International Archives of Food and Agricultural Sciences

Volume 1, Issue 1, 2019

Contact at:
https://cintarch.org/
editor@cintarch.org

ABOUT IAFAS

International Archives of Food and Agricultural Sciences (**IAFAS**) is published by **C-International Archives**. It is a peer-reviewed bi-monthly online open access journal containing original research papers, reviews, short communications and other types of research papers in all fields of food and agricultural sciences.

Submission of Manuscript

Please read the "Authors Guidelines" before submitting your manuscript. Manuscript can be submitted through our online submission platform at https://cintarch.org/submit-manuscripts/, or sent as an email attachment (together with the completed submission/copyright transfer agreement form) to editor.cintarch@gmail.com

A manuscript number will be mailed to the corresponding author shortly after submission.

Editorial Board

The board is about to be constituted.
The list shall be released as soon as members are appointed.

To join our editorial board, please send your CV to editor.cintarch@gmail.com

Authors Guidelines

We accept a manuscript on the understanding that it is reporting unpublished work and that it is not under consideration for publication elsewhere. The manuscript should be original work of authors and correspondence author will act as guarantor. All manuscripts received will be duly acknowledged.

Manuscript types

The types of manuscripts we routinely accept include: original research article, review article, case reports, short communication, research letter, letter to the editor, and correspondence.

Authorship

All authors should have made substantial contributions to the conception and design of the study; data collection analysis and interpretation; drafting and critical revising of manuscript for important intellectual content; and final approval of the version to be submitted.

Preparation of manuscript

Manuscript should be written in English and typed in Arial, Font size 11, and with a spacing of 1.5. Research articles should include the following: title, abstract, introduction, materials and methods, results (to include tables and figures), discussion, conclusion, limitations, acknowledgements, and references. Each of title to discussion should begin on a fresh page.

Title page

The title page should be the first page of the manuscript; it should contain an informative title, and the first name, initial and last name (i.e., surname) of each author (e.g., Brown E Morrison). Enter the authors' affiliation addresses below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Also specify the corresponding author (who is responsible for handling the correspondence at all stages of peer review publication) and the corresponding e-mail and postal address.

The title page should also contain a running title for the article (maximum of 10 words), word count for abstract, word count for text, and total number of tables and figures. It should also contain information on source of funding (e.g., *Funding: Nil*), and conflict of interest (e.g., *Conflict of Interest: None declared*).

Abstract

The abstract should be on the second page of the manuscript, it must be concise and factual (maximum of 250 words). The abstract should state briefly the purpose of the research, the principal results and major conclusions. Although, an unstructured abstract is acceptable, it should contain information on the problem statement, the aim of the study, the methods used, the relevant results, and a brief conclusion.

Keywords: About 3 to 6 keywords should be provided below the abstract.

Introduction

The introduction should give a short and clear account of the background of the study, the problem statement, the rationale (or justification) for the study and its aim and objectives. Only previous studies that are relevant to the problem being addressed in the present study should be cited.

Materials and Methods
This should contain information on the study design, study population, study centre or area (i.e., where the study was conducted) and when the study was conducted. For quantitative research, authors should supply information on sample size estimation, sampling technique, inclusion and exclusion criteria, as well as the method and instrument of data collection. If an instrument was adopted or adapted, the source(s) should be cited. The statistical tool used to analyze the data should be mentioned.
All manuscripts of studies involving experimental animals or human subjects should contain a statement on ethical approval from appropriate ethics committee. Authors are expected to prepare their manuscript based on the International Committee of Medical Journals Editors guideline on "Uniform requirements for Manuscripts submitted to Biomedical Journals" (Available from: http://www.icmje.org/).

Results
Results should be presented in a logical sequence in the text, tables, and figures, giving the main or most important findings first. Authors should not repeat in the text all the data in the tables or figures; only emphasize or highlight the important observations.
Tables
Each table should be inserted immediately after the text where it was reported. Tables should be numbered consecutively with Arabic numerals and the number should be followed by a brief descriptive caption, occupying not more than two lines, at the head of the table (e.g. *Table 1: Socio-demographic characteristics of respondents*).
Tables should be appropriately cited in the manuscript (i.e., the number of the table concerned should be indicated in the text where it was reported). Tables should normally be self-explanatory, with necessary descriptions provided underneath the table. Each column should have a heading and the units of measurement should be given in parentheses in the heading. Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.
Figures
Each figure should be inserted immediately after the text where it was reported. Figures should be numbers consecutively followed by a descriptive caption below the figure (e.g., *Figure 1: Main reason for not complying with occupational safety practices*). Figures should be appropriately cited in the manuscript (i.e., the number of the figure concerned should be indicated in the text where it was reported).
Authors are encouraged to use color to enhance the impact and clarity of figures. Figures should be prepared at a minimum of 300 dpi, and should be pasted as JPEG in the manuscript. However, use of tables and figures should be kept to a minimum. Total number of tables and figures should not be more than 7.

Discussion
The purpose of the discussion is to present a brief and pertinent interpretation of the results against the background of existing knowledge.

Conclusion
This should contain a clear statement of how the study advances knowledge and understanding in the field.

Limitation(s) of the study
The limitations encountered (that could affect the validity of the findings of the study) should be stated, as well as the actions taken to overcome them.

Acknowledgements
All contributors who do not meet the criteria for authorship as defined above should be listed in the acknowledgements section.

References
Havard referencing style should be used; in the text, a reference identified by means of an author's name should be followed by the date of the reference in parentheses; for example: (Alam, 2002).

For two authors, list both authors; for example: (Brown and James, 2016). When there are more than two authors, only the first author's name should be mentioned, followed by 'et al.' In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter; for example: (Morison, 2016a; Morison, 2016b). Two or more citations in the same parentheses should be arranged alphabetically not chronologically; for example (Abraham et al., 2016; David et al., 2013).

In the references list, write the authors' names and initials followed by the year of publication. All authors should be quoted even if they are more than six. The reference list is arranged alphabetically based on the surnames of the respective first authors.

Alam M (2002): Knowledge, Attitude and Practices among Health Workers on needle stick injuries. Annals of Saudi Med. 22: 5 – 6.

Braunwald E, Fauci AS, Kasper DL (2001). Principles of Internal Medicine. 15th ed. New York: Mc. Graw Hill. Pp. 588 – 591.

Nagao Y, Kawaguchi T, Yanalu K, Ide I, Haradu M, Kumashin R, Sata M (2005). Causal relationship between Hepatitis C core and the development of type 2 diabetes in Hepatitis C virus hyperendemic area: a pilot study. Int. J. Mol. Med. 16: 109-114.

Other types of manuscripts (including reviews, case reports and correspondence) should be prepared as described for original research papers (i.e., with respect to text style, tables, figures and references.

Publication charges
There is no submission charge; authors are required to pay a processing fee of $400. Publication of an article in International Archives of Food and Agricultural Sciences does not depend on the author's ability to pay the charges, and readiness to pay the processing fee does not guarantee acceptance of manuscript for publication. In the event of financial constraints, authors who may wish to request for publication fee waiver are required to do so while submitting their manuscripts (clearly stating the reasons for making the request). Authors will receive information about payment of publication fees at the time of acceptance of article.

Proofs
Prior to publication, a proof is sent to the corresponding author. Authors are advised to read the proof and correct minor typographical or grammatical errors. Authors should return proofs to the editorial office within 3 days.

Publication
Once proofs are received at the editorial office, the manuscripts are usually included in the next issue of the journal. The article will thereafter be published on the journal's website.

Publication notification
After the article is made available on the journal's website, a publication notice is sent to the corresponding author with links to the issue and article.

IAFAS Volume 1, Issue 1 (September – October 2019)

Table of Contents

Original Articles

International Archives of Food and Agricultural Sciences

Original Article

Website: https://cintarch.org/iafas-home/
DOI: https://doi.org/10.33515/iafas/2019.019/16

Species composition of soil macroarthropods in vegetable plots under continuous cultivation in Jos North Local Government Area of Plateau State, North Central Nigeria

Musa Ishaya[1], Georgina S. Mwansat[2], Hasley L. Njila[3], Akwashiki Ombugadu[4*], Mahanan J. Mafuyai[1], Michael P. Lapang[2]

[1]Department of Pest Management Technology, Federal College of Forestry, Jos, Nigeria, [2]Department of Zoology, Faculty of Natural Sciences, University of Jos, Jos, Nigeria,[3]Department of Science Laboratory Technology, Faculty of Natural Sciences, University of Jos, Jos, Nigeria, [4]Department of Zoology, Faculty of Science, Federal University of Lafia, Nasarawa State, Nigeria

ABSTRACT

Soil organisms are an integral part of agricultural ecosystems. Thus, species composition of soil macroarthropods in vegetable plots under continuous cultivation in Jos North Local Government Area of Plateau State, North Central Nigeria was carried out from August to October 2014. Two sampling techniques were used to collect macroarthropods from six different vegetable plots in three selected villages in Jos North LGA. A total of 3,346 macroarthropods were collected and identified into 5 classes, 20 orders, 79 families, 102 genera, 139 species and 2 unidentified. There was a significant difference ($P < 0.001$) in the mean abundance of macroarthropods in relation to classes. Hymenoptera 1552 (46.4%) were the most dominant taxa. Macroarthropods abundance and as well as species richness in relation to types of vegetable plots varied significantly ($P < 0.001$). The diversity of macroarthropods in the villages surveyed was high (H´ > 2.5). Thus, conservation and augmentation of species in vegetable plots should be encouraged.

Keywords: Macroarthropods, vegetable plots, abundance, diversity, villages

INTRODUCTION

Soil organisms are an integral part of agricultural ecosystems. The presence of a range of soil organisms is essential for the maintenance of healthy productive soils. Excessive reduction in soil biodiversity, especially the loss of species with unique functions, may have catastrophic effects, leading to the long-term degradation of the soil and loss of agricultural productive capacity (FAO, 2008). In each agro-ecosystem, soil fauna is an important component that sustains the health and quality of the soil for improved agricultural productions (Moron-Rios *et al*., 2010). Majorities of these soil fauna are invertebrate members of the decomposer community (Wolter, 2001).

Soils are critical transition zones and have addressed possible effects of global change on soil biota (Bardget *et al*., 2001). Soil is a large reservoir of biodiversity, often little known (Alfred *et al*., 1991, Henri *et al*., 2002). Soil communities are among the most species-rich compartments of terrestrial ecosystems (Anderson, 1975; Usher *et al*., 1979; Giller, 1996). “A soil macrofauna taxon is an invertebrate group found within terrestrial soil samples which has more than 90 percent of its specimens (individuals) in such samples visible to the naked eye” (IBOY Workshop, 2000). The soil fauna may also be referred to as exopedonic i.e. those that live outside the soil body and endopedonic which are those living inside the soil body (Alfred *et al*., 1991). Soil macrofauna groups include organisms like earthworms, millipedes, centipedes, ants, Coleoptera (adults and larvae), Isopoda, spiders, slugs, snails, termites, Dermaptera, Lepidoptera larvae and Diptera larvae (Castner, 2000). The effects of macroarthropods in and on soil result in changes in soil size, soil shape, arrangement of soil components and soil composition (Timo *et al*., 2006, Stephen *et al*., 2006, Takafumi and Nubohiro, 2006).

***Corresponding Author:** Akwashiki Ombugadu, Department of Zoology, Faculty of Science, Federal University of Lafia, Nasarawa State, Nigeria. E-mail: akwash24@gmail.com

Received: 11-10-2019 Revised: 30-10-2019 Published: 31-10-2019

Soil normally supports a diverse assemblage of macro arthropods, as distinct from microarthropods. The macroarthropods include Chilopoda, and Diplopoda larvae and sometimes adults of many Orders of insects of which the Coleoptera, the Diptera, the Isoptera and Hymenoptera are the most abundant. Some of the larger members of the Arachnida may also be included (Manasseh, 2005).

Crop type may influence the distribution of those members of the soil fauna which are specifically associated with particular food plant. Monoculture will eliminate those arthropods' species which are associated with other plants. Crop rotation decreases species diversity to even greater extent (Edwards and Lofty, 1969). There is a general decrease in the diversity and abundance of soil fauna when soil is ploughed and planted with crops. Crop types that require high agricultural inputs like fertilizers, herbicides and pesticides also influence the diversity and abundance of arthropods. For example, cabbage, tomato, tobacco etc. are crop types prone to arthropods pest attack, so application of synthetic pesticides to control these pests has deleterious effect on the natural enemies of these pests thereby resulting in population explosion of these pests (Croft, 1990). On the other hand, application of insecticides may lead to increase in the number of insects as a result of insect resurgence (Mafuyai, 2014).

Humans activities are known to alter the environment in diverse ways which tend to change the structure and organization of animal and plant communities or creating communities with unusual structures which has a far reaching consequences on biodiversity in a given area (McKinney, 2002; Gatson, 2003; Scharleman *et al.*, 2004; Monirul and Khan, 2005; Lees and Peres, 2006; Vitousek *et al.*, 2007; Kirika *et al.*, 2008; McKinney, 2008; Buczkowski and Richmond, 2012). The diversity of animals and plants generally declines as an inverse function of the intensity with which crops are cultivated using mechanized methods and agrochemicals. The intensity with which soils are cultivated also depletes soil-organism communities as a consequence of the toxic effects of agrochemicals, the physical disruption of their habitats, and the reduction in litter availability and hence the soil organic matter resource base. To such extent, management practices have important consequences on the composition and abundance of soil macrofauna communities (Lavelle *et al.*, 1999). Therefore, there was a need to understand species composition of soil macroarthropods in vegetable plots under continuous cultivation in Jos North Local Government Area of Plateau State, North Central Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried out in Jos, the capital of Plateau State of Nigeria located at the extreme north of the state between August and October 2014. Jos North Local Government Area is located at 9°55´N and 8°54´E (Figure 1). It has average height of about 1200 m above sea level. The natural vegetation of Jos Plateau is the Northern Guinea Savannah grassland. The edaphic feature is that of laterite and sandy soil type, differing from place to place on the Plateau (University of Jos Meteorological Station, 2012).

Sampling Sites

The study area was divided into three sampling sites. These sites were selected based on their involvement in mass vegetable production. They are Lamingo, Amazah (Mazah) and Kunga villages. A total of six major vegetable crops grown in Jos North LGA were selected. Each sampling site was subdivided into four plots. In Lamingo village, the following crops were selected: tomato, potato, maize and carrot; in Mazah village, cabbage, potato, carrot and maize were selected, while in Kunga village, potato, maize, carrot and lettuce were selected.

Sampling Materials and Techniques

A 10 x 10 metres quadrat was used in all the vegetable plots (tomato, potato, maize, carrot, cabbage and lettuce). Five pitfall traps made from bottles measuring 7 cm in height were filled up with formalin so as to immobilize trapped insect and thereafter funnels placed at the top were set in the corners and center of each quadrat. Samples were collected once a week for a standing period of 24 hours (Bater, 1996) in each site. This sampling procedure measures epigeic activity of soil-dwelling animals (Zimmer et *al.,* 2000; Sfenthourakis *et al.,* 2005; Santos *et al.,* 2007). While pitfall traps were set and collection was in progress, hand picking technique as adopted by Ellis (2013) and Tuf (2015) was used to collect available macroarthropods that were seen in the morning hours within the experimental plots. The collected macroarthropods from hand-picking technique were placed in separate collecting jars containing cotton wool soaked in chloroform so as to immobilize active macroarthropods and were further preserved in formalin for identification (Imam *et al*., 2010). The collected macroarthropods from both pitfall traps and hand-picking technique were transferred into well labeled collection bottles and taken to the insectary for further processing.

Identification of Macroarthropods

At the completion of the collection work, all the preserved macroarthropods were emptied into a petri dish one after the other from their various sample containers, identified and counted. The identification was done in the departmental insectary with the use of dissecting microscope and identification keys and illustrations provided by Borror and White (1970), Skaife (1979), Castner (2000) and Shattuck (2000). The identified macroarthropods were then grouped into Classes, Orders, Families, Species and common names based on the date of collection, technique used and total numbers present in each sample container.

Statistical Analysis

The data obtained was analyzed using R Console Software version 2.9.2. One-way analysis of variance (ANOVA) was used to compare the mean abundance of macroarthropods between Classes and as well as study sites. Pearson's Chi-square test was used to compare proportions of macroarthropods abundance and as well as species richness between types of vegetable plots. P-values < 0.05 were considered statistically significant. Macroarthropod species diversity was calculated using the Shannon-Wiener diversity index (H´):

$$H' = -\sum_{i=1}^{S} (Pi)\,(\ln Pi)$$

Where:
H' is the diversity index.
Pi is the proportion of individual species.
S is the total number of species in the habitat and,
i is the proportion of *S* species (Begon *et al*., 2003).

RESULTS

Soil macroarthropods' species checklist generated at the end of this study is shown in Table 1. A total of 3346 individuals of soil arthropods distributed into 5 Classes, 20 Orders, 79 Families, 102 Genera and 139 Species were collected (Table 1). Two individuals belonging to class Diplopoda and order Diptera could not be identified beyond Class and Order levels respectively. The most abundant class was Insecta while Chilopoda was the least. Soil microarthropod species identified as the most abundant were members of the family Formicidae having 1552 individuals (46.4%) followed by the Coleopterans with 744 individuals (22.2%) and Orthopterans with 299 individuals (8.9%).

Out of the 79 families identified, 11 families (13.9%) have been identified to contain some predaceous insects and these families include Anthocoridae, Mantidae, Lygaeidae, Nabidae, Pentatomidae, Cantharidae, Coccinellidae, Carabidae, Staphylinidae, Araneae and Tachinidae. On the other hand, phytophagous macroarthropods belonging to 66 families (83.5%) were identified and 2 (2.5%) were dipterans (haematophagus and scavengers in nature). Among the phytophagous families are Anthicidae, Tetrigidae, Gryllidae, Curculionidae, Tettigoniidae, Formicidae, Meloidae, Nitidulidae, Thripidae, Chrysomelidae, Aphididae and Miridae.

Lamingo village had the highest abundance of macroarthropods while Kunga village had least. There was no significant difference (F_{56} = 0.5835, Adjusted R^2 = -0.01457, P = 0.5613) in the mean abundance of macroarthropods in relation to study sites (Figure 2). Mazah had the most diverse species of macroarthropods in vegetable plots (H' = 2.920), followed by Lamingo (H' = 2.585) and the least diverse site was Kunga (H' = 2.558) as shown in Table 2. However, the Shannon-Wiener index values in the three sites showed no significant difference (χ^2 = 0.0303, df = 2, P = 0.985).

DISCUSSION

The high abundance and diversity recorded in this study clearly shows that the vegetable plots in the three selected sites are homes to a lot of macroarthropods in Jos North L.G.A. of Plateau State. This also implies that these vegetables are exposed to macroarthropod pest's attack. The abundance and diversity of soil macroarthropods observed in this study could be attributed to the availability of resources, principal of which is food. This agrees with the findings of Seastedt and Crossley (2004), who reported that in the presence of abundant resources, arthropods population can grow geometrically or exponentially and when the resources become depleted, the population growth rate slows down and reproductive output by adults become reduced.

The observed variation in the abundance of classes of macroarthropods for both techniques suggests that the vegetable plots favour the breeding success of the Class Insecta in the three sites. The diversity and abundance of members of the Class Insecta across the three sites may also be linked with the availability of resources across the study sites. This is consistent with the work of Njila *et al.* (2013), who reported that the health of an ecosystem is often measured by the biodiversity it holds, which is synonymous to its species abundance and diversity. Moreover, the class Insecta is the most diverse of all animal groups.

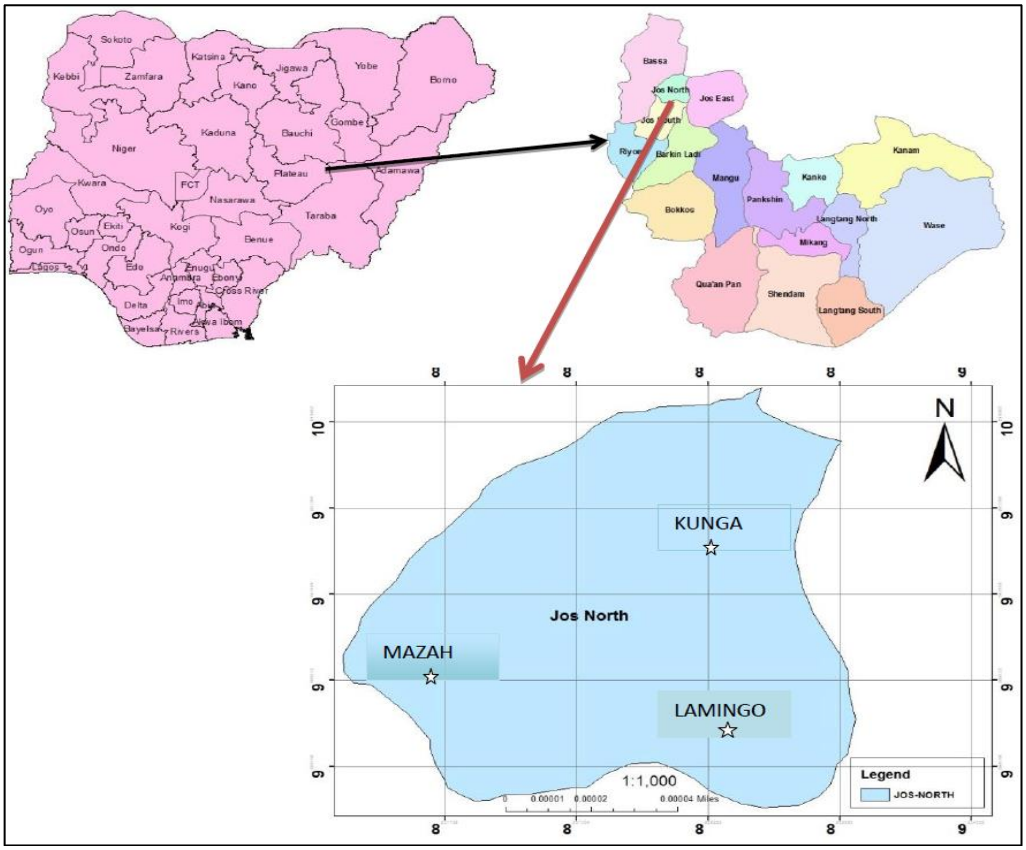


Figure 1: Map of Nigeria showing Plateau State and Plateau State showing Jos North LGA in relation to the three selected study sites (Source: Ishaya *et al.,* 2018)

There are more species of insects than there are species of all other animals combined (Hickman *et al.*, 2006). It could also be linked to the soil in the study sites being good for agriculture as reported by Scheu (2002) that the abundance and diversity of mesofauna is a good biological indicator of soil conservation status. The abundance of Hymenoptera is in line with the works of Liu *et al.* (1999), Liao *et al.* (2002), Xiong (2005) and Ishaya *et al.* (2018). They reported that Hymenoptera and Coleoptera were the dominant groups found in the tropical rainforest in China. Similarly, the abundance of Hymenoptera, mostly members of the family Formicidae is similar to the work of Frouz and Ali (2004) who found Formicidae to be the dominant group of soil macroarthropods in Florida upland habitats. This could probably be linked with their burrowing habit which enables them to escape natural enemies and effects of insecticides. This also agrees with the findings of Hickman *et al.* (2001) who reported high number of ants of the family Formicidae in a study carried out in Aldabra rainforest of India where dominance was linked to their foraging and feeding habits. Similarly, a study carried out on the impact of soil disturbance on insect abundance in Amurum Forest and surrounding farmlands in Jos East L.G.A of Plateau state, Nigeria revealed that the Familiy formicidae were the most abundant arthropods (Ombugadu *et al.,* 2017).

The lack of variation in macroarthropods abundance in relation to sites suggests that vegetable plots are subject to the same microclimatic conditions. This is contrary to Hughes *et al.* (2000) who reported that species abundance differs with various habitats. The calculated Shannon Weiner diversity index (H') indicated that the vegetable plots surveyed support diverse macroarthropod population since species diversity index H' for biological communities is not below 2.5 and does not exceed 5.0 (Hughes *et al.*, 2000) as reported by Njila *et al.* (2014).

Table 1: Checklist of soil macroarthropods of vegetable plots from 3 selected sites in Jos North L.G.A., Plateau State

Class	Order	Family	Species	Kunga		Lamingo		Mazah		Total (%)
				Pitfall trap	Hand picking	Pitfall trap	Hand picking	Pitfall trap	Hand picking	
Arachnida	Acari	Thrombidiidae	*Thrombidium* sp.	1	-	2	-	3	-	6 (0.18)
		Ixodidae	*Amblyomma* sp.	-	-	-	1	-	-	1 (0.03)
	Araneae	Agelenidae	*Agelenopsis* sp.	9	3	13	11	12	5	53 (1.58)
		Corinnidae	*Castianeira longipalpis*	1	-	-	-	-	-	1 (0.03)
		Corrinidae	*Trachelas* sp.	-	-	1	-	9	-	10 (0.30)
		Gnaphosidae	*Gnaphosa* sp.	-	1	-	-	1	-	2 (0.06)
		Pholcidae	*Pholcusphalagioides*	-	-	-	-	1	-	1 (0.03)
		Sicariidae	*Loxosceles recluse*	16	6	27	11	85	4	149 (4.45)
		Thomisidae	*Xysticus* sp.	-	-	-	2	1	-	3 (0.09)
	Opiliones	Phalangiidae	*Phalangium opilio*	-	-	1	-	-		1 (0.03)
Chilopoda	Geophilomor pha	Chilenophilidae	*Zelanion* sp.	1	-	1	1	3	1	7 (0.21)
		Geophilidae	*Geophilus* sp.	-	-	-	-	1	-	1 (0.03)
Crustacea	Isopoda	Oniscoidae	*Oniscus* sp.	-		1		-		1 (0.03)
			Oniscusasellus	-	1	-	-	-	-	1 (0.03)
			Porcellio scaber	2	-	-	-	-	-	2 (0.06)
Diplopoda	Polydesmida	Polydesmidae	*Polydesmus* sp.	1	1	-	18	1	-	21 (0.63)
	Unidentified	Unidentified	Unidentified	-	-	-	-	1	-	1 (0.03)
Insecta	Blattaria	Blatellidae	*Blattella germanica*	-	-	2	-	-	-	2 (0.06)
			Blattella lituricolis	5	-	-	-	-	-	5 (0.15)
			Supella longipalpa	-	-	-	-	-	1	1 (0.03)
		Blattidae	*Periplaneta Americana*	-	-	-	-	-	1	1 (0.03)
	Coleoptera	Alleculidae	*Pseudocistela pingius*	-	-	1	-	-	-	1 (0.03)
		Anthicidae	*Anthelephila* sp.	2	-	5	1	133	-	141 (4.21)
		Brentidae	*Altica* sp.	-	-	-	1	-	-	1 (0.03)
		Cantharidae	*Cantharis tuberculata*	-	-	3	1	-	-	4 (0.12)
		Carabidae	*Loxandrus* sp.	-	-	6	5	2	-	13 (0.39)
			Nebria brevicollis	-	-	-	-	5	-	5 (0.15)
			Scarites sp.	-	4	5	-	12	-	21 (0.63)
		Cerambycidae	*Petrognatha gigas*	-	-	-	-	1	-	1 (0.03)
		Chrysomelidae	*Podagrica uniformis*	-		4		-		4 (0.12)
			Deloyala guttata	-	-	-	1	-	-	1 (0.03)
			Diabrotica undecimpunctata	-	-	-	-	-	2	2 (0.06)

Table 1 contd.: Checklist of soil macroarthropods of vegetable plots from 3 selected sites in Jos North L.G.A., Plateau State

Class	Order	Family	Species	Kunga		Lamingo		Mazah		Total (%)
				Pitfall trap	Hand picking	Pitfall trap	Hand picking	Pitfall trap	Hand picking	
Insecta	Coleoptera	Chrysomelidae	*Podagrica dilecta*	-	-	-	17	-	-	17 (0.51)
		Cicindelidae	*Cicindela* sp.	-	-	4	-	3	-	4 (0.12)
		Coccinellidae	*Coccinella septempunctata*	1	97	1	14	-	28	141 (4.21)
			Epilachna varivestis	4	-	-	-	-	-	4 (0.12)
		Curculionidae	*Otiorhynchus* sp.	1	-	-	6	-	2	9 (0.27)
			Anthonomus grandis	-	-	-	2	9	-	2 (0.06)
			Omphalapion hookerorum	-	-	-	1	1	1	2 (0.06)
			Xyleborus sp	4	-	-	-	1	-	86 (2.57)
		Cydnidae	*Cydus aterrimus*	-	-	-	-	85	-	1 (0.03)
		Gyrinidae	*Dineutus* sp.	-	-	5	-	1	-	5 (0.15)
		Helodidae	*Macrodascillus* sp.	-	-	1	-	-	-	1 (0.03)
		Lanthridiidae	*Melanophthalma* sp.	-	-	-	-		-	1 (0.03)
		Lucidae	*Calopteron* sp.	-	-	1	-	3	-	1 (0.03)
		Lycidae	*Calopteron* sp.	-	-	-	-	1	1	1 (0.03)
			Calopteron discrepans	-	-	-	-		1	1 (0.03)
		Meloidae	*Epiacuta pennsylvanica*	2	9	3	51	3	2	70 (2.09)
		Nitidulidae	*Carpophilusobsoletus*	2	-	4	-	6	-	12 (0.36)
		Passalidae	*Passalus* sp.	1	-	3	-	6	-	10 (0.30)
		Scarabaeidae	*Ataeniusalternatus*	1	-	1	1	2	1	6 (0.18)
			Anomala distinguenda	-	-	-	-	-	1	1 (0.03)
			Anomala tibialis	-	-	-	-	1	-	1 (0.03)
			Larva	1	-	-	-	1	-	2 (0.06)
		Scolytidae	*Scolytus* sp.	-	-	-	-	-	-	1 (0.03)
		Silphidae	*Necrophila Americana*	-	-	1	-	2	-	1 (0.03)
	Coleoptera	Staphylinidae	*Creophilus maxillosus*	-	-	2	-	-	-	4 (0.12)
			Ocypus sp.	-	8	15	12	72	8	115(3.43)
			Paederus olens	-	-	3	-		-	3 (0.09)
			Paederus littoralis	-	-	-	-	-	6	6 (0.18)
		Tenebrionidae	*Tenebrio molitor*	3	-	12	9	10	2	36 (1.08)
	Collembola	Poduridae	*Podura* sp.	3	-	230	-	5	1	239 (7.14)
	Dermaptera	Forficulidae	*Forficula auricularia*	-	-	1	-	-	1	2 (0.06)
	Diplura	Japygidae		-	-	1	-	-	-	1 (0.03)
	Diptera	Bombyliidae	*Bombylius major*	-	-	1	-	-	-	1 (0.03)
			Bombylius sp.	-	-	-	-	1	-	1 (0.03)
		Drosophilidae	*Drosophila* sp.	1	-	14	-	23	1	39 (1.17)
		Tipulidae	*Tipula* sp.	-	-	-	-	-	1	1 (0.03)
		Tephritidae	*Euleia fratria*	-		4		1		5 (0.15)
		Phoridae	*Megaselia scalaris*	-		-		1	-	1 (0.03)
		Muscidae	*Musca domestica*	-		1		-	-	1 (0.03)
			Stomoxys calcitrans	-		1		-	-	1 (0.03)
		Simuliidae	*Simulium* sp.	-		-		1	-	1 (0.03)

Table 1 contd.: Checklist of soil macroarthropods of vegetable plots from 3 selected sites in Jos North L.G.A., Plateau State

Class	Order	Family	Species	Kunga		Lamingo		Mazah		Total (%)
				Pitfall trap	Hand picking	Pitfall trap	Hand picking	Pitfall trap	Hand picking	
Insecta	Diptera	Tachinidae	*Tachina* sp.	-		1		-	-	1 (0.03)
		Unidentified	Unidentified	-	-	-	-	1	-	1 (0.03)
	Hemiptera	Alydidae	*Alydus calcaratus*	-	-	2	1	2	2	7 (0.21)
		Cydnidae	*Cydnus aterrimus*	1	1	-	-	2	1	5 (0.15)
		Coreidae	*Leptoglossus* sp.	-	-	-	2	-	-	2 (0.06)
		Miridae	*Peritropis saldaeformis*	-		-		2		2 (0.06)
		Nabidae	*Nabis roseipennis*	-	-	-	4	-	3	7 (0.21)
			Lygus lineolaris	-	1	-	-	-	-	1 (0.03)
		Pentatomidae	*Alcaeorrhynchus grandis*	-	2	-	2	-	2	6 (0.18)
		Anthocoridae	*Anthocoris nemoralis*	-	1	-	-	-	-	1 (0.03)
		Geocoridae	*Geocoris* sp.	2	-	-	-	-	-	2 (0.06)
		Pentatomidae	*Halyomorpha halys*	-	2	-	-	-	2	4 (0.12)
		Pyrrhocoridae	*Pyrrhocoris* sp.	-	-	-	-	-	1	1 (0.03)
	Homoptera	Aphididae	*Aulacorthum solani*	-	-	1	-	-	-	1 (0.03)
		Cicadellidae	*Delphacodes* sp.	-	-	-	-	3	-	3 (0.09)
			Empoasca dolichi	-	-	1	-	-	-	1 (0.03)
			Empoasca sp.	-	-	-	-	1	-	1 (0.03)
			Graphocephala sp.	-	-	2	-	-	1	3 (0.09)
			Oncometopia nigricans	-	-	2	1	-	-	3 (0.09)
			Oncometopia sp.	2	-	-	-	-	-	2 (0.06)
		Dictyopharidae	*Dictyopharidae microrhina*	-	-	-	1	-	-	1 (0.03)
		Issidae	*Balduza bufo*	-	-	1	-	-	-	1 (0.03)
	Hymenoptera	Formicidae	*Camponotus consobrinus*	1		1		-	11	13 (0.39)
			Camponotus sp.	14	-	18	3	66	1	102 (3.05)
			Dasymutilla quadriguttata	1	-	12	1	2	-	16 (0.48)
			Formica sp.	212	-	439	2	7	-	658 (19.67)
			Hodotermes sp.	1	-	-	-	-	-	1 (0.03)
			Monomorium mini	120	-	356	2	264	2	744 (22.24)
			Pogonomyrmex sp.	3	-	12	1	2	2	20 (0.60)
			Paltothyreus tarsatus	22	-	4	-	4		30 (0.90)
			Occopyylla sp.	-	-	-	-	1	-	1 (0.03)
			Solenopsismandibularis	-	-	-	-	11	-	11 (0.33)
			Solenopsis sp.	-	-	4	-	1	-	5 (0.15)
		Ichnemonidae	*Dusoria* sp.	-	-	1	-	-	-	1 (0.03)
		Tiphiidae	*Myzinum maculate*	1	-	-	-	-	-	1 (0.03)
	Lepidoptera		Caterpillar	5	39	5	9	1	11	70 (2.09)
	Orthoptera	Acrididae	*Achurum carinatus*	2	-	-	1	-	2	5 (0.15)
			Chorthippus sp.	1	-	1	1	1	1	5 (0.15)

Table 1 contd.: Checklist of soil macroarthropods of vegetable plots from 3 selected sites in Jos North L.G.A., Plateau State

Class	Order	Family	Species	Kunga		Lamingo		Mazah		Total (%)
				Pitfall trap	Hand picking	Pitfall trap	Hand picking	Pitfall trap	Hand picking	
Insecta	Orthoptera		*Leptysma marginicollis*	9	8	-	-	-	3	20 (0.60)
			Romalea guttata	-	14	-	1	-	2	17 (0.51)
		Gryllidae	*Allonemobius* sp.	4	-	35	-	16	-	55 (1.64)
			Gryllus assimilis	32	2	60	14	9	1	120 (3.56)
			Hapithus sp.	-	-	1	-	2	-	3 (0.09)
		Tetrigidae	*Tetrix* sp.	4	11	8	15	10	11	59 (1.76)
			Tetrix aresona	2		1		-		3 (0.09)
			Paratettix sp.	-	-	-	3	-	-	3 (0.09)
			Unidentified	-	-	3	-	3	-	6 (0.18)
		Tettigoniidae	*Meconema thalassinum*	-	1	-	-	-	-	1 (0.03)
			Neoconocephalus sp.	-	-	-	1	-	-	1 (0.03)
			Ruspolis sp.	-	1	-	1	-	-	2 (0.06)
	Mantodea	Mantidae	*Archima latistyla*	-	1	-	1	-	-	2 (0.06)
			Sphodromantis viridis	-	1	-	-	-	1	2 (0.06)
	Phasmida	Diapheromeridae	*Bactrododema* sp.	-	-	1	-	-	-	1 (0.03)
	Thysanoptera	Thripidae	*Thrips* sp.	1	-	-	-	2	-	3 (0.09)
	Total (%)			**500 (14.94)**	**215 (6.43)**	**1366 (40.82)**	**236 (7.05)**	**914 (27.32)**	**115 (3.44)**	**3346 (100)**

The result from this survey also agreed with that of McDonald (2003) who reported that in natural systems, the value of H´ has been found to range from 1.5 for systems with low species richness and evenness to 3.5 for systems with high species evenness and richness. Mazah was the most diverse site over the other two sites; this may be due to series of insecticides spray most especially in the cabbage vegetable plot which might have led to resurgence of macroarthropods in high number in the site. Why Lamingo was the second most diverse site could probably be due to the use of insecticide in the tomato vegetable plot, thus giving rise to macroarthropods resurgence as well. This is similar with the work of Hardin *et al.* (1995), who reported that one of the causes of insect resurgence was their resistance to insecticides.

CONCLUSION

All the sites surveyed in the course of this study had good representation of all classes of macroarthropods encountered. The abundance of macroarthropods shows that the selected sites are good agricultural soil. Most of the families identified contain many phytophagus species which may constitute pest problems to the vegetables. However, there were also a good number of families containing predaceous species which help keep some of the pest species in check.

The population dynamics of the phytophagous groups should be carefully studied to know those that are capable of reaching pest status in the near future so that control measures would be put in place to check-mate them. The population of the predaceous species should be studied to know which among them may be potential biological control agents. Also, in view of the fact that most soil macroarthropods such as insects especially at their larval and adult stages are serious pests to agricultural crops, a detailed study of these organisms would be of great significance to enhance systematic actions such as collection and destruction of their adults and larval stages in order to fully undertake biological, chemical and cultural control.

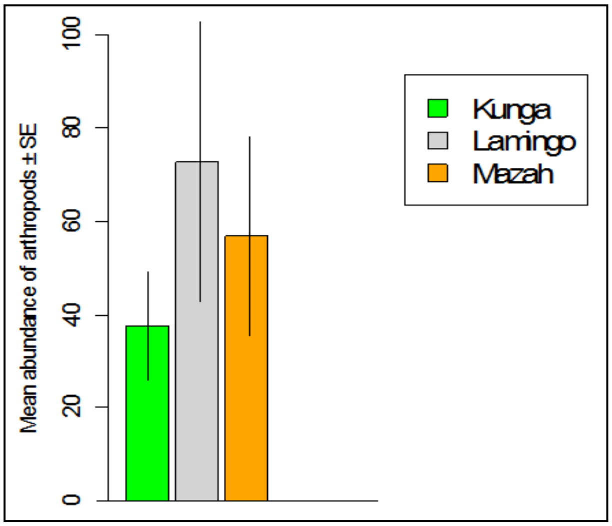


Figure 2: The mean abundance of macroarthropods in relation to sites for both collection techniques in Jos North, Plateau State

Table 2: Diversity of soil macroarthropods collected from three selected villages in Jos North L.G.A, Plateau State

Site	H′
Kunga	2.558
Lamingo	2.585
Mazah	2.920

Source of support

Nil.

Conflict of interest

None declared.

REFERENCES

Alfred JRB, Darlong VT, Hattar SJS, Paul D (1991). Microarthropods and their conservation in some North East Indian soil. Pp 309-319. In: Veeresh GK, Rajagopa lD, Virak Tamath CA (Eds). Advances in Management and Conservation of Soil Fauna. Bangalore.

Anderson JM (1975). The enigma of soil animal species diversity. In: Vanek J (Ed.). Progress in soil zoology. Prague: Czech. Acad. of Sciences. Pp. 51–58.

Bardgett RD, Anderson JM, Behan-Pelletier V, Brussard L, Coleman DC, Ettema C, Moldenke A, Schimel JP, Wall DH (2001). The influence of soil diversity on hydrological pathways and the transfer of materials between terrestrial and aquatic ecosystem. Ecosystems 4: 421-429.

Bater JE (1996). Micro- and macro-arthropods. In: Hall GS (Ed.). Methods for the examination of organismal diversity in soil and sediments. Wallingford, UK: CAB International. Pp. 163-174.

Borror DJ, White RE (1970). A field guide to the insects of America north of Mexico. Boston: Houghton Mifflin Company.

Buczkowski G, Richmond DS (2012). The effect of urbanization on ant abundance and diversity: a temporal examination of factors affecting biodiversity. PLoS One **7**(8): e41729.

Castner JL (2000). Photographic atlas of entomology and guide to insect identification. Gainesville, FL, USA: Feline Press.

Croft BA (1990). Arthropod biological control agents and pesticides. New York: John Wiley and Sons Inc.

Edwards CA, Lofty JR (1969). The influence of agricultural practice on soil microarthropods population. In: Sheals JG (Ed). The Soil Ecosystem. London: Systematics Association. Pp. 234-247.

Ellis M (2014). Impacts of pit size, drift fence material and fence configuration on capture rates of small reptiles and mammals in the New South Wales rangelands. The Australian Zoologist 36 (4): 404-412.

FAO (2008). Soil Macrofauna Field Manual- Technical Level. Rome: Food and Agricultural Organization of the United Nations. Available at: https://www.fao.org/3/a-i0211e.pdf [Last accessed on 2019 October 27].

Frouz J, Ali A (2004). Soil macroinvertebrates along a successional gradient in central Florida. Florida Entomology, 87 (3):386-390.

Gatson KJ, Blackburn TM, Goldewijk KK (2003). Habitat conservation and global avian biodiversity loss. Proceedings of the Royal Society B. Biological Science 270 (1521): 1293-1300.

Giller PS (1996). The diversity of soil communities, the "poor man's tropical rainforest". Biodiversity and Conservation 5: 135–168.

Hardin MR, Benrey B, Colt M, Lamp WO, Roderick GK, Barbosa P (1995). Arthropod pest resurgence: an overview of potential mechanisms. Crop Protection 14: 3-18.

Henri MA, Xavier D, Phillipe L (2002). Soil biodiversity: myth, reality or conning? Oikos 96 (1): 3-24.

Hickman CP, Roberts LS, Larson A (2001). Integrated principles of zoology. 11th ed. Boston, Mass: MC Graw Hill.

Hickman CP, Roberts LS, Keen SL, Larson A, I'Anson H, Eisenhour DJ, Ober WC, Garrison CW et al (2008). *Integrated principles of zoology*. 14th ed. Boston, Mass: McGraw-Hill.

Hughes JB, Daily GC, Ehrlich PR (2000). Conservation of insect diversity: a habitat approach. Conservation Biology 14 (16):1788-1797.

International Biodiversity Observation Year (2000). Soil macrofauna: an endangered resource in a changing world. Report of an international workshop held at IRD, Bondy (France) 19–23 June 2000.

Imam TS, Yusuf AU, Mukhtar MD (2010). A survey of some insect pests of cultivated vegetables in three selected irrigation areas along Jakara river, Kano, Nigeria. Int. J. Biol. Chem. Sci. 4 (2): 400-406.

Ishaya M, Mwansat GS, Ombugadu A, Njila HL, Mafuyai MJ, Lapang MP (2018). A comparison of pitfall traps and hand-picking techniques for studying macroathropods abundance in vegetable plots and the influence of abiotic factors on their abundance in Jos, Nigeria. J. Agric. Sci. Practice 3(4): 79-89.

Ishaya M, Ombugadu A, Daniel DG, Akemien N, Madaki D, Adejoh VA, Lapang MP, Ahmed HO (2018). Comparative study on composition of insect in close and open nursery of Federal College of Forestry Jos, Plateau State, Nigeria. J. Res. Forestry Wildlife and Environment 10 (1): 11-19.

Kamitani T, Kaneko N. (2006). The Earthtron Facility for below ground manipulation study. Ecological Research 21(3): 483-487.

Kautz T, Lopez-Fando C, Elimer FE (2006). Abundance and biodiversity of soil microarthropods as influenced by different types of organic manure in long term field experiment in Central Spain [2006]. Applied Soil Ecology 33(3): 278-285.

Kirika JM, Farwig N, Bohning-Gaese K (2008). Effects of local disturbance of tropical forests on frugivorous and seed removal of small-seeded afrotropical tree. Conserv. Biol. 22(2): 318-28.

Lees AC, Peres CA (2006). Rapid avifaunal collapse along the Amazonian deforestation frontier. Biol. Conservation 133: 198-211.

Liao C, Li J, Yueping Y (2002). The Community of soil animals in the tropical rain forest in Jianfeng Mountain, Hainan Island, China: composition and characteristics of community. Acto Ecologica Sinica 22 (11): 1866-1872.

Liu X, Liu Y, Guo L (1999). A comparative study on soil animals in different steppe types in Neimongol. Acto Scientiarum Naturalium Universtatis NeiMongol, (in Chinese) 30 (1):74-78.

Mafuyai HB (2014). Insect resurgence: implication for agriculture, health and sustainable environment. Being a key note address of the 45th Annual Conference of the Entomological Society of Nigeria, University of Abuja, Nigeria on 8th October.

Manasseh MT (2005). A comparative study on the diversity, distribution and abundance of microarthropods fauna in Plateau. Unpublished M.Sc. Thesis, Department of Zoology University of Jos, Nigeria.

McDonald GM (2003). Biogeography: Introduction to space, time and life. New York: John Wiley and Sons Inc.

McKinney ML (2002). Urbanization, biodiversity, and conservation, Bioscience, 52: 883–890.McKinney ML (2008). Effects of urbanization on species richness: a review of plants and animals. Urban Ecosystems 11(2): 161–176.

Monirul M, Khan H (2005). Species diversity, relative abundance and habitats use of the birds in the Sundarbans East Wildlife Sanctuary, Bangladesh. Forktail 21: 79-86.

Moron-Rios A, Rodriguez MA, Perez-Camacho L, Rebollo S (2010). Effects of seasonal grazing and precipitation regime on the soil macroinvertebrates of a Mediterranean old-field. European J. Soil Biol. 46(2): 91-96.

Njila HL, Mwansat GS, Imandeh GN (2013). Species abundance and diversity of soil mites (Arachnida: Acari) along the bank of River Benue in Adamawa state, North-Eastern Nigeria. Biol. Environ. Sci. J. Trop. 10 (4): 37-44.

Njila HL, Mwansat GS, Imandeh GN, Onyiba IA (2014). Abundance and distribution of adult and juvenile stages of soil microarthropods along the western bank of River Benue in Adamawa state North-Eastern Nigeria. African J. Natural Sciences 17: 37-47.

Ombugadu A, Mwansat GS, Chaskda AA, Njila HL (2017). Comparative insect abundance and diversity in Amurum Forest Reserve and surrounding farmlands, Jos, Nigeria. Ethiopian J. Environ. Stud. Manag. 10(9): 1200-1210.

Santos SAP, Cabanas JE, Pereira JA (2007). Abundance and diversity of soil arthropods in olive grove ecosystem (Portugal): effect of pitfall trap type. European J. Soil Biol. 43(2): 77-83.

Scharleman JPW, Green RE, Balmford A (2004). Land use trend in endemic bird areas: global expansion of agriculture in areas of high conservation value. Global Change Biol. 10(12): 2046-2051.

Scheu S (2002). The soil food web: structure and perspectives. European J. Soil Biol. 38(1):11-20.

Seastedt TR, Crossley DA (2004). The influence of arthropods on ecosystems. Bioscience 34:157-161.

Sfenthourakis S, Anastasiou ST (2005). Altitudinal terrestrial isopod diversity. European J. Soil Biol. 41(3): 91-98.

Shattuck SO (2000). Australian ants, their biology and identification. Collingwood, Australia: CSIRO Publishing.

Skaife SH, Ledger JI, Bannister A (1979). African insect life. Capetown: C Stuik Publ. Partsch S, Scheu S, Milcu A (2006). Decomposers (Lumbricidae, Collembola) affect plant performance in model grasslands of different diversity. Ecology 87 (10): 2548-58.

Tuf IH (2015). Different collecting methods reveal different ecological groups of centipedes (Chilopoda). Zoologia 32(5): 345-350.

University of Jos Meteorological Station (2012). The vegetation and edaphic features of Plateau State. A Seminar in the Department of Geography and Planning, Faculty of Environmental Science, University of Jos, Jos-Nigeria.

Usher MB, Davis PR, Harris JRW, and Longstaff BC (1979). A profusion of species? Approaches towards understanding the dynamics of the populations of the micro- arthropods in decomposer communities. In: Anderson RM, Turner BD. Taylor LR (eds). *Population dynamics*. Oxford: Blackwell Scientific Publications.

Vitousek PM, Mooney HA, Lubchenico MJ, Melillo JM (1997). Human domination of earth's ecosystems. Science 277(5325): 494–499.

Wolter V (2001). Biodiversity of soil animals and its function. European J. Soil Biol. 37: 221-227.

Xiong Y (2005). The community diversity of soil animals in the tropical and subtropical forests and the phylogeny of Collembola. PhD Thesis, East China Normal University, Shanghai.

Zimmer M, Brauckmann HJ, Broll G, Topp W (2000). Correspondence analytical evaluation of factors that influence soil macroarthropod distribution in abandoned grassland. Pedobiologia 44(6): 695-704.

How to cite this article: Ishaya M, Mwansat GS, Njila HL, Ombugadu A, Mafuyai MJ, Lapang MP (2019). Species composition of soil macroarthropods in vegetable plots under continuous cultivation in Jos North Local Government Area of Plateau State, North Central Nigeria. Int. Arch. Food Agric. Sci. 1(1): 1-10.

International Archives of Food and Agricultural Sciences

Original Article

Website: https://cintarch.org/iafas-home/
DOI: https://doi.org/10.33515/iafas/2019.021/17

Assessment of major vegetation zones in relation to associated fauna in Toungo sector of Gashaka Gumti National Park, Nigeria

Olalekan A. Akande[1*], Ambrose A. Ihidero[2], Toyese G. Akinade[2], Babatunde S. Ojo[2], Yusuf A. Ahmad[3]

[1]Department of Zoology, Ahmadu Bello University, Zaria, Nigeria
[2]Federal College of Wildlife Management, Forestry Research Institute of Nigeria, New-Bussa, Nigeria
[3]Department of Nutrition and Dietetics, Federal Polytechnic, Bauchi, Nigeria

ABSTRACT

The study surveyed the fauna species in relation to the vegetation zone in Gashaka Gumti National Park, Nigeria. The method used involved both primary and secondary data sources. The primary source of data involved field survey using line transects of 5Km each laid systematically at each vegetation zones of the sector of the park while secondary data were obtained by review of related documents on the park. Data were subjected to SPSS version 20 for descriptive statistics. The major fauna species associated with *Burkea africana* wooded Savannah were *Cercopithecus mona* (Mona monkey) which recorded the highest proportion with 35.38%, followed by *Cephalopus rufilatus* (Red flanked duiker) with 20.00%, while *Phataginus tricuspis* (Pangolins) and Piping hornbill recorded the least with 3.08% each respectively. The animals associated with *Afzelia Africana/Daniellia oliveri* vegetation zone were *Papio anubis* (Baboon) which recorded the highest proportion with 33.33%, followed by *Erythrocebus patas (Patas monkey)* with 18.84% and the least was *Syncerus* cafer (Buffalo) with 1.45%. Among the fauna species associated with *Prosopis Africana* vegetation zone, *Tragelaphus scriptus* (Bushbuck) recorded the highest proportion with 30.0%, *Cercopithecus aethiops* (Tantalus monkey), *Phacochoerus africanus* (Warthog) and *Ourebia ourebi* (Oribi) recorded 20.00% each respectively, and Crowned eagle recorded the least with 10.00%. In the *Accacia* vegetation zone, *Ptilopachus petrosus* (Stone partridge) recorded the highest proportion with 54.29%, while *Francolins bicalcarabus* (Francolins) and *Hippotragus equinus* (Roan antelope) recorded 37.14% and 8.57% respectively. It is hereby suggested that adequate protection should be given to this area in order to prevent the extinction of the wildlife species in the park.

Keywords: Vegetation zones, fauna, Gashaka Gumti National Park

INTRODUCTION

Nigeria's vegetation is one of the most endowed in Africa containing almost all the vegetation types that exist in other African countries and it is widely distributed in different zones of the country (Akinsoji *et al*., 2016). Nigeria has two broad belts of vegetation types namely, forest and savannah types. However, there is also mountain vegetation of the isolated high plateau regions in the central and far eastern parts of the country (Allem, 2000). The vegetation of an area is a product of the plant material available and the prevailing environmental condition which include both the physical environment, land forms, soils, climate and factors such as the use of fire and grazing including the modification of the environment by the vegetation itself through transpiration, circulation of minerals, and plants decay (Adjanohoun *et al*., 1991).

Vegetation makes up the habitat of wild animal species without which the animals will go extinct and it provides food, cover and escape cover for wild animal species. It is therefore important to regularly assess the vegetation and when necessary to manipulate it to suit wildlife management needs. The need to plan natural resources' management on the basis of accurate inventory, and take protective measures to ensure that the resources do not become exhausted is the concept of modern conservation. However, ecosystem degradation proceeds at alarming rates in many parts of Nigeria, including

***Corresponding Author:** Olalekan A. Akande, Department of Zoology, Ahmadu Bello University, Zaria, Nigeria.

E-mail: Akandehmd@gmail.com

Received: 17-10-2019 Revised: 28-10-2019 Published: 31-10-2019

some protected areas which are meant to be conserved (Gumnior and Sommer, 2012). Ladipo (2010), indicated that nearly 90% of the rainforests in Nigeria have been cleared as at 2006. This clearance is not restricted to the forests alone as all habitats are under threat from civilization and other unsustainable human activities. The careless attitude of the populace and the high rate of poverty in the country have also resulted in this heavy loss (Ayodele and Yang, 2012). In order to prevent forest loss and to preserve biodiversity, the Nigerian Government had established several National Parks. One of the national parks established by Government is Gashaka Gumti National Park (GGNP). The idea behind the setting up of protected areas is to safeguard important areas for their aesthetic, recreation and wildlife values.

A protected area has been defined as an area of land or sea especially dedicated to the protection and maintenance of biological diversity and of natural resources managed through legal or other effective means (Ayeni et al., 1982). In Nigeria, it is certain that the survival of the protected areas depends on the careful management of natural resources (Flora and Fauna) and their environment. Habitat destruction by farmers, hunters and illegal logging activities has contributed greatly to the continuous degradation of wildlife habitat resources within the Park. Poverty has been the main driver of depletion of the fauna and flora resources, yet the resources have to be protected. Information on assessment of vegetation zone and its associated fauna in our National Parks is scanty or not available, particularly in Gashaka Gumti National Park. A study on vegetation and the associated fauna species is essential to generate data on the importance of the vegetation that are present within the park and the fauna that utilize them, and the study will serve as a field guide for the park management in their various management practices.

MATERIALS AND METHODS

Study Area

Gashaka – Gumti National Park is situated at the foot of the Mambilla Plateau and covers a land area of about 6,731 km². It lies between latitude 6º55'N and 8º05'N and longitude 11º13' to 12º11'E. The Park was formerly known as Gumti, Gashaka and Serti Game sanctuaries in the 1970's but on 26th August 1991, the three game sanctuaries were merged and upgraded to a National park by the Nigeria National Park. The purpose of establishing the Park was for the purpose of nature conservation, recreation, ecotourism, scientific and medical research; and to promote the art, craft and other cultural values of the indigenous people of the immediate environment, just like any other Park. The Park is an outstanding tourist landmark in Taraba State. It is also the most diverse in terms of plant and animal species among the National Parks in Nigeria and West Africa as a whole.

Method and Instrument of Data Collection

The method used involved both primary and secondary data sources. The primary data source was field survey, using both direct and indirect (observation of wildlife indices). Line transect of 5Km were laid systematically in each of the identified major vegetation zones of the park. Reading was carried out at every 1Km intervals and data were entered into a data sheet on the field. The secondary data on the other hand comprised use of related documents on the park, especially those related to the past records of the vegetation. The study was carried out on three days of every first and last week of every month from 6am to 1pm, and 4 to 6.30pm morning and evening respectively.

Data Analysis

The data obtained were analyzed using the IBM SPSS version 20 computer statistical software package; the data were subjected to descriptive statistics and presented in tables as frequencies and percentages.

RESULTS

Table 1 shows the vegetation types and dominant tree species in the study area, four vegetation zones were identified, these include *Burkea Africana* wooded Savannah, *Afzelia africana/Daniellia oliveri* vegetation zone, *Terminalia macroptera* vegetation zone and *Acacia* vegetation zone; and also, 29 trees species were identified in all the identified vegetation zones. Table 2 shows the fauna species associated with *Burkea africana* wooded Savannah of which *Cercopithecus mona* (Mona monkey) recorded the highest proportion with 35.38%, followed by *Cephalopus rufilatus* (Red flanked duiker) with 20.0%, while *Phataginus tricuspis* (Pangolins) and Piping hornbill recorded the least with 3.08% each respectively.

The fauna associated with *Afzelia africana/Daniellia oliveri* vegetation zone are shown in Table 3, it was observed that *Papio anubis* (Baboon) recorded the highest proportion with 33.33%, followed by *Erythrocebus patas (Patas monkey)* with 18.84%, and the least was *Syncerus* cafer (Buffalo) with 1.45%. Table 4 shows the fauna species associated with *Prosopis Africana* vegetation zone of which *Tragelaphus scriptus* (Bushbuck) recorded the highest proportion with 30.00%, while *Cercopithecus aethiops* (Tantalus monkey), *Phacochoerus africanus* (Warthog) and *Ourebia ourebi* (Oribi) recorded 20.00% each respectively, and Crowned eagle recorded the least with 10.00%. The fauna associated with *Accacia* vegetation zone are shown in Table 5, *Ptilopachus petrosus* (Stone partridge) recorded the highest proportion with 54.29%, while *Francolins bicalcarabus* (Francolins) and *Hippotragus equinus* (Roan antelope) recorded 37.14% and 8.57% respectively.

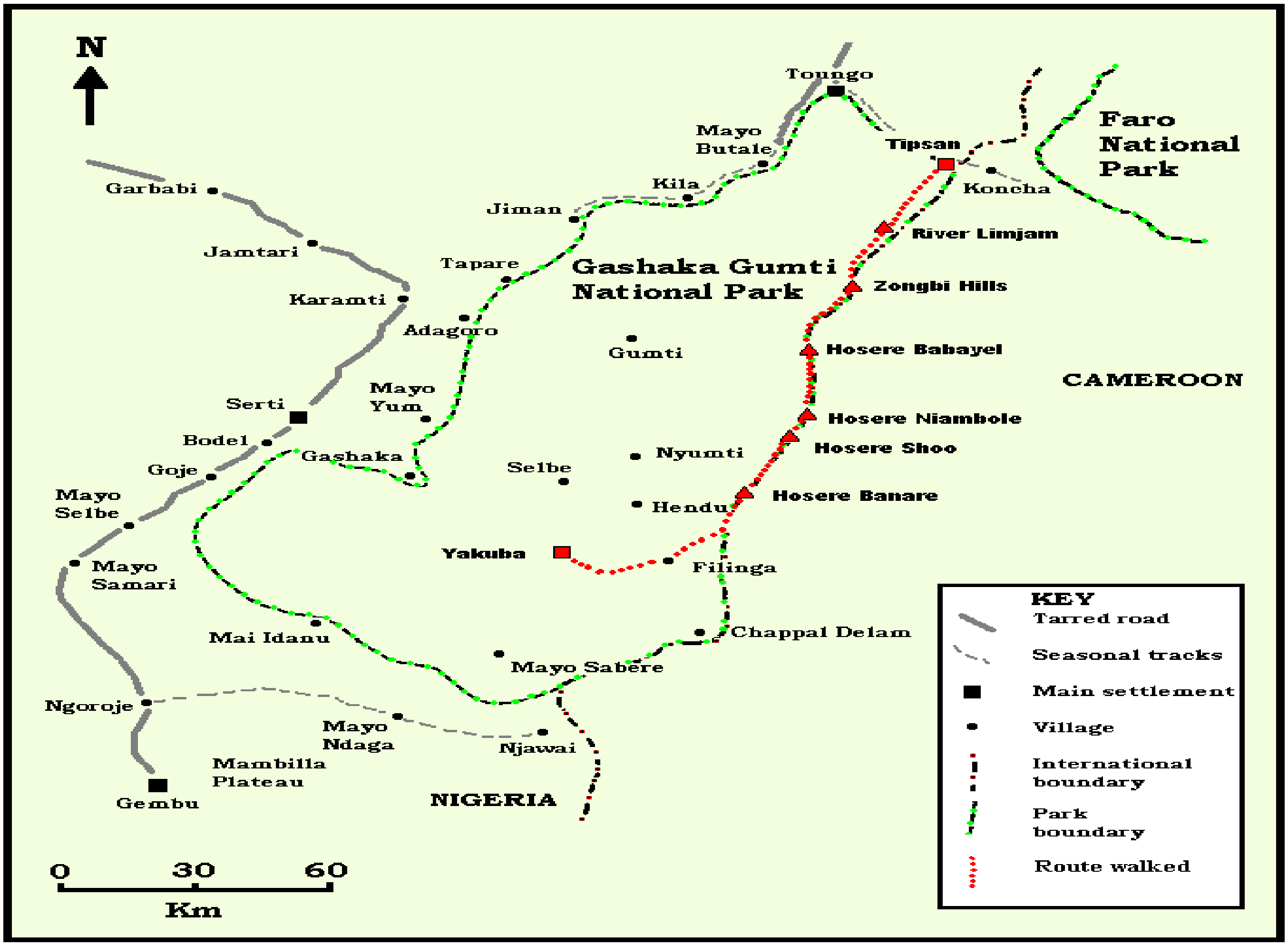


Figure 1: Map of the Study Area

Source: Oruonye et al. (2017).

Table 1: Major vegetation zones in the study area

Major vegetation zone	Location	Major tree/plant species
Burkea Africana woodedSavannah	Gumti	*Burkea africana, Terminalia avicenoidea, Terminalia superba, Milicia excels, Ceiba pentandra, Trilepisium madagsaacariense, Pseudospondias preussi, Celtis zenkeri, Ficus spp, Olax subscorpioidea*
Afzelia africana/Daniellia oliveri Vegetation Zone	Toungo	*Afzelia africana, Daniellia oliveri, Crossopteryx febrifuga, Piliostigma thonningii, Combretum spp, Isoberlina tomentosa,Parkiabiglobosa and Adansonia digitata*
Terminalia macroptera Vegetation Zone	Tipsan	*Terminalia macroptera, Prosopis Africana , Spondia mobin, Khaya senegalensis, Tamarindus indica, Sterculia setigera* and Vitex doniana
Acacia Vegetation zone	Jimam	*Acacia seyal, Acacia gournaensis, Piliostigma thonnigii, Detarium macrocarpum, Ficus doniana, Bombax costatum*

Table 2: Animal species associated with *Burkea Africana* vegetation zone

Scientific Name	Common Name	Number Sighted	Percentage (%)
Euxerus erythropus	Striped ground squirrel	8	12.30
Cercopithecus mona	Mona Monkey	23	35.38
Hylochoerus meinertzhageni	Giant forest Hog	3	4.62
Potamochoerus porcus	Red River-Hog	2	3.08
Cephalophus silvicultor	Yellow Backed Duiker	6	9.23
Cephalophus rufilatus	Red Flanked Duiker	13	20.00
Buceros bicornis	Piping Hornbill	2	3.08
Hippotragus equinus	Roan Antelope	2	3.08
Cercopithecus nicitans	Putty-nosed monkey	6	9.23
	Total	**65**	**100.0**

Table 3: Animal species associated with Afzelia *Africana/Daniellia oliveri* vegetation zone

Scientific Name	Common Name	Number Sighted	Percentage (%)
Syncerus caffer	African Buffalo	1	1.45
Taurotragus derbianus	Giant Eland	2	2.90
Atherurus africanus	Porcupine	2	2.90
Papio Anubis	Olive Baboon	23	33.33
Kobus ellipsiprymus	Waterbuck	3	4.35
Kobus kob	Kob	11	15.94
Hippotragus equinus	Roan Antelope	9	13.04
Erythrocebus patas	Patas Monkey	13	18.84
Cercopithecus nicitans	Putty-nosed monkey	5	7.25
	Total	**69**	**100.0**

Table 4: Animal species associated with *Terminalia macroptera* vegetation zone

Scientific Name	Common Name	Number Sighted	Percentage (%)
Cercopithecus aethiops	Tantalus Monkey	2	20.00
Tragelaphus scriptus	Bushbuck	3	30.00
Phacochoerus africanus	Warthog	2	20.00
Ourebia ourebi	Oribi	2	20.00
Stephanoaetus coronatus	Crowned Eagle	1	10.00
	Total	**10**	**100.0**

Table 5: Animal species associated with *Acacia* vegetation zone

Scientific Name	Common Name	Number Sighted	Percentage (%)
Ptilopachus petrosus	Stone partridge	19	54.29
Hippotragus equinus	Roan Antelope	3	8.57
Francolinus bicalcarabus	Francolins	13	37.14
	Total	**35**	**100.0**

DISCUSSION

In nature wild animals and plants are not evenly distributed all over the habitat in any area (Wilson and Boulter, 2000), therefore the species' distribution in Gashaka Gumti National park (Tougo sector) is not an exception. Four major vegetation zones were identified in this sector of the park; these include *Burkea Africana* wooded Savannah, *Acacia* vegetation zone, *Terminalia macroptera* and *Afzelia africana/Daniellia oliveri* vegetation zones. Roan antelopes (*Hippotragus equinus*) were distributed over the entire vegetation zone but were more associated with *Afzelia africana/Daniellia oliveri* vegetation zone.

The conservation status of some of the large mammals in the park was considered to be either endangered or vulnerable. The vulnerable species included Reedbuck, Striped Hyaena, common Jackal and Black and White Columbus monkey. Other species like Waterbuck, Leopard and Hunting dog were also considered to be endangered species. Species like Mona Monkey, Patas Monkey, Roan antelopes, Kob, Baboon and Stone Partridge were widely distributed within the Park and were common. Saha (2003) reported that food and escape cover play an important role in habitat selection of animals. Therefore, conservation of wildlife within protected areas depends mainly on maximizing the numbers of habitat patches that support self-sustaining populations. *Terminalia macroptera* had the lowest species diversity and succession status. The vegetation is fragile and looks like a regenerated vegetation. This could be due to frequent bush burning; and the adverse effects of bush burning have been listed by various authors (Afolayan, 1978). The result of the four vegetation zones investigated revealed that the vegetation type that had the highest plant species diversity was *Burkea Africana* wooded savannah. These findings are in agreement with the report of Obot (1986) on the woodland savannah of Borgu sector of Kainji Lake National Park.

The results of this work show that all the plants in the vegetation zone were highly utilized by the animals' species present in the study area. It was revealed that the Park has a wide spread ungulate species from different sub-families due to the following reasons. Firstly, extensive savannah grassland provides food for large number of grass-eating herbivores, food which is absent from rain forest although savannah contain fewer number of different mammal species than those in rain forest never support a greater total number of mammals (Andrew, 1999). Secondly, the open woodland and low shrub structure of the savannah is generally unsuitable for arboreal and other rainforest mammals, but it is suitable for these savannah mammals (Andrew, 1999).

Information from the park authorities also revealed that the decision to preserve five (5) broad species of plants including *Afzelia africana, Isoberlinia doka, Isoberlinia tomentosa, Diospyros mespiliformis* and *Acacia seyal* lead to the major conflict between the park authorities and the Fulani herdsmen that were involved in illegal grazing and looping. Moreover, they destroyed large plant species by cutting them down so that their cattle can fed on them, particularly at the time when grasses are scarce, or when the dry season is at its extreme around April and May.

CONCLUSION

In conclusion, it is quite clear from this study that all the four vegetation zones identified were the most preferred habitat for the wild animals in the Toungo sector of Gashaka Gumti National Park. It can be deduced from the study that the study area is a woodland savannah vegetation zone; it is an area of transition between Guinea and Sudan savannah vegetation zones which comprised numerous medium trees and grass under growth. Adequate protection should be given to this area in order to prevent the extinction of the wildlife species in the park. The study recommends that new laws on strict protection and conservation of parks should be made by government to enhance proper check of offenders, and the Park authorities should engage the support zone communities in conservation and protection programs to create mutual relationship between the park management and the communities.

Source of support

Nil.

Conflict of interest

None declared.

REFERENCES

Afolayan TA (1978). The effects of fires on the vegetation in Kainji Lake National Park, Nigeria. Oikos 31(3): 376-882.

Adjanohoun E, Ahiyi MRA, Ake-Assi L, Dramane K, Eewude JA, Fadoju SO, Gbile ZO, Goudote E, Johnson CLA, Keita A, Morakinyo O, Ojewole JAO, Olatunji AO, Sofowora EA (1991). Tradition medicine and pharmacopoeia contribution to ethnobotanical and floristic studies in Western Nigeria. Lagos, Nigeria: Organization of African Unity Scientific, Technical and Research Commission.

Akinsoji A, Adeonipekun PA, Adeniyi TA, Oyebanji OO, Eluwole TA (2016). Evaluation and flora diversity of Gashaka Gumti National Park 1, Gashaka Sector, Taraba State, Nigeria. Ethiopian J. Environ. Stud. Manag. 9(6): 713-737.

Allem AC (2000). Ethnobotanical testimony on the ancestors of cassava (Manihot esculenta Crantz. subsp.esculenta). Plant Genetic Resources Newsletter 123: 19-22.

Andrew D (1999). Gashaka-Gumti National Park: A Guidebook. Lagos: Gashaka-Gumti National Park, NCF/WWF-UK.

Ayeni JSO, Afolayan TA, Ajayi SS (1982). Introductory handbook on Nigeria wildlife. New Bussa, Nigeria: Kainji Lake Research Institute.

Ayodele AE, Yang Y (2012). Diversity and Distribution of Vascular Plants in Nigeria. Huayu Nature Book Trade Co. Ltd.

Gumnior M, Sommer V (2012). Multi-scale, multi-temporal vegetation mapping and assessment of ecosystem degradation at Gashaka Gumti National Park (Nigeria). Res J Environ Earth Sci 4(4): 397-412.

Ladipo D (2010). The state of Nigeria's forests. IITA Research for Development Reviews. Available at: http:/r4dreview.iita.org/index.php/2010/04/'08/the-state-of-nigerias-forests/ [Last accessed 2019 October 29].

Obot EA (1996). Ethnobotanic survey of Okwango Division of Cross River National Park. Workshop on the Rain forest of South-eastern Nigeria, held at University of Calabar, Nigeria.

Saha S (2003). Patterns in woody species diversity, richness and partitioning of diversity in forest communities of tropical deciduous forest biomes. Ecography 26(1): 80-86.

Wilson MN, Bourlter PS (2000). Spatial aspects of vegetation structure. Tropical rain Forest Ecosystems: Structure and Function Ecosystems of the World. New York: Elsevier Scientific Publishing Co. Pp. 29-47.

How to cite this article: Akande OA, Ihidero AA, Akinade TG, Ojo BS, Ahmad YA (2019). Assessment of major vegetation zones in relation to associated fauna in Toungo sector of Gashaka Gumti National Park, Nigeria. Int. Arch. Food Agric. Sci. 1(1): 11-16.

International Archives of Food and Agricultural Sciences

Original Article

Website: https://cintarch.org/iafas-home/
DOI: https://doi.org/10.33515/iafas/2019.018/18

Ticks infestation and diversity on indigenous cattle reared in Qua'an Pan LGA of Plateau State, Nigeria

Pam G. Rwang[1], Hussein O. Ahmed[1], Akwashiki Ombugadu[1*], Hussaini Y. Hamid[1], Cyril D. Nkup[2]

[1]Department of Zoology, Faculty of Science, Federal University of Lafia, Nasarawa State, Nigeria
[2]Department of Biology, College of Arts, Science and Technology, Kurgwi, Plateau State, Nigeria

ABSTRACT

Ticks are distributed all over the world, they infest on livestock and man as a necessity to feed on blood at some stage of their life which results in transmission of tick-borne diseases. Therefore, the study on ticks infestation and diversity on indigenous cattle reared in Qua'an Pan Local Government Area of Plateau State, Nigeria was carried out between November 2014 and July 2015. Two hundred cattle (123 females and 77 males) were randomly selected across five locations; of these, 97 (48.5%) individuals were infested with 200 ticks. The infestation rate of the ticks was predominant in Namu 60.0% (15/25) and least in Kurgwi 38.0% (19/50). However, there was no significant difference ($P > 0.05$) in ticks' infestation across the five selected locations. A significantly higher proportion ($P < 0.05$) of female cattle (61.5%) was infested with ticks as compared to males (38.5%). Six tick species were identified from the 200 ticks collected, of which *Hyalomma ruficipes* was the most predominant 65 (32.5%) followed by *Amblyomma variegatum* 51 (25.5%), *Rhipicephalus sanguizeove* 47 (23.5%), *Boophilus neoroplus* 27 (13.5%), while *Otobuis* species and *Haemophysalis* species were the least 5 (2.5%). Thus, there was a significant difference ($\chi^2 = 94.42$, df = 5, $P < 0.001$) in tick abundance between species. The diversity of ticks in the area was relatively low ($H' = 1.5$). To this end, cattle owners should constantly monitor the body of their cattle weekly to keep them free of ticks.

Keywords: Ticks, cattle, infestation, diversity

INTRODUCTION

Ticks are legged spider-like creatures that occur in great variety (Katie, 1986). They are cosmopolitan but are reported to be more prevalent in warmer climates (Oluwoch *et al.,* 2009; Adejoh *et al.,* 2019). They are found to infest on livestock and man as a necessity to feed on blood at some stage of their life. Feeding occurs by burying their head in the skin of their host to suck blood, deriving nutritional requirements directly from its host (Adejoh *et al.,* 2019). Ticks are distributed all over the world, but occur principally in tropical and sub-tropical countries and are capable of taking-in many times their weights in blood, with a corresponding increase in width. Tick bites in humans could result to tick borne diseases (TBD) such as human babesiosis, Borrelia miyamotoi and anaplasmosis (Ikpeze *et al.,* 2007) and ticks also play a vital role in the transmission of other diseases such as babesiosis, anaplasmosis, piroplasmosis and canine erhlichiosis etc. among livestock animals (Akinboade and Dipeolu,1983).

Ticks can rapidly cause great problems to livestock owners such as severe economic losses and are also offensive in a home where no animal is kept (Inci, 2016; Meneghi *et al.,* 2016). Tick bites are reported to cause mechanical damage, inflammation, toxicosis, paralysis, allergy and anemia (Jongejan and Uilenberg, 2004). Among the ectoparasites infesting cattle, ticks are very significant and harmful because of their blood-sucking habits and direct debilitating effect which may produce pathological changes and may also lead to severe injury, reduced impact on cattle productivity or even death (Ikpeze, 2012). Tick infestation further results to low

***Corresponding Author:** Akwashiki Ombugadu, Department of Zoology, Faculty of Science, Federal University of Lafia, Nasarawa State, Nigeria. E-mail: akwash24@gmail.com

Received: 7-10-2019 Revised: 01-11-2019 Published: 05-11-2019

production yield in terms of both quantity and quality of any livestock. Cattle are hampered by the effect of ticks, which are often complicated by problems of poor management as well as inadequate nutrition. Tick infestation leads to the removal of appreciable quantity of blood from an animal (John *et al.,* 2017). They cause serious skin irritation which may become infested by bacteria resulting to sores.

Marufu *et al.* (2011) reported that in Nigeria, the nomadic system of grazing which is a common phenomenon has exposed cattle to ticks infestation by at least four genera of ticks. It has been observed that unrestricted movement of livestock in search of water and pasture increases and promotes tick–host contact which could lead to high prevalence of tick infestation among cattle (Ayana *et al.,* 2013). This study was conceived due to the fact that there is paucity of information on ticks infestation and diversity on indigenous cattle reared in Qua'an Pan Local Government Area of Plateau State, Nigeria.

MATERIALS AND METHODS

Study Area

Qua'an Pan is a Local Government Area located in the southern part of Plateau State, Nigeria, with the headquarters in Ba'ap. It has coordinates 8°48′N 9°09′E, an area of 2,478 km^2 and a population of 196,929 (Plateau State Information and Communication Development Agency, 2016). It shares boundaries with Shendam, Pankshin, Bokkos and Lafia Local Government Areas making it one of the Local Government Areas that share boundaries with most Local Government Areas. The major towns include Deomak, Bwall, Kwalla, Kurgwi, Kwande, and Namu. It is also made up of diverse ethnic groups among which are Deomak, Bwall, Muryang, Geomai, and Hausa/Fulani Kanata. Agriculture is the mainstay of the economy of the local government area with production of major cash crops such as yam, rice, maize, millet and cassava, while the livestock reared include cattle, sheep, goat, pig and poultry. Fruit crops such as guava, cashew, citrus and mangoes are also grown in large and commercial quantities.

Sampling Procedure and Identification

A total of 200 indigenous white Fulani breed (*Bos indicus*) cattle which comprised 123 females and 77 males were randomly selected from the entire sample population using simple random sampling technique. Fifty cattle were selected from Kwalla, Doemak, Kurgwi while 25 cattle were selected from Namu and Bwall. In each site, visible adult ticks were collected using blunt steel forceps by thorough examination of the entire body surface of the selected cattle. The ages of the study subjects were estimated on the basis of the dentition score method developed for zebu cattle under a low plane of nutrition (Katie, 1986) and on information provided by their owners [recorded either as 'calf' (0-6 month), juvenile (6-24months) or adult (older than 24 months)]. The animal body was divided according to the method of Ikpeze *et al.* (2015) into five quadrants, namely the head (mouth, eye and ear); the neck (neck and dewlap); the trunk (thorax, abdomen and tail); the groin (scrotum, anus and udder); and the limbs (shoulder, forelimb and hind limb). All sample collection was carried out between the hours of 6 to 10 in the morning. Ticks from each animal were stored separately in vials containing 70% ethanol and labeled accordingly. In the laboratory, ticks were counted and identified by the genus and species level with the aid of a microscope and relevant morphological keys according to Fallis (1980), Soulsby (1986) and Okello-Onen *et al.* (1999).

Statistical Analysis

Data obtained were analyzed using R Console Software (version 3.2.2). Descriptive statistics was used to calculate percentages. The proportions of ticks' abundance in relation to location, gender and as well as between tick species were compared using Pearson's Chi-square (χ^2) test to determine any differences at 5% level of significance (Roa, 2007). Shannon-Wiener diversity index according to Begon *et al.* (2003) and Lamead (2011) was used to determine the diversity of ticks in the area.

$$H' = -\sum_{i=1}^{S}(Pi)(In\ Pi)$$

Where:
H' is the diversity index
Pi is the proportion of individual species
S is the total number of species in the habitat and,
i is the proportion of S species
Diversity index ranges from 0-5. Diversity index of 0-2.4 indicates low diversity, while 2.5-5 indicates high diversity.

RESULTS AND DISCUSSION

Ninety-seven (48.5%) of the 200 cattle sampled were infested with ticks (Table 1) of which two hundred individual ticks were collected. This is in accordance with the finding by Adejoh *et al.* (2019) who recorded a prevalence of 56.0% in cattle sold at Shinge livestock market in Lafia, Nasarawa State, North Central Nigeria. Also, Ikpeze (2012) reported that factors such as heat and carbon dioxide emitted by cattle as well as attraction pheromones secreted by attached male ticks are also known to increase the rate of infestation of ticks on any species of cattle. Tick infestation in relation to locations was predominant in Namu 60.0% (15/25) followed by Kwalla 58.0% (29/50), then Bwall 48.0% (12/25), and Doemak 44.0% (22/50), while Kurgwi was the least infested 38.0% (19/50) as shown in Table 1. However, there was no significant difference (χ^2 = 7.00, df = 4, P = 0.136) in the prevalence of tick infestation across the five selected sites.

The observation that the indigenous white Fulani were more preponderant among cattle found in all locations of the study site when compared to other local and exotic species may be responsible for the observed prevalence and infestation in the study site. This is in agreement with the findings of Opara and Ezeh (2011) who reported that the white colour of white coloured breed of cattle more readily serve as attractant to ticks than the dark coloured breeds.

Table 1: Prevalence of ticks infestation in relation to locations in Qua'an Pan Local Government Area of Plateau State

Location	No. Examined	No. Infested (%)
Kwalla	50	29 (58.0)
Doemak	50	22 (44.0)
Kurgwi	50	19 (38.0)
Namu	25	15 (60.0)
Bwall	25	12 (48.0)
Total	**200**	**97 (48.5)**

Tick infestation rate was higher in females 60.1% (74/123) than males 29.9% (23/77), and the difference was significant (χ^2= 10.19, df = 1, P = 0.001) in tick infestation rate between sex. Out of 200 ticks collected, predominant of the ticks were collected from female cattle 123 (61.5%) than males 77 (38.5%) (Table 2). Therefore, ticks abundance in relation to sex of cattle showed a high significant difference (χ^2 = 10.58, df = 1, P = 0.001). The observed preference of ticks for female cattle may possibly be related to more regular frequent intervals of stops by females to breast feed their young. This agrees with the finding by Adejoh *et al.* (2019) who recorded more ticks on cows (55.5%) than bulls (45.5%) in a study on the prevalence of ticks infesting cattle in Lafia, Nasarawa State, North Central Nigeria. This finding is in agreement with the report of Fasanmi and Onyima (1992) on a review on current concepts in the control of ticks and tick-borne diseases in Nigeria. Also, it is believed to be due to the heat and carbon dioxide emitted by cattle. In addition, attraction pheromones secreted by attached male ticks (Ikpeze, 2012) on male cattle at the front of the herd may attract other ticks which attach to the female and young cattle in the middle and back of the herd. This is however in contrast to the findings of Ikpeze *et al.* (2015) which showed that more ticks were collected from male cattle than females in Nnamdi Azikiwe University Awka premises. Solomon *et al.* (2001) attributes this to the behavioral differences in the life cycle of the female ticks that when fully engorged, they drop off to the ground to lay eggs while the male ticks tend to remain on the host for several weeks or months to mate as many females as possible before falling off the host to die.

Table 2: Distribution of ticks infestation in relation to sex of cattle

Sex	No. Examined	No. of Cattle Infested (%)	No. of Ticks Collected (%)
Male	77	23 (29.9)	77 (38.5)
Female	123	74 (60.2)	123 (61.5)
Total	**200**	**97 (48.5)**	**200**

Table 3 showed that *Hyalomma rufiscipes* was the most abundant 65 (32.5%) followed by *Amblyomma variegatum* 51 (25.5%), then *Rhipicephalus sanguizeove* 47 (23.5%), and *Boophilus neoroplus* 27 (13.5%), while *Otobuis spp* and *Haemophysalis* spp. had the least prevalence of 5 (2.5%) respectively. Therefore, there was a significant difference (χ^2 = 94.42, df = 5, P < 0.001) in the abundance of the six tick species. The finding of *Amblyomma variegatum* not having the highest prevalence rate in this study is contrary to the works of Obadiah and Shekaro (2011) in Zaria, Ejima and Ayegba (2011) in Idah Local government of Kogi state and Ikpeze *et al.* (2011) in Enugu and Anambra States. Also, it worthy to note that apart from the abundance of hard ticks in Qua'an Pan Local Government Area, there is an existing evidence of the presence of soft ticks. The presence of soft ticks *Otobius* spp. may probably indicate gradual encroachment of soft ticks on the Plateau. This is in agreement with the findings in studies conducted by Ahmed and George (2002), and Dogo (2002). However, ticks diversity in the area is relatively low with a diversity index of H′ = 1.5088 (Table 3). This is in accordance with the finding by Ikpeze *et al.* (2011) who obtained low tick species diversity on trade cattle at Enugu and Anambra States, South-eastern Nigeria.

Table 3: Checklist of tick species collected from cattle in Qua'an Pan LGA, Plateau State, Nigeria

Species	Total (%)	Pi	In(Pi)	Pi[In(Pi)]
Hyalomma rufiscipes	65 (32.5)	0.325	-1.12393	-0.36528
Amblyomma variegatum	51 (25.5)	0.255	-1.36649	-0.34846
Rhipicephalus sanguizeove	47 (23.5)	0.235	-1.44817	-0.34032
Boophilus neoroplus	27 (13.5)	0.135	-2.00248	-0.27033
Otobuis species	5 (2.5)	0.025	-3.68888	-0.09222
Haemophysalis species	5 (2.5)	0.025	-3.68888	-0.09222
Total	**200 (100)**			**-1.5088**

H' = -∑(Pi)ln(Pi); H' = - (-1.5088); H' = +1.5088; H' ≈ +1.5

CONCLUSION

About half of the cattle population sampled was infested on by diverse ticks which suggest the likelihood for transmission of tick-borne diseases (TBDs) in the area. It is therefore necessary for cattle owners to adhere to control measures such as maintaining regular proper sanitation, land cultivation, and regular examination of cattle for ticks, and prompt treatment of those infected cattle to reduce the risk of transmission of TBDs and their adverse effects in both animal and human populations. In addition, the State Government should institute surveillance on TBDs and also organize periodic awareness campaign on their prevention and control, on radio and television.

Source of support

Nil.

Conflict of interest

None declared.

REFERENCES

Adejoh VA, Pam VA, Uzoigwe NR, Naphtali RS, Yohanna JA, Pam RG, Ombugadu A, Pam DD, Dogo KS (2019). Prevalence of hard ticks infesting cattle in Lafia, Nasarawa State, North Central Nigeria. J. Agric. Res. Natural Resources 3(1): 001-019.

Ahmed A, George BDJ (2002). Incidence of hard ticks (Ixodidae) on horses around Zaria. Nigerian Vet. J. 23(1): 70-74.

Akinboade OA, Dipeolu OO (1983). Bovine babesiosis in Nigeria: detection of Babesia organisms in salivary glands of Boophilus decolaratus collected on trade cattle. Zentralbl Veterinarmed B. 30(2): 153-155.

Ayana D, Eshetu D, Abunna F (2013). Survey of Ixodid ticks on cattle in Borana pastoral area, Ethiopia. Acta Parasitologica Globalis 4(1): 14-23.

Begon M, Harper JL, Townsend CR (1996). Ecology: individuals, population and communities, 3rd ed. Cambridge, Massachusetts, USA: Blackwell Science Ltd. Pp. 884-912.

Dogo GI (2002). Current Status of Bovine babesiosis in Nigeria - An Overview (unpublished) paper Presented at Dermatophilosis Research Centre NVRI, Vom. 18th April 2002.

Ejima IA, Ayegba AE (2011). Relative abundance of hard ticks on reared cattle (Family Bovidae: *Bos* spp.) in Idah Local Government Area (LGA), Kogi State, Nigeria. The Zoologist 9: 9-16.

Fallis AM (1980). Arthropods as pests and vectors of disease. Vet. Parasitology 6(1-3): 47-73.

Fasanmi F, Onyima VC (1992). Current concepts in the control of ticks and tick-borne diseases in Nigeria – A review. Status and Recent Advances in Tick Management in Africa. 13(4): 615-619.

Inci A, Yildirim A, Duzlu O, Doganay M, Aksoy S (2016). Tick-borne diseases in Turkey: a review based on One Health Perspective. PLoS Negl. Trop. Dis. 10 (12): e0005021.

Ikpeze OO, Eneanya CI, Onyido AE (2015). Burden, seasonality, sex ratio and sites of ticks of public health importance on cattle found at Amansea, Anambra state, Nigeria. Int. J. Research – Granthaalayah 3(12): 61-71.

Ikpeze OO (2012). Ecology of ticks (Acarina: Ixodidae) on cattle in Nnamdi Azikiwe University Awka, Anambra state, Nigeria. PhD. Thesis. Department of Parasitology and Entomology, Nnamdi Azikiwe University Awka.

Ikpeze OO, Eneanya CI, Chinweoke OJ, Aribodor DN, Anyasodor AE (2011). Species diversity, distribution and predilection sites of ticks (Acarina: Ixodiade) on trade cattle at Enugu and Anambra States, South-eastern Nigeria. The Zoologist 9:1-8.

Ikpeze OO, Eneanya CI, Nwokedi OJ (2007). Environmental surveillance of canine babesiosis as an early alert system on emerging human babesiosis. J. Adv. Med. Pharm. Sci. 1(3): 19-23.

John M, Raman M, Ryan K (2017). A tiny tick can cause a big health problem. Indian J. Ophthalmol. 65(11): 1228–1232.

Jongejan F, Uilenberg G (2004). The global importance of ticks. Parasitology 129 Suppl: S3-14.

Lamead GA (2011). Species diversity and abundance of wild birds in Dagona-Waterfall Sanctuary Borno State, Nigeria. Afri. J. Env. Sci. Tech. 5(10): 855-866.

Marufu MC, Qokweni L, Chimonyo M, Dzama K (2011). Relationships between tick counts and coat characteristics in Nguni and Bonsmara cattle reared on semi-arid rangelands in South Africa. Ticks Tick Borne Dis. 2(3): 172-177.

Meneghi DD, Stachurski F, Adakal H (2016). Experiences in tick control by acaricide in the traditional cattle sector in Zambia and Burkina Faso: possible environmental and public health implications. Front Public Health 4: 239.

Obadiah HI, Shekaro A (2012). Survey of tick infestation in cattle in Zaria Abattoir, Nigeria. J. Veterinary Advances 2(2): 81-87.

Okello-Onen J, Hassan SM, Essuman S (1999). Taxonomy of African ticks: an identification manual. Nairobi, Kenya: International Centre of Insect Physiology and Ecology (ICIPE).

Oluwoch JM, Revers B, van Jaarsveld AS (2009). Host parasite distribution pattern under stimulated climate: implications for tick-borne diseases. Int. J. Climatol. 29: 993-1000.

Opara MN, Ezeh NO (2011). Ixodid ticks of Borno and Yobe states of Northeastern Nigeria: breed and coat colour preference. Animal Res. Int. 8(1): 1359-1365.

Plateau State Information and Communication Development Agency (2016). Plateau State Information and Communication Development Agency. The Governor's Office, Jos, Plateau State. www.plateaustate.gov.ng/page/quaan-pan. [Last accessed on September, 2019].

Roa KV (2007). Biostatistics: a manual of statistical methods for use in health, nutrition and anthropology. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

Solomon G, Nigist M, Kassa B (2001). Seasonal variation of ticks on calves in Sebeta in western Shewa Zone. Ethiopian Vet. J. **7** (1 and 2): 17-30.

Soulsby EJL (1986). Helminths, arthropods and protozoa of domesticated animals, 7th ed. London: Bailliere Tindal.

Thear K, Fraser A (1980). The complete book of raising livestock and poultry. Clerkenwell, London: Pan Books Ltd.

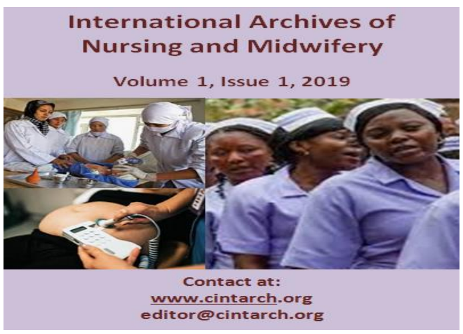
How to cite this article: Rwang PG, Ahmed HO, Ombugadu A, Hamid HY, Nkup CD (2019). Ticks infestation and diversity on indigenous cattle reared in Qua'an Pan LGA of Plateau State, Nigeria. Int. Arch. Food Agric. Sci. 1(1): 17-21.

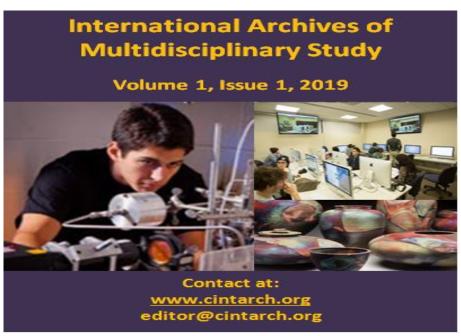
C-International Archives

Publishing and Research Consultancy Services

C-International Archives publishes international peer-reviewed bi-monthly online open access journals containing original research papers, reviews, short communications and other types of research papers in all fields of arts, medical and social sciences (including but not limited to): Agriculture and Food Sciences, Animal Sciences, Basic Medical and Clinical Sciences, Biological Sciences, Earth Sciences, Economics, Finance and Business Studies, Engineering and Computer Sciences, Humanities, Education and the Arts, Management and Social Sciences, Physical Sciences, Plant and Crop Sciences, Pure and Applied Sciences, and Veterinary Medicine

Our Journals





Please submit your manuscript at: https://cintarch.org/submit-manuscripts/

For more information, inquiry or complaints; please contact us at: https://cintarch.org/contact-us/