyliota australis* (0.70%) had the highest and lowest avifauna frequencies in grassland, woodland and riparian respectively. From the findings of this study, it indicated that many of the species (*Hyliota australis, Hyliota australis, Treron calvus, Bubulcus ibis, Oena capensis, Dicrurus adsimilis, Pterodes senegallus, Ciconia nigra* and *Urotriorchis macrourus)* were available in allthe transects across the study area. The finding of this study in relation to avifauna species distribution is not unconnected with the observation of Khobe and Kwaga (2016) who observed that decreased or degraded forest area could lead not only to loss of biodiversity but also individuals of the ecosystem. Abubakar and Abubakar (2013) made similar observation during their study of Nguru Lake.

The abundance of avifauna species in the wood land and riparian areas might have been influenced by its micro-climate for optimum performance of the ecosystem. This finding is in agreement with Akosim *et al.,* (2007) who observed that plants do not only provide food for animals/birds including insects but also influences micro-environment for the optimum performance of other fauna species. The finding of this study is also in strong agreement with Santhalashmi *et al.,*(2014) who reported that species composition, abundance and distribution is a function of its rich habitat with ecological requirements of the species in question

The result of avifauna species diversity in the study area is presented in Table 7. The diversity ranged from 0.2926 to 0.3885, 0.2642 to 0.3850 and 0.2757 to 0.3823 in grassland, woodland and riparian habitats respectively The findings of avifauna species diversity and abundance did not vary very much between transects as well as amongst the habitats. This could be probable due to similar distribution of habitat variables. The value of 1.0000and 0.9999 obtained in woodland as well as riparian reached maximum, indicating high species of avifauna in the study area. This may not be unconnected with the available ecological requirements of the habitats. This finding is in agreement with the report of Bideberi (2013) and Kwaga *et al.,* (2017) who reported that, diversity, distribution and abundance of avifauna species is related to their habitat types.

IV. Conclusions

The study focused on the abundance and diversity of avifauna species in Modibbo Adama University of Technology Yola, Adamawa State, Nigeria. From the results obtained, it can be concluded that there was a great similarity in the bird species composition in the study area. Avifauna species richness and diversity were compared in related habitats. Considering the importance of the fragments, the grassland served as a corridor within which farming activities and source of livelihood (fuel wood, herbs, food, grazing animals etc.) were confined. Inventory should be carried on other fauna, insects and reptiles to ascertain the wild animal resources of the area.



Source: Department of Geography, Mautech. Yola (2015)

Figure 1: Map of Girei Local Government Showing the study Area

Table 1: Avifauna Species Abundance in Grassland of the Study Area (Morning session 6.30-9.30am)

S/N	Species common name	Scientific name	Frequencyper Transect I	II	III	Total	Percentage
1.	African grey hornbill	*Tockus nasutus*	2	--	--	2	1.27
2.	African mourning dove	*Streptopelia rosegrisea*	3	1	2	6	3.82
3.	Grey-rumped swallow	*Pseudhirundo griseopyga*	2	5	--	7	4.45
4.	Southern hyliota	*Hyliota australis*	1	--	3	4	2.54
5.	African mustached wabler	*Melocichla mentalis*	--	2	--	2	1.27
6.	Black bee-eater	*Merops Muelleri*	--	1	4	5	3.18
7.	African green pigeon	*Treron calvus*	4	5	6	15	9.55
8.	Red-bill dwarf hornbill	*Tockus camurus*	6	1	--	7	4.45
9.	Thich-billed cuckoo	*Pachycoccyx audeberti*	1	--	4	5	3.18
10.	Abyssinian roller	*Coracias abyssinicus*	3	2	2	7	4.45
11.	Cattle egret	*Bubulcus ibis*	6	--	1	7	4.45
12.	Red-checked cordon bleu	*Uraeginthus bengalus*	4	--	1	5	3.18
13.	Green-throated sunbird	*Chalcomitra rubescens*	4	4	3	11	7.00
14.	Masked weaver	*Ploceus vitellinus*	6	3	1	10	6.36
15.	Senegal coucal	*Centopus senegalensis*	3	--	4	7	4.45
16.	Namaqua dove	*Oena capensis*	1	2	6	9	5.73
17.	Nimbia flycatcher	*Melaenormis annamarulae*	2	6	1	9	5.73
18.	Forked tailed drongo	*Dicrurus adsimilis*	5	1	--	6	3.82
19.	Yellow billed expecker	*Buphagus africanus*	1	5	1	7	4.45
20.	Brown-chested alethe	*Alethe peliocephala*	--	1	--	1	.64
21.	Fine-chested alethe	*Alethe castanea*	--	5	2	7	4.45
22.	Spotted-sand grouse	*Pterodes senegallus*	--	3	--	3	1.91
23.	Black stork	*Ciconia nigra*	3	--	6	9	5.73
24.	Long-tailed hawk	*Urotriorchis macrourus*	4	1	1	6	3.82
	Total		61	50	46	157	99.88

Field Survey, 2018

Table 2: Avifauna Species Abundance in Woodland of the Study Area (Morning session 6.30-9.30am)

S/n	Species common name	Scientific name	Frequency per Transect I	II	III	Total	Percentage
1.	African grey hornbill	*Tockus nasutus*	2	--	--	2	1.00
2.	African mourning dove	*Streptopelia rosegrisea*	--	2	2	4	2.00
3.	Grey-rumped swallow	*Pseudhirundo griseopyga*	3	--	2	5	2.50
4.	Southern hyliota	*Hyliota australis*	10	--	4	14	7.00
5.	African mustached wabler	*Melocichla mentalis*	4	10	--	14	7.00
6	.Black bee-eater	*Merops muelleri*	4	--	6	10	5.00
7.	African green pigeon	*Treron calvus*	2	6	--	8	4.00
8.	Red-bill dwarf hornbill	*Tockus camurus*	--	4	2	6	3.00
9.	Thich-billed cuckoo	*Pachycoccyx audeberti*	--	6	2	8	4.00
10.	Abyssinian roller	*Coracias abyssinicus*	2	2	6	10	5.00
11.	Cattle egret	*Bubulcus ibis*	2	4	2	8	4.00
12.	Red-checked cordon bleu	*Uraeginthus bengalus*	4	2	1	7	3.50

Field Survey, 2018

13. Green-throated sunbird	*Chalcomitra rubescens*	6	2	4	12	6.00
14. Masked weaver	*Ploceus vitellinus*	2	6	8	16	8.00
15. Senegal coucal	*Centopus senegalensis*	1	3	2	6	3.00
16. Namaqua dove	*Oena capensis*	3	1	2	6	3.00
17. Nimbia flycatcher	*Melaenormis annamarulae*	--	6	1	7	3.50
18. Forked tailed drongo	*Dicrurus adsimilis*	1	2	--	3	1.50
19. Yellow billed expecker	*Buphagus africanus*	4	6	1	11	5.50
20. Brown-chested alethe	*Alethe peliocephala*	1	4	--	5	2.50
21. Fine-chested alethe	*Alethe castanea*	5	2	3	10	5.00
22. Spotted-sand grouse	*Pterodes senegallus*	2	8	5	15	7.50
23. Black stork	*Ciconia nigra*	2	--	1	3	1.50
24. Long-tailed hawk	*Urotriorchis macrourus*	1	1	8	10	5.00
	Total	61	77	62	200	100.00

Field Survey, 2018

Table 3: Avifauna Species Abundance in the Riparian of the Study Area (Morning session 6.30 9.30am)

S/n	Species common name	Scientific name	Frequency per Transect I	II	III	Total	Percentage
1.	African grey hornbill	*Tockus nasutus*	--	--	8	8	2.94
2.	African mourning dove	*Streptopelia rosegrisea*	5	2	5	12	4.41
3.	Grey-rumped swallow	*Pseudhirundo griseopyga*	2	--	6	8	2.94
4.	Southern hyliota	*Hyliota australis*	2	5	--	7	2.57
5.	African mustached wabler	*Melocichla mentalis*	5	--	10	15	5.51
6.	Black bee-eater	*Merops muelleri*	5	6	--	11	4.04
7.	African green pigeon	*Treron calvus*	7	10	7	24	8.82
8.	Red-bill dwarf hornbill	*Tockus camurus*	5	6	--	11	4.04
9.	Thich-billed cuckoo	*Pachycoccyx audeberti*	--	2	9	11	4.04
10.	Abyssinian roller	*Coracias abyssinicus*	2	5	1	8	2.94
11.	Cattle egret	*Bubulcus ibis*	--	7	4	11	4.04
12.	Red-checked cordon bleu	*Uraeginthus bengalus*	8	4	2	14	5.14
13.	Green-throated sunbird	*Chalcomitra rubescens*	--	4	6	10	3.67
14.	Masked weaver	*Ploceus vitellinus*	3	--	3	6	2.20
15.	Senegal coucal	*Centopus senegalensis*	10	3	--	13	4.77
16.	Namaqua dove	*Oena capensis*	--	4	1	5	1.83
17.	Nimbia flycatcher	*Melaenormis annamarulae*	5	--	8	13	4.77
18.	Forked tailed drongo	*Dicrurus adsimilis*	8	8	1	17	6.25
19.	Yellow billed expecker	*Buphagus africanus*	8	--	9	17	6.25
20.	Brown-chested alethe	*Alethe peliocephala*	1	2	7	10	3.65
21.	Fine-chested alethe	*Alethe castanea*	1	2	6	9	3.30
22.	Spotted-sand grouse	*Pterodes senegallus*	2	3	1	6	2.20
23.	Black stork	*Ciconia nigra*	3	1	2	6	2.20
24.	Long-tailed hawk	*Urotriorchis macrourus*	1	1	8	10	3.67
	Total		93	75	104	272	96.21

Field Survey, 2018

Table 4: Avifauna Species Abundance in the Grassland of the Study Area (Evening session 3.00-6.00pm)

S/n	Species common name	Scientific name	Frequency per Transect I	II	III	Total	Percentage
1.	African grey hornbill	*Tockus nasutus*	2	--	1	3	1.82
2.	African mourning dove	*Streptopelia rosegrisea*	3	--	1	4	2.43
3.	Grey-rumped swallow	*Pseudhirundo griseopyga*	1	1	5	7	4.26
4.	Southern hyliota	*Hyliota australis*	1	5	--	6	3.65
5.	African mustached wabler	*Melocichla mentalis*	--	2	4	6	3.65
6.	Black bee-eater	*Merops muelleri*	--	3	1	4	2.43
7.	African green pigeon	*Treron calvus*	--	6	--	6	3.65
8.	Red-bill dwarf hornbill	*Tockus camurus*	4	--	2	6	3.65
9.	Thich-billed cuckoo	*Pachycoccyx audeberti*	6	--	5	11	6.71
10.	Abyssinian roller	*Coracias abyssinicus*	1	2	1	4	2.43
11	.Cattle egret	*Bubulcus ibis*	4	--	5	9	5.48
12.	Red-checked cordon bleu	*Uraeginthus bengalus*	3	5	--	8	4.87
13.	Green-throated sunbird	*Chalcomitra rubescens*	8	10	1	19	11.58
14.	Masked weaver	*Ploceus vitellinus*	--	1	10	11	6.71
15.	Senegal coucal	*Centopus senegalensis*	--	1	--	1	0.61
16.	Namaqua dove	*Oena capensis*	1	--	2	3	1.82
17.	Nimbia flycatcher	*Melaenormis annamarulae*	2	4	6	12	7.32
18.	Forked tailed drongo	*Dicrurus adsimilis*	4	1	2	7	4.26
19.	Yellow billed expecker	*Buphagus africanus*	--	4	1	5	3.05
20.	Brown-chested alethe	*Alethe peliocephala*	--	2	1	3	1.82
21.	Fine-chested alethe	*Alethe castanea*	1	1	4	6	3.65
22.	Spotted-sand grouse	*Pterodes senegallus*	2	5	1	8	4.87
23.	Black stork	*Ciconia nigra*	5	1	5	11	6.71
24.	Long-tailed hawk	*Urotriorchis macrourus*	1	1	1	3	1.82
		Total	48	57	59	164	99.85

Field Survey, 2018

Table 5: Avifauna Species Abundance in the Woodland of the Study Area (Evening session 3.00-6.00pm)

S/n	Species common name	Scientific name	Frequency per Transect I	II	III	Total	Percentage
1.	African grey hornbill	*Tockus nasut*	2	--	1	3	2.14
2.	African mourning dove	*Streptopelia rosegrisea*	2	4	4	10	7.14
3.	Grey-rumped swallow	*Pseudhirundo griseopyga*	2	--	8	10	7.14
4.	Southern hyliota	*Hyliota australis*	--	3	4	7	5.00
5.	African mustached wabler	*Melocichla mentalis*	1	5	2	8	5.71
6.	Black bee-eater	*Merops muelleri*	--	2	--	2	1.42
7.	African green pigeon	*Treron calvus*	2	3	--	5	3.57
8.	Red-bill dwarf hornbill	*Tockus camurus*	5	--	11	16	11.42
9.	Thich-billed cuckoo	*Pachycoccyx audeberti*	--	1	3	4	2.85
10.	Abyssinian roller	*Coracias abyssinicus*	2	2	2	6	4.28

11. Cattle egret	*Bubulcus ibis*	1	--	1	2	1.42
12. Red-checked cordon bleu	*Uraeginthus bengalus*	1	3	--	4	2.85
13. Green-throated sunbird	*Chalcomitra rubescens*	4	2	--	6	4.28
14. Masked weaver	*Ploceus vitellinus*	--	5	5	10	7.14
15 .Senegal coucal	*Centopus senegalensis*	2	--	--	2	1.42
16. Namaqua dove	*Oena capensis*	--	5	2	7	5.00
17. Nimbia flycatcher	*Melaenormis annamarulae*	2	--	1	3	2.14
18. Forked tailed drongo	*Dicrurus adsimilis*	--	2	3	5	3.57
19. Yellow billed expecker	*Buphagus africanus*	1	--	4	5	3.57
20. Brown-chested alethe	*Alethe peliocephala*	4	--	2	6	4.28
21. Fine-chested alethe	*Alethe castanea*	1	--	--	1	0.71
22. Spotted-sand grouse	*Pterodes senegallus*	--	4	--	4	2.85
23. Black stork	*Ciconia nigra*	--	5	--	5	3.57
24. Long-tailed hawk	*Urotriorchis macrourus*	5	4	--	9	6.42
Total		37	50	53	140	99.70

Field Survey, 2018

Table 6: Avifauna Species Abundance in the Riparian of the Study Area (Evening session 3.00-6.00pm)

S/n	Species common name	Scientific name	Frequency per Transect I	II	III	Total	Percentage
1.	African grey hornbill	*Tockus nasutus*	2	1	2	5	3.04
2.	African mourning dove	*Streptopelia rosegrisea*	--	2	1	3	1.82
3.	Grey-rumped swallow	*Pseudhirundo griseopyga*	4	3	2	9	5.48
4.	Southern hyliota	*Hyliota australis*	--	1	--	1	0.70
5.	African mustached wabler	*Melocichla mentalis*	--	1	5	6	3.65
6.	Black bee-eater	*Merops muelleri*	6	4	2	12	7.31
7.	African green pigeon	*Treron calvus*	1	--	1	2	1.21
8.	Red-bill dwarf hornbill	*Tockus camurus*	2	5	--	7	4.26
9.	Thich-billed cuckoo	*Pachycoccyx audeberti*	--	6	10	16	9.75
10.	Abyssinian roller	*Coracias abyssinicus*	3	1	2	6	3.65
11.	Cattle egret	*Bubulcus ibis*	--	2	1	3	1.82
12.	Red-checked cordon bleu	*Uraeginthus bengalus*	5	--	6	11	6.70
13.	Green-throated sunbird	*Chalcomitra rubescens*	1	10	--	11	6.70
14.	Masked weaver	*Ploceus vitellinus*	2	--	5	7	4.26
15.	Senegal coucal	*Centopus senegalensis*	--	1	4	5	3.04
16.	Namaqua dove	*Oena capensis*	--	1	1	2	1.21
17.	Nimbia flycatcher	*Melaenormis annamarulae*	7	--	1	8	4.87
18.	Forked tailed drongo	*Dicrurus adsimilis*	1	2	--	3	1.82
19.	Yellow billed expecker	*Buphagus africanus*	3	--	1	4	2.43
20.	Brown-chested alethe	*Alethe peliocephala*	--	5	--	5	3.04
21.	Fine-chested alethe	*Alethe castanea*	--	1	3	4	2.43
22.	Spotted-sand grouse	*Pterodes senegallus*	2	--	--	2	1.21
23.	Black stork	*Ciconia nigra*	--	2	1	3	1.82
24.	Long-tailed hawk	*Urotriorchis macrourus*	4	1	1	6	3.65
	Total		48	57	59	164	85.16

Field Survey, 2018

Table 7: Avifauna Species Diversity in the study Area

Habitat Type	Transects	Morning session	Evening session
Grassland	I	0.3885	0.2926
	II	0.3184	0.3475
	III	0.2929	0.3597
Simpson Diversity Index		0.9998	0.9998
Woodland	I	0.3050	0.2642
	II	0.3850	0.3571
	III	0.3100	0.3785
Simpson Diversity Index		1.0000	0.9998
Riparian	I	0.3419	0.2926
	II	0.2757	0.3472
	III	0.3823	0.3475
Simpson Diversity Index		0.9999	0.9998

Field Survey, 2018

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7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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