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Factors Influencing Visitation and Revisit in some Zoos and Parks of Southwest Nigeria

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Abstract
The study investigated factors influencing visit and revisit to selected zoological gardens and parks in southwest Nigeria. Structured questionnaires were administered to 400 visitors at University of Ibadan Zoo, FUNAAB Zoo, Shodex Garden and LUFASI Park. Most (55.9%) of the visitors were first timers while 44.18% were revisiting. About, 73% of the visitors were not satisfied with the services while only 48% showed willingness to revisit. Identified factors leading to poor visit include exorbitant gate fee as well as inadequate information about the zoos and park in printed format and on internet and social media. For the poor revisit, identified factors include poor marketing strategy, poor customer relationship, paucity of exotic animals and poor recreational activities. To improve visit to the zoos and park, there is need for provision of incentives in the form of reduced entry fee, and introduction of membership card and volunteering services.

Keywords: Ex-situ conservation**,** recreation, wildlife management, zoo visit and revisit

INTRODUCTION

Keeping of wildlife in captivity has been a symbol of power and of religious significance ancient times. Animals were displayed for entertainment of royal dignitaries and the paying public at circus (Gusset *et al*., 2014). Zoo as tourist attraction Centres have evolved from mere menageries to scientifically run and professionally managed institutions (Hutching & Conway,1995). Due to growing realization and better documentation, modern zoos are now shifting their focus from entertainment of visiting public to education, research and conservation. They are now finding ways to help conserving wild animals and their habitat. (Gusset & Dick, 2011)

Zoos in the 21st century provide more than mere recreation (Tribe & Booth, 2003). They keep people aware of the beauties of nature and the need to preserve wildlife. Zoos serve as a classroom to educate the public on the importance of conservation, animal care and environmental awareness (Moss & Esson, 2013: Adam & Salome, 2014). Zoo facilities provide children space to run around and develop their motor skill while making new friends Zoo visiting promote bonding between family members by providing a perfect way for family re-union, and unusual opportunity to attend a special function or event such as World Wildlife Day together (Anderson, 2003: Hazan & Azam, 2007). There have been tremendous increases in the number of zoo attendance over the past few decades and these visits are usually inspired in most cases by desire to see at close range real, live and exotic animals. (Mooney *et al*., 2020).

Zoological gardens and parks, despite their huge potentials cannot survive on a long term except they meet the curiosity and satisfy the needs of their visitors, since they depend on the financial support provided by visitors for day to day running of their conservation projects (Jorden &

Du Plessis, 2014; Kohshaka *et al.*, 2016). It is expedient to know why visitors are in the Zoo, whether for recreation, educational, self-enjoyment or family engagement. Knowing the purpose of visit will enable zoos management to capture the needs of their visitors and plan for them accordingly (Jorden & Du Plessis, 2014).

Nigerian zoological gardens and parks have great potentials to flourish and generate more foreign exchange for the country but unfortunately due to lack of funding, poor infrastructural development and lack of tourism culture patronage is usually lower than expectation (Yager *et al.*, 2015, Morenikeji, 2018) Most of the time, those who visit don't revisit due to lack of enjoyment and satisfaction with services rendered by Zoos and parks (Omonona & Kayode, 2011). Previous studies by Alarape *et al.* (2015) and Ogunjinmi *et al*. (2017) have identified some of the factors motivating zoo visit in Nigeria. This present study samples the opinions of zoo visitors with the view to determine the level of satisfaction and investigate factors influencing the visit and revisit in some Zoos in the southwest Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried out between April and July 2018 in four zoological gardens and park in the Southwest Nigeria. Data were collected from the University of Ibadan Zoological Garden, Ibadan, and Oyo state, Federal University of Agriculture (FUNAAB) Zoological park; Shodex Garden and Lekki Urban Forest Animal Sanctuary Initiative (LUFASI) Park, Lagos (Table 1). The studied zoos and parks were selected based on their popularity, accessibility and their track record of having high frequency of tourist influx.

The *University of Ibadan Zoological Garden*

The University of Ibadan Zoological Garden started as a teaching and research arm of the department of Zoology, University of Ibadan and metamorphosed into a full –fledged Zoo in 1974 (Adefalu *et al*., 2014). The zoo is opened to visitors round the week and is devoted mainly to conservation, education and entertainment. The zoo is rich in a wide collection of fauna consisting of herbivores, Avian, Carnivores, Primates and reptiles.

The Federal University of Agriculture, Abeokuta, Zoo Park

Federal University of Abeokuta Zoological Park is the first of its kind in Ogun State Nigeria. Situated on a 62 Hectares of land located about 200 metres away from the main gate of the University of Agriculture, Abeokuta. The Park was established in a conserved lowland forest area interspersed by a derived savanna vegetation. The Zoo houses different fauna, including antelope, hyenas, Jackal, monkeys, bird of different species and reptile. The park was open to the public in 2010 (Yisau *et al*., 2013)

Lekki Urban Forest Animal Sanctuary Initiative (LUFASI Park)

Lufasi Nature Park covers a large area of about 20 hectares of land at the Majek area (Km 41) along the Lekki-Epe Express Way. Located at 6.4646^{o} N, 3.6546^{o} E using coordinates on the world map, this park is home for the Ekki "Iron Wood" tree (*Lophira Alata*), the endangered Hooded Vulture (*Necrosyrtes Monachus)* and the African Pied Hornbill (Tockus fasciatus). The vegetation consists of pockets habitats of swamp forest and oil-palm plantation with large garden spaces and pond side landscapes for recreation and celebrations. Lufasi Nature Parks aims to help conserve native biodiversity, educate about Climate Change and the natural environment, and collaborate with the wider community of stakeholders.

Shodex Garden

Shodex Garden is a recreational centre located at 251/253, Ikorodu road, Anthony bus stop, Lagos, Nigeria. It is a garden that has its various services in event centers and venues. It offers a range of activities like swimming, sightseeing, relaxing etc. It also has a mini-zoo for tourists and visitors.

Table1: Description of the Study Area and distribution of questionnaires (n=400)

Study Site	Location State	Coordinate	Description	Ownership	Number of respondents per Zoo
University of Ibadan	Oyo State	7.4437˚ N, 3.8955˚ E	Zoological Garden	Institutional	100
Federal University of Agriculture, Abeokuta	Ogun State	7.229˚N, 3.4466˚E	Zoological Park	Institutional	100
Shodex Garden	Lagos State	6.5714˚N, 3.36759˚ E	Zoological Garden	Private	100
Lekki Urban Forest Animal Sanctuary Initiative (LUFASI) Park, Lekki, Lagos	Lagos State	6.446˚N, 3.6546˚E	Animal Sanctuary& Park	Private	100

Sampling and Data Collection Method

Sampled population comprises of the visitors encountered at the Zoological garden and parks during the survey. The respondents were randomly selected from the pool of visitors. Data were collected through self-administered structured questionnaires. One hundred (100) questionnaires were randomly administered to respondents in each zoo (University of Ibadan, Federal University of Abeokuta, LUFFASI and SHODEX garden respectively). All the four hundred (400) questionnaires administered in total were retrieved. The target group cuts across different socio-economic classes including students, private practitioners, civil servants and unemployed. The respondents' age were between from 18 years and >60 years. Sampling was carried out without bias for gender and nationality. Equal number of questionnaires were administered to both male and female. Respondents were selected based on willingness to participate in the survey. The survey takes into consideration the respondents independent variables (demographic profile) such as: age, gender, marital status, educational background, Occupation. Dependent variables measured include accessibility to the recreational centres, source of information about the zoo, perception or opinion about the zoos and park, their views on the hospitality and customer relation experience, perception on safety, quality of exhibits and animal welfare. Information gathered was used to compute the visitors' expectation, satisfaction and willingness to patronize or revisit the zoo thereafter.

Reliability of the test instrument

In order to test the reliability of the questionnaire used on field a small sample (n=40) which was 10% of the total questionnaires to be administered on field was initially tested among the staff and students and casual workers in the university of Lagos. The resultant response obtained (pretest) was then compared with the response generated on field by the authors (post field) as a small sample test of reliability.

Data Analysis

Descriptive statistics such as mean, mode, frequencies, percentages as well as Tables, graphs and charts were used. Primary data generated through the structured questionnaire were analyzed with Microsoft Excel version 2016

RESULTS

The demographic characteristics of the respondents interviewed were recorded and shown in Table 2 below. Most (53.7%) of the

respondents surveyed were female while the male population were just 46.3% in all the studied population. It was also revealed that seventy-six per cent (76%) of the respondents were adults with age ranging from <20-60 years and above. The literacy level was high (as about 77% of the respondents attained either tertiary education (polytechnic and university education). The survey also revealed that most (57.5%) of the respondents are gainfully employed. The frequency of zoo visit is reported in Table 3. The study showed that most (55.9%) of the respondents are first time zoo visitors while the remaining 44.1% are repeat visitors.

Table 2: Demographic characteristics of respondents encountered at selected zoos and parks

Description		Shodex garden (n = 100)	University of Ibadan Zoo (n = 100)	FUNAAB Zoo (n = 100)	LUFASI Park (n = 100)
Gender	Male	52%	33.3%	52%	48%
	Female	48%	66.7%	48%	52%
Age range (in years)	< 20	24%	16.7%	36%	20%
	21 – 30	36%	83.3%	36%	56%
	31 – 40	0%	0%	24%	16%
	41 – 50	36%	0%	4%	8%
	51 – 60	0%	0%	0%	0%
	> 60	4%	0%	0%	0%
Highest Education attained	Primary Education		4%	12%	0%
	Secondary Education		40%	0%	12%
	Polytechnic		20%	88.2%	28%
	University		36%	0%	60%
Occupation	Self employed	40%	6.7%	16%	12%
	Private sector	16%	0%	20%	60%
	Unemployed	0%	0%	16%	4%
	Civil servant	8%	3.3%	4%	20%
	Student	36%	90%	44%	0%

Table 3: Frequency of visit among the respondents

Type of visit	Location				
	Shodex Garden	University of Ibadan zoo	FUNAAB zoo park	LUFASI Park	Cumulative percentage (%)
Revisit	40%	44%	40%	52%	44.1%
First-time visit	60%	56%	60%	48%	55.9%

Sources through which the respondent learnt about the zoos are illustrated in Figure 1. Close to thirty-three percent (32.4%) claimed to have learnt about the zoo through television, newspaper advertisement and social media/internet while the majority (67.6%) learnt about the zoos through friends and family.

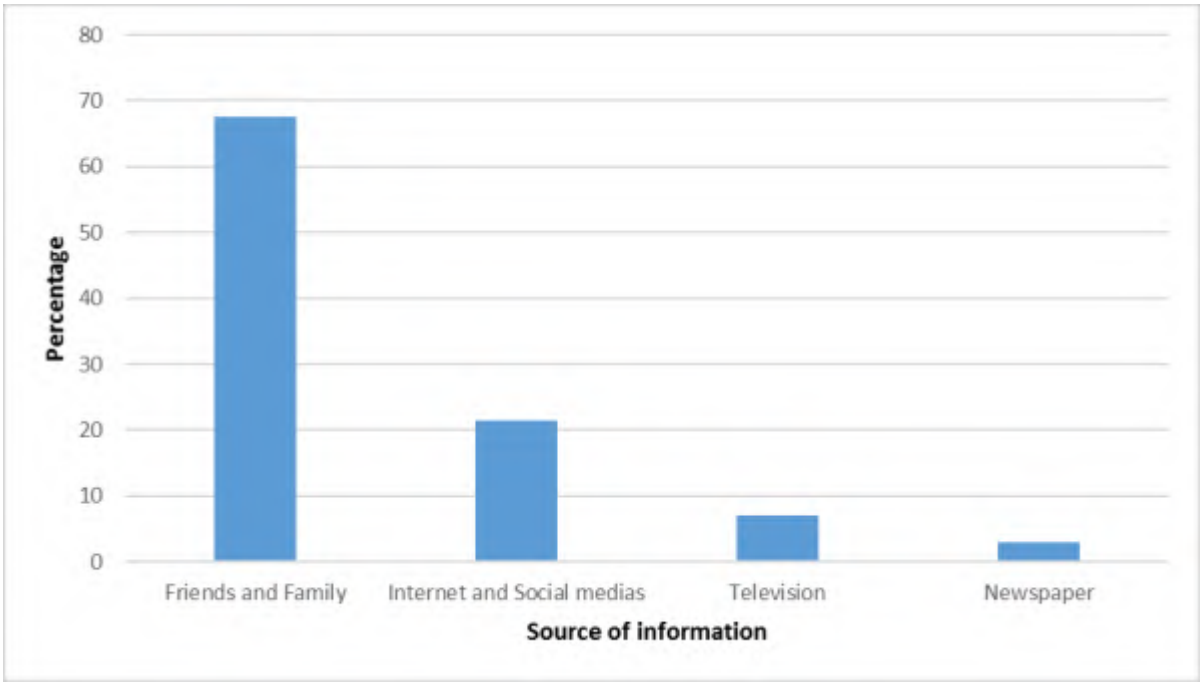

Figure 1: Visitors' sources of information about the zoos

The opinion of respondents on the amount of money charged by the zoos as gate fee is shown in Table 4. Entry fee varied with children paying between 300 – 1000 and adults paying between 500 and 1000 naira. The perception of respondents on the activities and the level of satisfaction with activities at the zoo is showed in Table 5 and Figure 2. Sixty percent (60%) of the respondents believed that the entry fee charged was too exorbitant. Majority (93%) of the respondents said they enjoyed nature walk/sight-seeing, relaxation, animal viewing and animal feeding time mostly while only a few (7%) said they enjoyed the education initiative /programs show- cased by the zoos (Table 6). Majority of the visitor (73%) considered their experience at the zoo to be either poor, fair or were indifferent in their opinion as regarding the level of satisfaction attained at the zoo. Only twenty-seven percent (27%) of the respondents rated their experience at the zoo as excellent

The opinion of the respondent about the services rendered by the zoos to the visitors is shown in Figure 3. Majority (81%) of the respondents rated

the customer service as either poor, fair while some are indifferent. Nineteen per cent (19%) of the respondents believed that the services rendered by the zoos are excellent. The desire of respondents to repeat their visit is shown in Table 4. Only 48% of the visitors indicated an interest to make a repeat visit. Fifty –two percent (52 %) indicated loss of intrest in return trip following the disatisfaction with their first visit. Some of the factors perceived by respondents to be responsible for poor zoo visit in the southwest Nigeria are highlighted in Figure 5. Some of these factors include busy schedule (29%), poor costumer relationship (21%), inadequate zoo marketing (21%), and lack of basic facilities (11%), paucity of animal species (10%) and poor zoo management / animal welfare (8%).

Table 4: Gate fee across the study location

	Entry Fee per location			
Category of visitors	Shodex	University of Ibadan zoo	FUNAAB zoo	LUFASI park
Children	500	300	500	
Adult	1000	500	1000	1000
Group of 10	Negotiable	Negotiable	Negotiable	1000 per head

Table 5: Respondents' opinion on entry fee

Opinion	Shodex	University of Ibadan zoo	FUNAAB zoo	LUFASI
Appropriate	24%	76%	36%	28%
Expensive	76%	24%	64%	72%

Table 6: Activities enjoyed by visitors at the study area

Activities	Shodex	University of Ibadan zoo	FUNAAB zoo	LUFASI park
Relaxation	40%	0%	20%	48%
Education	4%	0%	4%	20%
Animal view and animal feeding time	16%	23.5%	36%	12%
Nature walks and sight-seeing.	40%	76.5%	40%	20%

The respondents' opinion about the state of the facilities in the selected zoos is shown on Table 7. Respondents agreed that the zoos have the required facilities for visitors safety, however, majority (94.29%), complained of inapropriate provision of safety barriers, warning signs(71.74%), solution to potential animal escape (66.67%) and maintenance of animal house and exhibit (57.63%) as well as inadequate staff training (73.47%).

Table 7: Perception of visitors on the facilities at the zoo

Facility assessment	Absent	Present	Present and appropriate	Present but inappropriate
Provision of barriers	10.77%	89.23%	5.71%	94.29%
Trained staff	23.53%	76.47%	26.53%	73.47%
Warning signs	30.9%	69.1%	28.26%	71.74%
Solutions to potential risk from escaped animals	42.62%	57.38%	33.33%	66.67%
Provisions to tackle future disease outbreak	43.08%	56.92%	25.71%	74.29%
Maintenance of animals house and exhibits	14.29%	85.71%	42.37%	57.63%

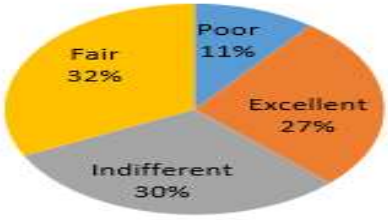

Figure 2: Visitors rating of experience at the zoo/park

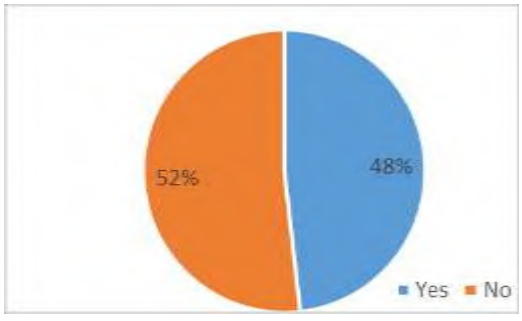

Figure 4: Willingness of visitors to revisit Zoos

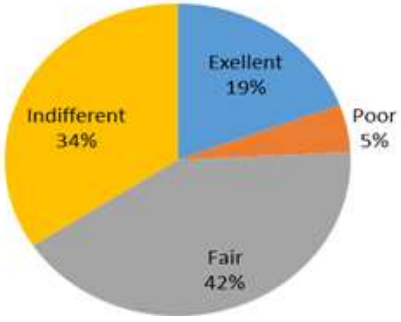

Figure 3: Visitors rating of customer's service rendered at recreational centers

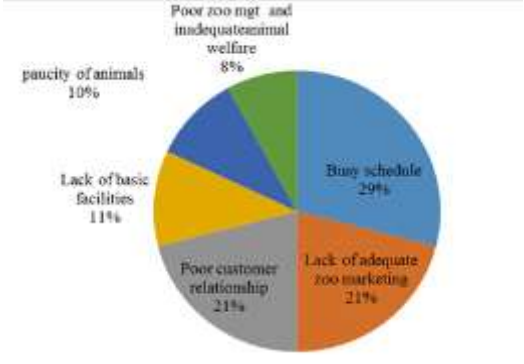

Figure 5: Perceived reasons for poor patronage at recreational centre

DISCUSSION

This study showed that about fifty-six percent (55.9%) of the visitors encountered during this study were first time zoo visitors. This implied that the number of people visiting for the first time was more than those revisiting. This shortfall in the number of second time visitors could be due to lack of interest as a result of unpleasant experience during their previous visit (Fennell, 1999).Studies have suggested that impression of visitor about zoo during their first visit influences their attitude ,visitors' perception can be influenced by the type of animals, the type of exhibit displayed and how the visitor perceive the zoo keepers(Godinez & Fernandez,2019).Its pertinent therefore that zoo managers should go extra mile in sensitizing their visitors (Borokini, 2013), helping them to make the best use of their time in the zoo (Catibog-sinha, 2008) and also to make the zoo environment conducive for them to stay and to revisit (Alarape *et al*., 2015).

The study also shows that most of the respondents learnt about the zoo mostly through interaction with friends and families (67.6%) and Social media (21.4%) while only a few claimed to learn about the zoos through television and newspapers. This agrees with the findings of Alarape *et al*. (2015) who reported that the highest number of visitors sampled (35%) at Markurdi Zoological garden learned about the zoo through friends and family. This shows how important and effective inter-personal relationship could be in spreading information about zoo However, zoos and parks owners should not stop at this level but leverage on the use of social media for more effective coverage and also intensify their marketing effort via television, newspapers, internet as well in order to remain visible and accessible to the public. The study revealed that ninety-three per cent (93%) of the visitors came to the zoos mainly for entertainment-related activities such as nature walk, sightseeing. Only seven per cent (7%) of the population claimed to visit for an educational purpose such as school excursion. This agrees with Turley (1999) who identified pleasure or desire to get away from busy work schedule as the primary motivation for zoo visit in the United Kingdom and Boyd *et al*. (2014) who in tandem with Knezevic *et al*. (2016) identified curiosity to see and watching of wild animals in captivity, and desire to relax ,spending quality time to enjoy nature as the main motivation for Zoo visiting. Adetola and Adedire (2018) also stressed that people come to zoos and parks to be entertained watching animals especially during the feeding times, spending valuable time with loved ones to strengthen the family bond. Consequently, for zoos to fulfil their conservative objective and meet their target there is need to incorporate both the social and the psychological needs of visitors while planning the zoo programs. Although zoo provides ample opportunity for relaxation and recreation, yet most of the respondents interviewed (73%) were not satisfied with either the facilities or the quality of serves rendered in the Zoos. They considered the basic facilities provided by some of the zoos such as benches, toilet, parking spaces, warning sign and the play area to be inadequate. The respondents complained about the quality of services rendered, lack of tour guides, insufficient information about the zoos on the internet and exorbitant entry fee charged. As a result of the high level of dissatisfaction experienced by the visitors, only 48 per cent of the survey population was willing to make return trips. Hence in order to encourage visitors to keep visiting there is need for the zoo administrators to make the facilities more comfortable and appealing for the visitors to patronize.

CONCLUSION

The study thus identifies lack of motivation due to busy and tight business schedule coupled with inadequacy of zoo facilities, exorbitant gate fees, paucity of exotic animals, poor zoo management and animal welfare techniques, inappropriate marketing skill, lack of innovation and poor costumers' services as some of the major factors driving poor zoo poor visit and revisit in the southwestern Nigeria. In order to improve the current level of zoo patronage Zoo managers should step up their games by upgrading their zoos in compliance with the 21st century standard. Zoo management should ensure that basic facilities and need such as benches, shelters, parking space, catering services, zoo gift shops, convenience and play area are available for the use of visitors and also ensure that their day to day activities are publicized on social media and internet for potential visitors to see. Innovative and customer's friendly strategies should be adopted by zoos and while advertising their

products and services. This will go a long way to create a lasting relationship between the zoological parks and the public.

Safety is important to visitors and their loved ones while within the zoo environment, so, adequate protective structures and measures such as enclosure, stand-off barriers and restraint should be put in place as a matter of necessity to keep visitors away from a potentially dangerous animal and biohazard. In order to create a positive image about zoo and also motivate the public to visit, zoo staff members should be trained to be friendly, polite and to demonstrate high sense of professionalism while relating with visitors. The Zoo community should aspire to build profitable relationship by extending educational opportunities to schools and corporate bodies inviting them to participate in well-structured education program and activities on special events such as World Wildlife Day and World Biodiversity Day.

In order to augment the high entry fee which in most cases is one of the major deterrents to zoo visit. Zoological gardens and parks should do service and product promotion .This involves provision of incentives in the form of free entry or reduced entry fee for visitors at certain periods of the year. Alternatively, the use of coupons could be introduced as a way to reduce entrance fee or promote free entrance. Certain days in the month could be declared free entry day for children and even adults. This on the long run will stimulate the recipients of opportunity or the coupons to come to the zoo over and over again. Zoo and park membership card is another vital tool that could be helpful in increasing influx, patronage and commitment to zoos visit. Regular visitors and sponsors should be encouraged to take membership card which allows them to have access to the park and zoo several times depending on their category without paying gate fee. This will encourage many more visitors to become card holders and be more frequent at zoos.

Opportunity for volunteering services should be made available to interested members of the public. This will allow the zoo management to save cost of paying salaries while the volunteering individuals will get the opportunity to visit the zoo at no cost. Such individual would be willing to pay on other days and would also serve as an agent in spreading good recommendation about the zoo.

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Visitors' Perception of Destination Image and Satisfaction in Selected Ecotourism Destinations in Southwest, Nigeria.

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ABSTRACT
The attributes of the different destinations form the basis for different image, expectations and satisfaction. In this context, the purpose of this paper is to determine visitors' perception of destination image and satisfaction with the destination. Data for the study were collected through questionnaires administration on visitors to selected ecotourism destinations. Data obtained were presented descriptively and analyzed using analysis of variance (ANOVA) .The study revealed significant differences in visitors' perception of destinations' image. Regarding visitors' satisfaction of the destinations, the study has found that there is no significant difference in visitors' perception of destination image and their satisfaction with the destinations. The findings in this study could enhance visitors' pre-visit decision; assist in effective design and management of selected ecotourism attractions, as well as improving marketing strategies to fulfill the needs of ecotourists and other tourism industry stakeholders.

Key Words: Determine, perception, destination, image, satisfaction, attributes, Nigeria.

INTRODUCTION

People all over the world are always drawn to natural attractions such as magnificent waterfalls, unique wildlife, mountainous landscapes and a host of others**.** Nature-based tourism or ecological tourism is one of the fastest growing sectors within the global tourism industry (Buckley, 2004) The suggestion that eco- friendly tourism was growing three times faster globally than the tourism industry as a whole (UNWTO) 2004, cited in The International Ecotourism Society TIES (2006) came into limelight when people began to seek alternative options for mass tourism in the early 1980s. The concept of ecotourism has emerged as an effective platform that offers alternative tourism wherein people tour natural regions with an objective to execute eco-friendly activities, to learn and research about their environment. Ecotourism which allows the tourist to go to relatively undisturbed natural areas for the purpose of enjoying the phenomena of nature combines wildlife and adventure tourism experiences accounts for a larger share of some countries' gross domestic product (UNWTO,1991). According to the UNWTO (2018) World Tourism Barometer, it is estimated that destinations worldwide received 1,083 million international tourist arrivals between January and September 2018, and by 2030, the number of international tourist arrivals worldwide is forecast to reach 1.8 billion. In the present day, ecotourism has gained significant prominence

and is turning out to be a fast-developing segment in the existing global tourism industry including Nigeria with abundance natural resources and cultural heritage. As a matter of fact, Nigeria is actively including ecotourism as an integral aspect of her strategies for conservation and economic growth.

Anaiah *et al.* (2009) revealed that most tourists visited tourists‟ sites or destination due to environmental factors such as, climatic, weather condition and scenery of the environment, while some other tourists made their trip due to the socio-cultural attributes and events of the destination areas. Precisely, ecotourists are individuals who spend a predetermined number of days engaged in environmentally base activities and have unique motives for visiting natural areas (Palacio & McCool, 1997). However, the complex issues that influence the choice, the perception of tourists about a destination's and satisfaction with the destination are matters of concern. The institutions and agencies responsible for the development and promotion of tourism destinations need to determine the factors influencing tourists' destination choices. It is recognized that destination is not only a tourism product, offering an integrated experience to customers, but it is a perceptual concept, which is interpreted subjectively by the consumers and is dependent on a wide range of factors (Buhalis, 2000). Curry *et al.* (2006) examined the term perception from a psychological perspective and noted the difference not only between image and perception but also between seeing and perception. The authors define the perception process as that "by which sensations are selected, organized and interpreted" and one which "is strongly influenced by factors such as individual's experience, education and cultural values.

Image is the totality of impressions, beliefs, ideas, expectations, and feelings accumulated towards a place over time by an individual or group of people" (Kim & Richardson, 2003). "Destination image is an interactive system of thoughts, opinions, fee-lings, visualizations, and intentions toward a destination" (Tasci *et al*., 2007). The formation of tourist destination image has been researched over the past four decades and is considered to be one of the most important areas or research in destination marketing (Pike, 2002). Its principal constructs consist of the destinations cognitive and affective images along with its overall image (Baloglu & McClearly, 1999) which has more recently been included and linked to the cognitive influences of holiday choice and behavior (Lin *et al.,* 2007). As the numbers of tourists who visit eco-tourism settings or protected areas increased sharply in recent years, it is necessary to understand more about eco-tourist perception of destination image and visitor satisfaction. Once a destination has been established as such, it is very important to ensure that visitors have a positive assessment of their experience. Visitor Satisfaction was more a judgment or evaluation than an attitude and is a complex construct with numerous associated measurement issues (Yüksel & Rimmington, 1998). Past research has operationalized satisfaction at both the overall satisfaction and attribute satisfaction levels. Attribute satisfaction has been defined as consumer subjective satisfaction judgment resulting from observation of attribute performance (Oliver, 1997). Taking into account the multidimensional nature of the concept of satisfaction, it is desirable to use a multi-attribute approach where overall satisfaction is a function of attribute level evaluations (Voon & Lee, 2009). Following these areas of research, this paper seeks to analyze the components and attributes of visitor's perception of destination image and satisfaction in selected ecotourism destinations in the study.

MATERIALS AND METHODS

Study Area

The study was conducted in selected ecotourism destinations in Southwest Nigeria. The study sites were Okomu National Park, Edo State, Lekki Conservation Centre, Lagos State, Idanre Hills, Ondo State, Ikogosi Warm Spring, Ekiti State and Osun Osogbo Sacred grove, Osun State, Nigeria. The area in the southwest lies between longitude 2°311 and 6°001 East and Latitude 6°211 and 8° 371N (Agboola, 1979) with a total land area of 77,818 km2 and a projected population of 28, 767, 752 in 2002 (NBS, 2011). The southwest part of the study area is bounded in the East by Edo and Delta states, in the North by Kwara and Kogi states, in the West by the Republic of Benin and in the south by the Gulf of Guinea. Edo state as part of the South South is an inland state in central southern Nigeria. It is bounded in the

north and east by Kogi State, in the south by Delta State and in the west by Ondo State. Generally, climate and vegetation of the study areas is tropical in nature and it is characterized by wet and dry seasons. The temperature ranged between 21 and 34°C while the annual rainfall ranged between 150 and 3000 mm. The wet season is associated with the Southwest monsoon wind from the Atlantic Ocean while the dry season is associated with the northeast trade wind from the Sahara desert. The vegetation in Southwest Nigeria is made up of fresh water swamp and mangrove forest at the belt.

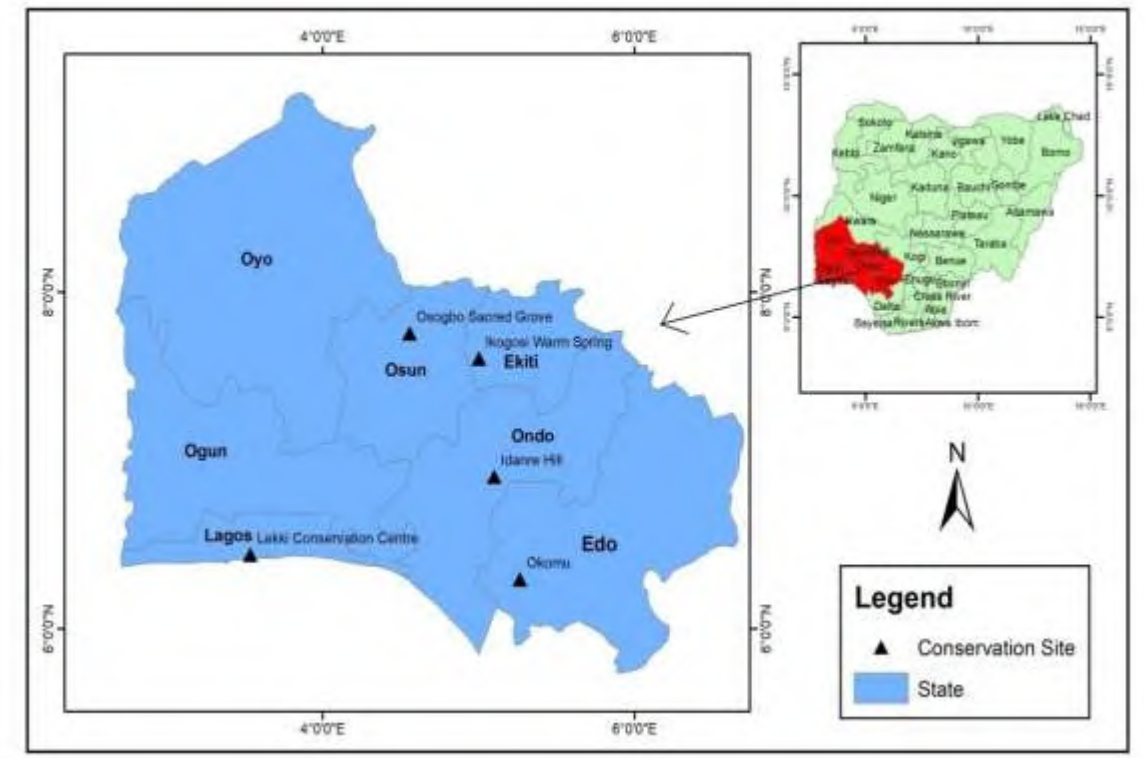

Figure: 1: Map showing some of the study sites in South-west and part of South-south Nigeria.

Population and Sampling

The population for the study was visitors drawn from selected ecotourism destinations. Four hundred and twelve (412) visitors were randomly selected for the study, using Krejcie Morgan (1970) method for determination of sample size.

Data Collection and Analysis

The instruments for data collection was structured questionnaire, consisting of personal details of visitors such as gender, age, marital status, nationality, religion, monthly income and membership of environmental non-governmental organizations (NGO). Data collection also includes face to face interview with the visitors, staff, local residents and personal observations made in the research areas. These was done in order to provide additional information needed to support the claims of the respondents in the study. Visitors' perception of destination image were rated on a 6- point Likert scale (1 = strongly disagree; 2 =disagree; 3= undecided; 4= agree; 5= strongly agree) while visitors' perception of satisfaction was rated in Likert scale as (1= not at all satisfied; 2=merely satisfied; 3= neutral; 4= satisfied and 5= very satisfied).

Other variables included in the study were gender age, marital status, State of origin, nationality, l

education, religion, occupation, and monthly income. Data collected were analyzed and presented using descriptive and inferential statistics. The descriptive techniques include the use of tables, graphs, means, standard deviation, and percentages. The inferential statistics employed was ANOVA.

RESULTS

Socio-Demographic Characteristics of Visitors to the Selected Destinations

The result in Table 1 (socio-economic characteristics) shows that out of 412 sampled visitors, 234 were males representing 56.8% and 178 were females representing 43.2%. This result indicated that more male visitors visited selected destinations area than female. Table 2 shows that 245 visitors were within the age of 25 to 50 years representing (59.5%). This was followed by 122 visitors within the age group of 15-24 years representing (29.6%). In addition, 38 visitors who are in the age bracket of 51-54 represent (9.2%). Those who are above 64 years were 3 representing (0.7%) while the least age group of 0 to 14 years were 4 representing (1.0 %). The result reveals that more than half of the visitors totaling 221 (53.6%) were married, followed by 167 visitors who were single (40.5 %). The least category of visitors (8) (1.9%) were divorced/ separated. On religion, 306 visitors (74.3%) practiced Christianity, 101 (24.5%) practiced Islamic religion while only 5 of the respondents (1.2 %) practiced traditional religion.

Result further indicates that 29.3% of respondents were public sector employees. This is followed by 26.4% that were self-employed, 20.8% of the respondents were students, 13% that were working in the private sector. Those retired were 5.9%. Those categorized as 'others' were 4.12% while 0.48% were those unemployed. On monthly Income, 119 visitors (28.9%) of respondents were in the highest income category of more than ₦80,000/month while the least was ₦61,000 and ₦80,000 (8.5%). The findings indicate that 333 visitors representing (80.8%) were not members of NGOs on conservation or environment while 79 (19.2%) were members.

Visitors' Perception of Destination Image

Results on visitors' perception of destination image are presented in Table 2. The mean of visitors' perception of destination image ranges from 3.81 to 4.53. The highest mean (4.53) was for "the quality of the environment in terms of safety, security, cleanliness, hospitality, tranquility and pleasant weather is satisfying" while the lowest mean was for perceived attitude of the destinations' host community does not affect its image with a mean of 3.81.

Visitors' Satisfaction with Ecotourism Destination

Relating to visitors' satisfaction of the destination, results shows that visitors were satisfied by "feeling welcome and free to explore the destination without restriction" with the highest mean of 4.45 and also in terms of activities of tour guides in providing relevant explanation on the attraction with a mean of 4.43 while the lowest mean was for "information and availability of brochures in English, French and local languages (Table 3).

Differences in Visitors' Perception of Destinations' Image and their Satisfaction

Table 4 reveals that there is a statistically significant difference in visitors' perception of destination image ($p < 0.01$). On visitors' satisfaction, findings show that there is no statistically significant difference in visitors' satisfaction of the destinations ($p > 0.05$).

Table 1: Visitors' socio-economic characteristics (n=412)

Variable	Frequency	Percentage (%)
Gender		
Male	234	56.8
Female	178	43.2
Age		
0-14	4	1.0
15-24	122	29.6
25-50	245	59.5
51-64	38	9.2
65 and above	3	0.7
Marital Status		
Single	167	40.6
Married	221	53.6
Divorced/Separated	8	1.9
Widow/Widower	16	3.9
Religion		
Christianity	306	74.3
Islam	101	24.5
Traditionalist	5	1.2
Occupation		
Public sector	120	29.3
Self employed	109	26.4%
Students	86	20.8%
Private sector	54	13.0
Retired	24	5.9
Unemployed	2	0.5
Others	17	4.1%
Monthly Income		
1000-20000	86	20.9
21000-40000	79	19.2
41000-60000	50	12.1
61000-80000	35	8.5
>80000	119	28.9
No income	43	10.4
Membership of NGO on conservation		
Yes	79	19.2
No	333	80.8

Table 2: Visitors' perception of destinations image

Perceptional Statement	**Mean**	**SD**
The quality of the environment in terms of safety, security, cleanliness, hospitality, tranquility and pleasant weather is satisfying.	4.53	0.69
There is adequate provision of amenities in terms of accommodation, electricity, water communication and recreation at the destination	4.04	0.92
Infrastructure (i.e. restaurants, cuisine, shop facilities and accommodations) are crucial aspects of destination image.	4.23	0.88
Accessibility and the entire transportation system such as routes, traffic flow, trails, boat parking information and parking facilities is adequate.	4.18	0.87
Climate/weather contribute significantly to destination image	3.90	0.87
Outdoor activities at the destination need to be improved upon.	4.09	0.89
Destination image influences tourist's behavior.	4.04	0.88
Perceived attitude of the destination's hosts community does not affect its image.	3.81	1.11
Destination image influences destination selection process.	4.03	0.90
Information about ecodestination is important in travel decision making	4.13	0.88
Promotional activities using articles and reports significantly affect destination's image.	4.09	0.94
Price and value (i.e. food, accommodation), good value for money, attractions and activities and good bargain shopping are considerable aspects of destination image	4.19	0.92
Tour guide and information is adequate.	4.11	0.85
Information about the history, culture, heritage, artifacts and relics are essential aspect of destination image formation.	4.37	0.70

Table 3: Visitors' satisfaction with ecotourism destination

Satisfaction Statements	Mean	SD
Satisfaction statement on communication		
Information and availability of brochures in English, French and local languages.	3.99	0.98
Sufficient information to enjoy the attraction.	4.35	0.71
Detailed information about forbidden and limited behaviors at the attractions.	4.36	0.78
Activities of tour guides in providing relevant explanation on the attraction.	4.43	0.69
Satisfaction statement on Responsiveness		
Feeling welcome and free to explore the destination without restriction	4.45	0.71
Convenient open hours and waiting time for service at the attraction.	4.30	0.74
Courtesy, efficiency and attitude of staff at helping and promptly attending to visitors' requests and complaint	4.41	0.73
Satisfaction statement on assurance		
Accessibility of the attraction.	4.40	0.71
Visitor safety and Security at the attraction.	4.40	0.71
Sufficient and comfortable place to sit and relax.	4.36	0.77
Parking facility available.	4.36	0.74
Satisfaction statement on empathy		
Personal attention provided to visitors when needed.	4.40	0.74
Facilities and equipment offered at convenient location.	4.26	0.82
Good viewing and comfortable facilities available.	4.37	0.74
Consideration needs for elderly and disable visitors.	4.15	0.85
Satisfaction statement on natural resources		
Presence of fauna and flora at the attraction.	4.34	0.73
Tranquility of the attraction as a rest area.	4.33	0.72
Uniqueness and authenticity of the attraction.	4.35	0.72
Unspoiled nature resources and availability of variety of species.	4.12	0.87

Table 4: Difference in visitors' perception of destination image and their satisfaction with the destinations

Variable	F-value	P-value	Decision
Perception	4.189	0.002	S
Satisfaction	2.031	0.089	NS

DISCUSSION

Major findings in study indicate a significant difference in visitors' perception of destinations' image. Visitors perceived the image of selected ecotourism destinations differently in terms of the quality of the environment as regards safety, security, cleanliness, hospitality, tranquility and pleasant weather. The observed differences could be due to selected destinations' peculiarities in the exhibition of natural and cultural values, historical significance, natural or built beauty offering leisure and amusement.

Different types of tourism destinations (ethnic, cultural, historical, environmental and recreational tourism destinations) serve the goal to meet tourists' needs and purposes according to geographical location, environment and nature or man-made structures in urban and rural destinations. Safety and security are strong elements of concern to visitors and also are cleanliness of the environment, hospitality, tranquility and pleasant weather. This simply affirms that image is important for the decision to visit a place. Tourists' perception of a destination's image as a preferred choice for travel is crucial. The finding is consistent with similar study conducted by Rajesh (2013) who reported that destination image construct has been influenced by factors such as infrastructure and facilities, attraction, safety and security, cleanliness, friendly host community, rejuvenation and service, price and affordability. This is an indication that the various marketing information disseminated by staff of the destinations to visitors is effective to influence the formation of cognitive images. Destination images according to Naidoo, Ramseook and Ladsawut (2010) affect tourists travel decisions and behaviour towards that destination as well as the level of satisfaction, recollection and the tourism experience. In contrast to this finding, it has to be understood that the projected image and the received image are not always the same. The discrepancy might be due to alteration and modification of the message either by the source of communication or by the receiver.

On visitors' satisfaction of the destinations, the study has found that there is no significant difference in visitors' perception of destination image and their satisfaction. This suggest that satisfaction statement relating to communication, responsiveness, assurance, empathy and natural resources dimensions have significant effect on overall satisfaction of visitors. The finding is consistent with Naidoo *et al.* (2010) in their study on assessment of visitor satisfaction with nature based attraction in Mauritius. On responsiveness, visitors were satisfied by feeling welcome and free to explore the destination without restriction. Staffs at the destinations are courteous, efficient and responsive. Satisfaction statement on communication also revealed that visitors had detailed information to enjoy the attraction as well as information about forbidden and limited behaviour at the destination. It was also found that the destinations are accessible, safe and comfortable while personal attention is provided. Tasci and Boylu (2010) indicated that safety and security of a destination are seen to have a big impact on the level of satisfaction with a tourist trip. In contrast to this finding however, Tse and Wilton (1988) suggests that consumers' satisfaction or dissatisfaction with a product can be assessed only by examining their evaluation of the actual performance. The implication of the result is that the level of satisfaction attained by an individual may influence their future intentions, in terms of revisiting a destination and/or recommending it to other people. Again, destination managers need to know how their consumer groups define satisfaction and then interpret satisfaction scales to accurately target,

report, and respond to satisfaction levels. Results suggest that different ecodestinations may need to use different satisfaction scales, or tailor scales to different types of consumers. Rather than looking at all aspects of choice/consumption experience, managers can concentrate on those that are of direct interest or are directly controllable. As a result, managers are able to obtain "true" consumer responses that are relevant to managerial decision making. Having a clear understanding of the causes and nature of visitor satisfaction and dissatisfaction can assist in the promotion and development of tourism destinations and enterprises.

CONCLUSION

Major findings in study indicate a significant difference in visitors' perception of destinations' image. It is found that visitors perceived the image of the destination differently in terms of the quality of the environment in the areas of safety, security, cleanliness, hospitality, tranquility and pleasant weather. Observed differences could be as a result of an individual's mental representation of knowledge, feelings and overall perception of a particular destination's image arising from effectiveness of the marketing information gathered by visitors to influence the formation of cognitive images and the uniqueness of the attraction. Also, selected eco destinations have their peculiarities in the exhibition of natural and cultural values, historical significance, natural or built beauty offering leisure and amusement.

Different types of tourism destinations (ethnic, cultural, historical, environmental and recreational tourism destinations) serve the goal to meet tourists' needs and purposes according to geographical location, environment and nature or man-made structures in urban and rural destinations. On visitors' satisfaction with the destinations, the study showed that there is no significant difference in visitors' perception of destination image and their satisfaction with the destination. This suggest that satisfaction statement relating to communication, responsiveness, assurance, empathy and natural resources dimensions have significant effect on overall satisfaction of visitors. The findings in this study could assist in effective design of ecotourism attractions, as well as improving marketing strategies to fulfill the needs of ecotourist and other tourism industry stakeholders.

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Large and Terrestrial Small Mammal Survey Along the Pampana River, Sierra Leone

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ABSTRACT
A survey of large and terrestrial small mammals was conducted in 2016 along the Pampana River in northern Sierra Leone as part of the biodiversity studies for the proposed Betmai Hydroelectric Project (BHP). Data were collected through direct observations, reconnaissance walks and informal interviews for large mammals and live traps for terrestrial small mammals. Nine species of large mammals belonging to 8 families were recorded, including 4 primates, 3 ungulates and 2 carnivores. Informal interview with local people and guides confirmed another 14 species of large mammals belonging to 8 families, including 5 primates, 4 ungulates, 3 carnivores and 2 scaly ant eaters. Small mammals consisted of 1 shrew and 7 rodents belonging to 7 families. Measures to mitigate impacts of the project activities should, therefore, address the continued existence of the remaining riverine forest and forest regrowth habitats of the resident large and small mammal communities.

Keywords: Betmai Hydroelectric Project, *Pan troglodytes verus*, Pampana River, habitat loss

INTRODUCTION
Sierra Leone is located at the western limit of the Upper Guinea rainforest in West Africa, a region designated as one of the global biodiversity 'hotspots', that is home to several endemic and threatened species which are of global conservation concern (Bakarr *et al*., 2004). However, this entire range of the Upper Guinea forest has of recent been reduced to relatively small tracts occurring mostly in reserves or protected areas. In Sierra Leone, the extent of forest disappearance and accompanying loss of biodiversity is well recognized (Garnett & Utas, 2000, Wadsworth & Lebbie, 2019).

Although, there is no clear legal definition of forests in Sierra Leone (Wadsworth & Lebbie 2019), however, it is reported that an estimated 75% of the country was once forested (Lebbie 2002). With much of Sierra Leone having suitable climatic and edaphic conditions for moist evergreen and semi-deciduous forest, only an estimated >5% of the country remained in forest fragments by the mid-1970s, with much of the original forest lost to logging and farming activities (Naughton-Treves & Weber, 2001). Presently, land area in Sierra Leone is dominated by a series of mosaic of vegetation types including farm bush, swamp, savanna, mangrove and fragments of secondary and primary forests mostly restricted to isolated patches on hill tops and sacred groves (Lebbie, 2001, Lebbie 2016), surrounded by agricultural communities, bush fallows, active farms and plantations.

Despite the degree of threat, a few protected areas in Sierra Leone still habour a significant proportion of rare plant and animal species. For example, Gola Rainforest National Park in the southeast and Loma Mountains National Park in

north, the only two extensive remaining tracts of primary forest in the country harbours several mammal species of conservation concern including the critically endangered Western Chimpanzee (*Pan troglodytes verus),* the endangered pygmy hippopotamus (*Choeropsis liberiensis),* western Red Colobus monkey (*Procolobus badius)* and Diana monkey (*Cercopithecus diana)* (Klop *et al.,* 2008, Kortenhoven, 2008, Brncic *et al*., 2010, Abu-Bakarr *et al.*, 2013).

We present here results from a survey of large and terrestrial small mammals conducted in northern Sierra Leone. This survey is part of biodiversity studies of the Environmental and Social Impact Assessment (ESIA) for the Betmai Hydroelectric Project (BHP) that was conducted in 2016. It is important to note that, no previous surveys of mammals have been conducted in the BHP area prior to this study. This study, therefore, is an assessment of mammalian composition in the BHP area which will serve as baseline information on large and terrestrial small mammals in the area and will also help inform the project impact on the resident mammalian communities.

MATERIAL AND METHODS

Study Area

The study was conducted around the Betmai Falls (N08^{0}43'18.6"/W011^{0}40'50.8") situated along the Pampana River, in Tonkolili District, northern Sierra Leone (Figure 1) in September 2016. The area is part of the Sula Mountains ecosystem within the 'Guinea Highlands' considered an 'extremely high conservation priority" for mammals in West Africa (Bakarr *et al.,* 2001). The vegetation was characterized by a mosaic of forest (mostly restricted to galleries and steep hills), forest regrowth, farm bush and savanna. The area has a tropical climate with two pronounced seasons that is characteristic of Sierra Leone: a pronounced wet season from May to October, and a dry season from November to April. Economic activities of communities in the area is dominated by rice cultivation.

Data Collection on Large Mammals

Surveys were conducted using a combination of both active methods and Informal interviews (Bennun *et al.,* 2002). The active method included direct observation of species, tracks, dung, calls and nests to determine presence and distribution of large mammals. Direct observations were made during reconnaissance walks across all vegetation types in the study area. At the start of each reconnaissance survey, time and date were recorded. For any detections made during the surveys, about 10 minutes was spent observing and recording the following: name of species, time, number of individuals sighted (in the case of a group), type of habitat and GPS position. At the end of each survey, the time and duration of the survey were recorded.

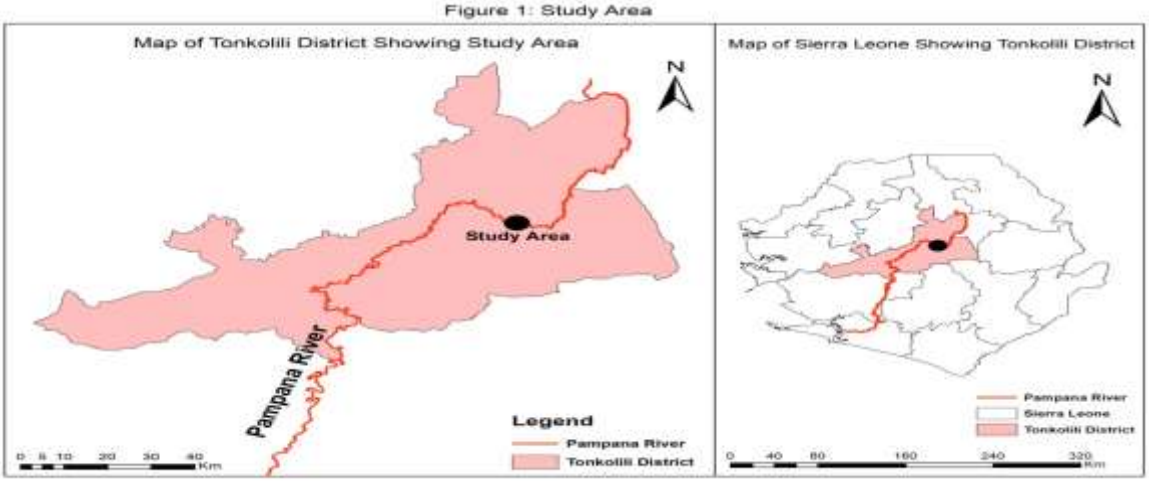

Figure 1: Map of Tonkolili District showing the study area

Data Collection

Informal Interviews

To complement data from reconnaissance walks, informal interviews with local people and field guides were conducted to gain any additional information on the mammal species in the area. During the interviews, the locals and guides were asked to list the species they knew existed in the study area. Utmost care was taken to prevent interviewees from indicating the presence of a species not found in the area. Where necessary, pictures were not used for species identification to avoid local people and field guides fitting animals to pictures thus creating errors as experienced in previous surveys. During the interviews, locals were also questioned on their use of mammal species in the area.

Data Collection on Small Mammals

This involved trapping mainly shrews and small rodents in different habitats (Decher *et al*. 2010). Observations were also made for signs of the presence of large rodents such as squirrels, porcupines and cane rats. Trap sites were established in all habitat types in the study area (Table 1). Each site was sampled with a 200-meter trap line that had 10 Sherman live traps baited daily with palm kernel fruit and located 20 meters apart and checked daily in the mornings and evenings. One trap line of 10 pitfall bucket traps connected by 50 meters of plastic drift fence with 5 meters spacing was also set at the edge of a swamp. At each trap site, sampling was done for 2 consecutive days and nights except for the pitfall trap line that had 4 consecutive days and nights of sampling. Each live animal trapped was identified and immediately released back to their habitats. Field identification was based on Kingdon (2004). Trap nights for the Sherman live traps and pitfall bucket traps were calculate using the following formula:

Trap nights = number of traps x number of nights

Table 1. Trap types, sampling effort, GPS coordinates and habitat description of trap sites

Trap Line (Trap Type)	No. of Traps	No. of Nights	Trap Nights	Coordinates (N, W)	Habitat
T1 (Sherman)	10	2	20	084318.6, 0114050.8	Forest edge
T2 (Sherman)	10	2	20	084339.4, 0114115.8	Forest edge
T3(Sherman)	10	2	20	084339.7, 0114104.7	Forest interior
T4 (Sherman)	10	2	20	084335.3, 0114105.7	Forest interior
T5 (Sherman)	10	2	20	084325.0, 0114100.1	Farm bush and swamp
6 (Pitfall)	10	4	40	084335.3, 0114105.7	Swamp
Total			140		

RESULTS

Large Mammal Species Diversity

A total of 9 species of large mammals belonging to 8 families were recorded during this study (Table 2). These include 4 primate, 3 ungulate and 2 carnivores. In addition to the 9 species of large mammals recorded, the informal interviews further confirmed an additional 14 species of large mammals belonging to 8 families in the study area (Table 2). This includes 5 primates, 4 ungulates, 3 carnivores, and 2 of scaly ant-eaters. Three primate species, *Cercopithecus campbelli*, *Cercocebus atys* and *Cercopithecus petaurista* were sighted and heard, while 1 species, the Critically Endangered *Pan troglodytes verus* was recorded based on evidence of their nests. For the ungulates, two species, *Cephalophus maxwelli* and *Tragelaphus scriptus* were recorded based on their feeding, track and dung evidence while *Potamochoerus porcus, Civettictis civetta* and *Mungos gambianus* were recorded based on their feeding evidence only.

Pan troglodytes verus nests were encountered on 2 separate occasions. In the first instance, we recorded recent nests on 7 different palm trees in farm bush less than 100m from the Pampana River and less than 1 km from the water intake area upstream. In addition, pith removal was observed on 5 palm trees as feeding evidence of chimpanzees in the same area. Secondly, 3 rotten nests were observed in forest patches along stream close to the base camp. Considering the fact that these two encounters occurred at different locations indicate that each encounter may have been a separate group or possibly the same group occupying the 2 locations at different times. However, this cannot be ascertained given that each group's home-range is unknown and would require an extensive long-term study to determine. Mixed groups of *Cercopithecus campbelli* and *Cercopithecus petaurista* were sighted on 3 different occasions, twice in forest fragments close to the area where the project powerhouse will be located and once in farm bush north of the base camp. On each occasion, each species had >3 individuals including young and adults. Only 1 group of *Cercocebus atys* (>4 individuals) was sighted in farm bush along the main footpath leading from the base camp to Ropiti village. Members of the plant team also reported seeing more than 2 individuals in a forest fragment close to the Pampana River south of the base camp.

Table 2. Large mammals recorded in the study area.

Order	Family	Species	Common Name	O	N	H	F	T	D	I	IUCN Status
Primates	Loridae	*Peridicticus potto*	Potto							X	LC
		Galagoides demidoff	Demidoff's Galago							X	LC
	Galagonidae										
	Hominidae	*Pan troglodytes verus*	Western Chimpanzee		X					X	CR
	Cercopithecidae	*Cercopithecus campbelli*	Campbell's Monkey	X		X				X	LC
		Cercocebus atys	Sooty Mangabey	X		X				X	NT
		Cercopithecus petaurista	Spot-nosed Monkey	X		X				X	LC
	Colobidae	*Procolobus badius*	Red Colobus Monkey							X	EN
		Colobus polykomos	Black and White Colobus							X	VU
		Papio papio	Guinea Baboon							X	NT
Artiodactyla	Antelopinae	*Philantomba maxwelli*	Maxwell's duiker				X	X	X	X	LC
		Tragelaphus scriptus	Bushbuck				X	X	X	X	LC
	Bovidae										
		Neotragus pygmaeus	Royal antelope							X	LC
	Antelopinae										
		Cephalophus niger	Black duiker							X	LC
		Hyemoschus aquaticus	Water Chevrotain							X	LC
	Tragulidae										
	Bovidae	*Syncerus caffer*	African Buffalo							X	LC
	Suidae	*Potamochoerus porcus*	Red River Hog				X			X	LC

		Phataginus tricuspis	Tree Pangolin							X	LC
Pholidota	Manidae	*Smutsia gigantea*	Giant Pangolin							X	LC
Carnivora	Viverridae	*Civettictis civetta*	African civet				X			X	LC
	Nandininae	*Nandinia binotata*	African Palm Civet								LC
	Herpestidae	*Mungos gambianus*	Gambian mongoose				X			X	LC
		Herpestes sanguinea	Slender Mongoose							X	LC
		Crossarchus obscurus	Cusimanse							X	LC

Total Species = 23

Note: O=observed, N=nest, H=heard, F= feeding evidence, T=tracks, D=dung, I=interviews
CR= Critically Endangered, VU=Vulnerable, LC = Least Concern, NT=Near Threatened

Small Mammal Species Diversity

A total of 11 individuals comprising of 1 shrew species and 7 species of rodents were recorded (Table 3) during a total of 140 trap nights (Table 1). Two other rodents, *Funisciurus pyrropus* and *Xerus erythropus* were sighted while a third rodent species, *Hylomyscus alleni* was caught by local guides at the base camp. Only 1 shrew species, *Crocidura nimbasylvanus* was captured in the pithfall trap during this study.

Result from the informal interviews also confirmed the presence of 3 species of rodents already recorded during this study (*Funisciurus pyrropus, Paraxerus poensis and Xerus erythropus)* and an additional 4 species of rodents including *Atherurus africanus, Hystrix cristata, Cricetomys gambianus* and *Thryonomys swinderianus* (Table 3). Result from the informal interviews also revealed that local people in the BHP area only utilize mammals for bush meat consumption.

Table 3. Terrestrial small mammals recorded in the study area.

Order	Family	Species	Common Name	O	N	H	F	T	D	I	IUCN Status
Rodentia	Hystricidae	*Atherurus africanus*	Brush-tailed porcupine							X	LC
		Hystrix cristata	Crested porcupine							X	LC
	Sciuridae	*Funisciurus pyrropus*	Fire-footed Rope Squirrel	X		X				X	LC
		Paraxerus poensis	Green Squirrel	X						X	LC
		Xerus erythropus	Stripped Ground Squirrel	X						X	LC
		Hylomyscus sp.	African wood mice	X							LC
	Muridae	*Dephomys defua*	Dephua Rat	X							LC
		Hylomyscus alleni	Wood mouse	X							LC
		Malacomys longipes	Common Long-footed Rat	X							LC
		Hybomys	Hump-nosed	X							LC

		Vnivittatus	mouse				
	Dendromurinae	*Dendromus sp.*	Climbing mice	X			LC
		Praomys tullbergi	Tullberg's Soft-furred Rat	X			LC
	Nesomyidae	*Cricetomys gambianus*	Giant Poached Rat			X	LC
	Thryonomyidae	*Thryonomys swinderianus*	Grass cutter/Cane Rat			X	LC
	Soricidae	*Crocidura nimbasylvanus*	Shrew	X			-
Insectivora							
Total Species = 15							

Note: O=observed, H=heard, F= feeding evidence, T=tracks, D=dung, I-interviews LC = Least Concern

DISCUSSION

Evidence of the diversity and abundance of large mammals recorded during this survey was considerably high while for small mammals (rodents and shrews) was generally low. All large mammal species recorded during our surveys are included in the 71 large mammal species previously documented for Sierra Leone (Grubb *et al*. 1998, Nippon Koei UK 2007, Kortenhoven 2008, Brncic *et al.* 2010, Abu-Bakarr *et al.* 2013). Therefore, 42% of the large mammal species previously listed for Sierra Leone is known to occur in the study area while 12 are endemic to the Upper Guinea region.

A group of chimpanzee nests with the same age usually gives an insight into the number of individuals within the group (Nippon Koei UK 2007, Kortenhoven 2008). Therefore, the seven recent nests encountered during this study is probably an indication that a group with at least 7 individuals occurs in the study area and are utilizing the mosaic of habitats along the Pampana River. All the seven nests were of the same age and no re-use nests were observed. Previous studies in the watershed of the Bumbuna Hydroelectric Project area, further south of the BHP area, recorded 4 chimpanzee communities and an estimated total population of 33 – 38 individuals based on nest counts (Nippon Koei UK 2007). In an environmental offset study at Loma for biodiversity losses resulting from inundation of the Bumbuna Hydroelectric Project catchment area, Kortenhoven (2008) estimated a chimpanzee density of 5.75 individuals per km^2 using nest counts. Also, the evidence of pith removal from palm trees for feeding by chimpanzees observed during this study was also observed in the Bumbuna area (Nippon Koei UK 2007) and elsewhere in Africa (Humle 2003).

Although, nest sites and feeding evidence were focused on forest patches and farm bush, responses from local people however, indicated that chimpanzees were often seen in the study area especially in forest patches prior to the start of project activities. They maintained that chimpanzees were frequently encountered in all habitat types in the area but have now become less common probably due to the increased farming activities in the project vicinity and possibly due to potential human-chimpanzee conflict in the area.

Two other primate species, *Cercopithecus campbelli* and *Cercopithecus petaurista* were frequently encountered through direct sighting or calls in forest patches and regenerating farm bush indicating that they are widely distributed in the area. *Cercocebus atys* were encountered less. Responses from local people also confirmed this to be true. There was no evidence of two forest dependent species, *Procolobus badius* and *Colobus polykomos* despite both species being reported to occur in the area by local people. However, the presence of other forest dependent species could probably prove a justification and also indicate that the patches of forest ecosystem found in the study area are still healthy to harbour forest dependent species. Other species such as *Pan troglodytes verus*, *Cercopithecus campbelli, Cercocebus atys, Galagoides demidoff, Peridicticus potto and Cercopithecus petaurista* are adapted to changes in the forest ecosystem.

Potamochoerus porcus, Tragelaphus scriptus and *Cephalophus maxwelli* tracks were frequently encountered in all habitat types throughout this study. Responses from the locals also confirmed their presence in all sections of the study area. Similar records of these species have been made in Outamba-Kilimi National Park (Harding 1984), Gola Rainforest National Park (Klop *et al.* 2008), Bumbuna (Nippon Koei UK 2007) and Loma Mountain Forest Reserve (Kortenhoven 2008). All rodents and shrew recorded during this study are known to occur in Sierra Leone (Grubb *et al.* 1998). No threatened or new species for Sierra Leone was recorded. In comparison, more species of rodents and shrews were recorded in these other studies probably because of the duration and the number and different types of traps used. Anadu and Djosso (2008) recorded 14 species in the Loma mountains area, including 2 musk shrews and 94 mice; Decher *et al.* (2010) in a survey of small mammals conducted on the upper Seli River in central Sierra Leone recorded 11 rodents and 3 shrews including *Crocidura nigeriae*, which was new shrew record for Sierra Leone. About 9 years later, in a similar study along the same Seli River further north, Weber *et al.* (2019) recorded 3 shrews and 11 rodents during a baseline study for the Bumbuna Phase II hydroelectric project. Monadjem (2010) also recorded 9 species of shrews and 11 species of rodents (including *Colomys goslingi*, also a new rodent record for Sierra Leone) during a weeklong survey in the corridor areas between the Gola Rainforest National Park in Sierra Leone and the Gola National Forest in Liberia.

Comparing results of this study with other studies in the Upper Guinea forest region also indicates the importance of the study area for terrestrial small mammal diversity. A total of 11 individuals comprising of 1 shrew species and 7 species of rodents were recorded during this study. In the Cavally forest of Ivory Coast, Decher *et al.* (2005a) recorded 6 shrews and 11 rodents during a ten-night survey. In a similar study in southwest Ghana, Decher *et al.* (2005b) recorded 6 shrews and 10 rodents during a two-week survey. A long-term survey of the National Park of Upper Niger in Guinea reported 9 insectivores and 24 rodents among the total mammal species recorded (Ziegler *et al*., 2002). This survey reported the White-toothed shrew, *Crocidura denti* as a new record for Guinea, and the second record for West Africa. A similar study of terrestrial small mammal species richness and abundance in Liberia recorded 5 species of rodents and 6 shrews of which 3 species, *Crocidura jouvenetae, Hylomyscus simus* and *Hybomys planifrons* were the most dominant (Akpatou 2019). Omogbeme and Oke (2018) reported 17 species of rodents and 3 species of insectivores from their small mammal surveys in Okomu National Park, Edo State, Nigeria.

Hunting using shotguns was observed and increasing contact and conflict between humans and wildlife may result in an escalation of hunting. Primates and other large mammals are the primary targets of hunters (Eves & Bakarr 2001, Brncic *et al.* 2010) and hunting pressure drastically affects their population in the Upper Guinea forest region (Bakarr *et al*. 2004, Eves & Bakarr 2001). Davies (1987) reported that hunting probably affected primate populations to a greater extent than timber extraction in the Gola Forest Reserves. The use of snares especially around farms and the forest interior was also observed in the study area and this activity can also impact the resident wildlife in the area.

Bush meat consumption is the only utilization of mammals by local people in the project area. They kill their animals using shot guns or snares. Although no established bush meat market exists in the area, however, a dead animal is either taken home for household consumption or sold to anyone who can afford to buy.

The presence of the critically endangered western chimpanzee indicates that the study area is of considerable concern for the conservation of biodiversity. Generally, mammal species are reasonably distributed especially in existing forest patches and forest regrowth throughout the project area. Although the project activities will negatively impact mammals in the form of habitat loss, most of the species can tolerate a variety of habitat types (Hanson-Alp *et al.* 2003, Brncic *et al.* 2010). Measures to mitigate impacts of the project activities should, therefore, address the continued existence of these riverine forest and forest regrowth habitats of the resident large and terrestrial small mammal communities.

CONCLUSION

In conclusion, the study indicates that much damage has already been done to the mammal assemblage in the BHP area due to long term farming activities resulting to habitat loss in form of deforestation and hunting by the local community. However, wildlife monitoring and conservation awareness programme can be

initiated in the area and the surrounding communities. Because the mammal assemblage is already adapted to the present nature of the environment, there may be no need to interfere with this situation. A programme could be developed to monitor the mammal populations and their habitat. Together with this monitoring, an environmental awareness programme should be carried on a regular basis to educate people on everything from sustainable hunting to wildlife laws. The monitoring activity, in conjunction with the environmental awareness programme, may help prevent further pressure on the mammals and their habitat.

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Constraints to the Management of Animals in Kano Zoo and its Implication on Zoo Visitors

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ABSTRACT
The study focuses on the constraints to the management practices adopted in Kano Zoo and its implication on zoo visitors. Questionnaires were administered to adult visitors (n=100). There were more male visitors (77%) than female visitors (23%) while single and married were 70% and 29% respectively. A higher proportion of the respondents were tertiary education level students (39%) and civil servants (27%). The visitor's awareness of animal's management in zoological gardens was relatively high. The constraints to animal management in the zoo were lack of fund and inadequate government policies. It is very crucial that zoos intensify their efforts to meet the need of both visitors and zoo community. Furthermore, zoos must develop innovative methods to engage the public to inspire a greater interest and enhance their understanding of zoo management.

Keywords: Kano zoo, constraints, visitors, management practices

INTRODUCTION
A zoological garden, zoo park or zoo is a place where wild animals (both exotic and native species) and in some instances domesticated animals are exhibited in cages and enclosures for public viewing (Croke, 1997). In such establishment animals are given more intensive care than is possible in reserves and sanctuaries. The captive animals' propagation is one way of encouraging growth of depleted wildlife species population and so properly planned programme of zoo establishment and development is considered as one of the effective methods for conservation of wildlife. Environmental study and the conservation of the environment have become subjects of major importance all over the world, not only from the point of view of preventing pollution, but also that of conserving water supplies by protecting water shed, conserving soil, flora and fauna. Conservation in zoos can provide an important facility for research at both pure and applied levels, in both the field and the laboratory in colleges and universities. According to MacDonald (2005) zoos maintain over 500,000 individuals of terrestrial vertebrates, representing 3000 species of mammals, birds, reptiles and amphibians. Bygott (1979) emphasized that the primary function of zoo creators is to make the visit a leaving experience. The attention and effort given to wildlife conservation and tourism in both state and federal levels have been noted. Zoos play an important role in wildlife conservation (Chris & Jan, 2010).

Generally, the establishment of zoos was borne out of the need to guarantee the safety of threatened wild animals (Uloko, 2004). The only guarantee man can provide is a largely unused

potential for developing resources to satisfy the need of people, and yet many flora and fauna species are dying out without their potential even being recognized. Borokini (2013) stated that over 600million people visit zoological gardens annually around the world hence they have great potential for global conservation awareness.

According to Borokini (2013), ex-situ ('off site', 'out of place') conservation is a set of conservation techniques involving the transfer of a target species away from its native habitat to a place of safety, such as a zoological garden, botanical garden or seed bank. Its primary objective is to support conservation by ensuring the survival of threatened species and the maintenance of associated genetic diversity. To do so, ex-situ institutions preserve the genetic or reproductive material of a target species, or take care of the living target species for the purpose of reintroduction. In its simplified form, the concept is likened to Noah's ark, wherein species are maintained in a place of safety until factors threatening their existence in the wild have been removed and reintroduction is likely to be successful.

Ex-situ techniques target plant and animal populations. Techniques vary according to the characteristics of the species to be preserved, which dictates the type of material to be preserved (e.g. whole animals, pollen and seeds). Ex-situ collections of plants are established by storing seeds, conserving pollen and through the storage of plant shoots in conditions of slow or suspended growth (in vitro conservation). Ex-situ techniques applicable to animal populations include the storage of embryos, semen/ovule/DNA, or captive breeding through the establishment of field gene banks and livestock parks. Lively debate surrounds ex-situ techniques, with much deliberation over when ex-situ measures are appropriate and justified In particular captive breeding and reintroduction programs have sparked controversy due to, among others, the difficulty in establishing self-sustaining captive populations the high costs involved in captive breeding programs (Balmford *et al.,* 2007), the poor success of reintroduction attempts, and the negative genetic effects of domestication on reproductive rates. Some species are however more susceptible to captive-breeding programs than others. For example, the global loss of amphibian species is mainly tackled through captive- breeding because the small body size, low maintenance requirements, repeated breeding and high fecundity of frogs allows a rapid build-up of captive populations. The role of zoos in captive breeding is probably of only limited value in conserving wildlife (Hancocks, 2001; Dixon and Tracers, 1994), however, in the light of three major constraints. The first is that there is limited space available for captive breeding, or devoted to holding threatened species (Bartos & Kelly, 1998). The second constraint is the high cost of producing captive bred animals in zoos. For instance, in Australia it has been estimated to cost on average $6,546 for each native animal produced for reintroduction (Perth Zoo, 2000). Reintroduction of captive bred wildlife requires monitoring and improvement if it is to have a significant conservation impact (Mallinson, 2003). A third constraint is the availability of secure suitable habitat. Alibahai and Jewell (1994) estimate that it costs more than 16 times as much to maintain a black rhino in captivity that to protect enough appropriate wild habitat to support it.

MATERIALS AND METHODS

Study Area

The Kano Zoo is the largest zoo established in Nigeria; covering a land area of 100ha, in which only 25ha were put into used and the remaining 75 ha as rangeland. It was officially opened in 1972 by the then Military Governor of Kano State, Audu Bako, as Kano Zoo which, was later changed to Audu Bako Zoological Garden, Kano. Kano state has a Sudan savannah vegetation, and occupies an area of about 43,000 km^2 lying between $10^0$30' North and latitude $12^0$03' north and longitude $8^0$32' East and is about 1549 feet above the sea level. In the immaculately clean and tidy zoological garden, there is a collection of 60 different species and 200 individuals of animals at present. The zoo is open seven days a week and there is a restaurant with a Cool Spot to relax. It is strategically located within the garden. It opens from 7:30am in the morning to 6:30pm in the evening. The gate fee was a hundred naira (Nigeria currency) per adult and fifty naira per child while organized group-like associations or clubs may pay in groups or sometimes gain access without payment.

Data Collection Method

Sampling and Research Design

This study was conducted at Zoological Garden, Kano State between May and June 2017. Data was collected using simple random sampling. A total of one hundred (100) visitors were sampled. Visitors survey was conducted in order to appraise the level of management of animals in the zoo. Questions were asked from the visitors about conception about zoos in general and the main reasons for visiting the zoo. The instrument was pretested. The questionnaire was divided into two sections. The first section was on demographics of the visitors and the zoo keepers. These questions have been routinely used in other studies in previous studies to understand the background of the participants and to assess which proportions of the public are being surveyed (Reade & Waran, 1996). Visitors were asked about their age, highest education level, income frequency, and occupation. The second section asked questions on the management of animals at the Kano Zoological Garden.

Procedure of Data Collection

Data were collected at five different locations within the Zoo between 8: 00am to 5:00pm. The site locations for administering the survey within the zoo were selected to ensure that visitors had viewed several exhibits on their way, out to determine whether the exhibit influenced opinions. The curator of the zoo was interviewed to obtain information on the zoos conservation policies.

Data analysis

The responses from the questionnaires were appropriately collected and subjected to percentage analysis using SPSS version 20 statistical package. Bar charts were also used in the presentation of result**.**

RESULTS

Demographic Information

The study indicates that 77% of the visitors were male and 23% female. Most respondents were between the age of 18-28 years old, representing 64% of the sample. Only 4% of respondents were within age 59-68 years old and above. A considerable proportion (70%) of the respondents was single and only a relatively lower proportion (29%) was married. Divorcee were represented by 1%. Also, respondents with tertiary level of education were 68%, with a handful of secondary level (26%), primary (3%) and non-formal education (3%). Majority of the respondents were students (39%) while 27% were in full time employment. In addition, 22% of the respondents were into business and 12% were farmers. Almost half of the respondents got their income monthly 42%, while 29% is on the daily basis few of the respondent were on weekly 21% and only 8% were receiving their income on the yearly basis.

Zoo conservation awareness

A large proportion (73%) of zoo visitors indicates that zoo plays important roles in the management of animals in the study (Figure 1). Visitors' response to role of zoo management is in Figure 2. Forty- seven (47%) participated in management of animals in zoological garden, while only (33%) did not. Majority of visitors (50%) participated in the management of animals in the zoo, while (30%) were not participated (Figure 3).

Table 1: Demographic information of visitors

Variables	Frequency Distribution	Percentage (%)
Age		
18-28	64	64.0
29-38	18	18.0
39-48	8	8.0
49-58	6	6.0
59-68	4	4.0
Sex		
Male	77	77.0
Female	23	23.0
Education		
Non formal	3	3.0
Primary	3	3.0
Secondary	26	26.0
Tertiary	68	68.0
Occupation		
Business	22	22.0
Civil servant	27	27.0
Famers	12	12.0
Others	39	39.0
Frequency of income		
Daily	29	29.0
Weekly	21	21.0
Monthly	42	42.0
Yearly	8	8.0
Marital status		
Single	70	70.0
Married	29	29.0
Divorced	1	1.0

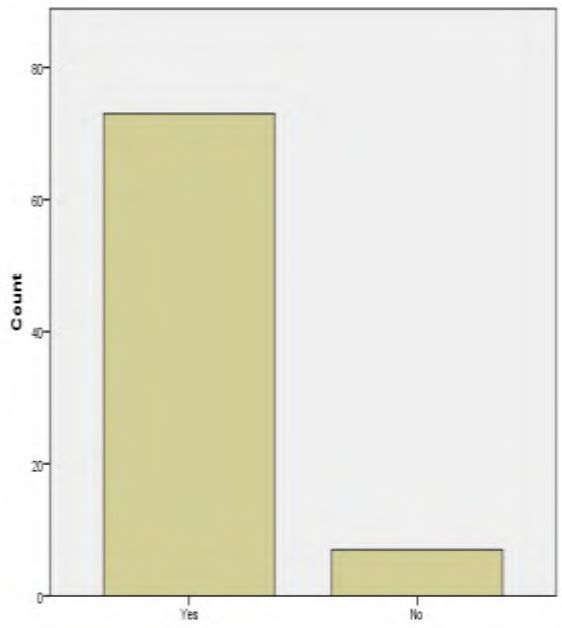

Figure 1: Visitors' awareness of animal management in the zoo

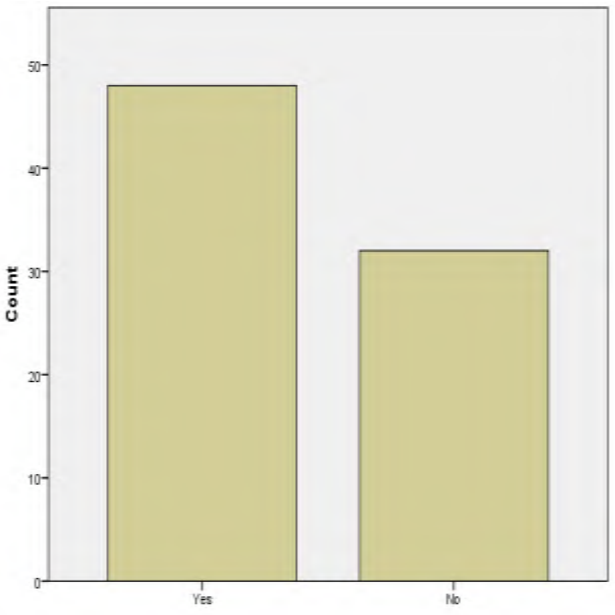

Figure 2: Visitors responses to role of zoo in the management of animals

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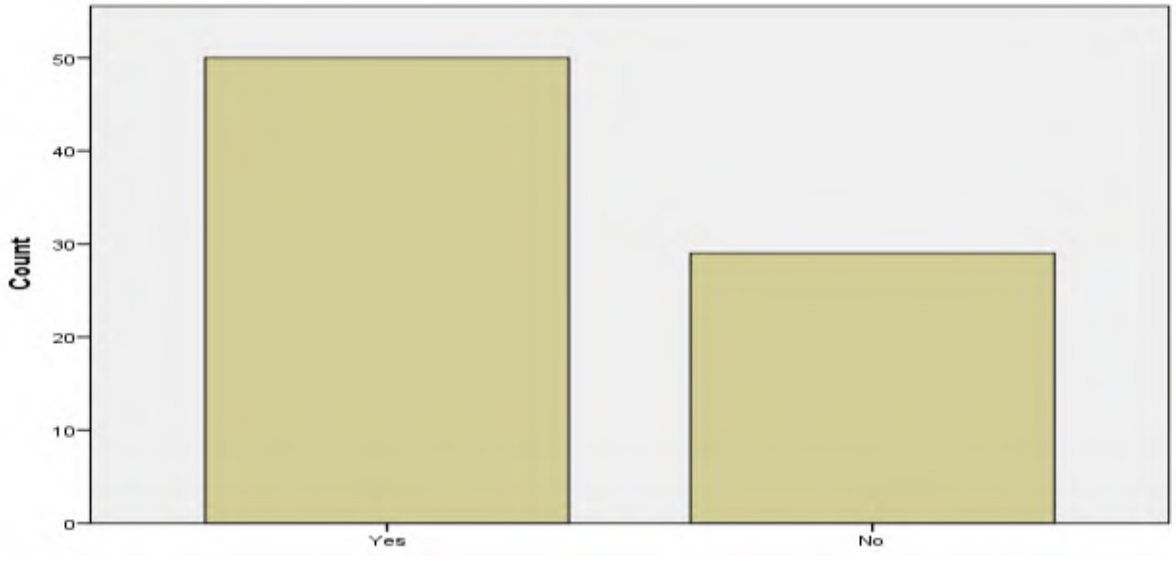

Figure 3: Visitors participation of the management of animals in the zoo

Perceived constraints of animal management by visitors

Respondents identified lack of fund (23%), government policies (19%) and lack of information (12%) as the major constraint to management of animals in Kano Zoo (Figure 4).

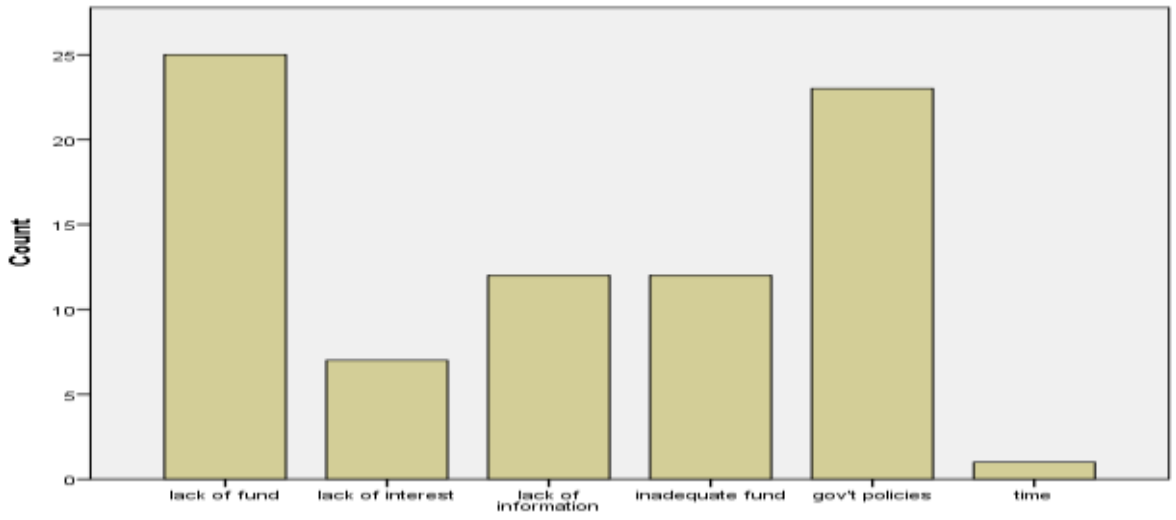

Figure 4: Visitors contribution to management of animals in the zoo

DISCUSSION

There were more male visitors than female as recorded in this study with majority single and were between 18-28 years. These findings are similar with the findings of Uloko and Iwar, (2011 at Markudi Zoological Garden and Manatarium on Conservation Education Benue state. Also, the higher number of males compared to females may be due to women's more involvement in household chores and home-keeping thereby having limited time for zoo entertainment. Large proportion of the visitors were aware of the management of animals in zoos and a considerable proportion acknowledge the roles of zoos in the management of animals. Visitors play a very important role in the management of animals.

This study revealed that the visitors perceived that lack of funding as the main challenge. Some of the visitors are of the opinion that government policy constitutes the major hindrance to management of animals in the zoological garden. These could be due to the large number of unemployment among potential visitors in the study area because majority of the respondents were students. On the other hand, several visitors fingered the lack of information as the major constraint. Suggesting that, the zoos method of information dissemination to the public is inadequate.

CONCLUSION

The enclosures of the animals were well designed and there is provision of enrichments in some of the cages and holding fences. The animal enclosures were always clean, the clean and wash the cages and holding fences with hypo, liquid soap, detergent and water on a daily basis depending on the nature of the animals and the design of the cages/enclosure. The animals are fed on a daily basis and some species at day interval depending on the animal and what they feed on, and the availability of the nutrient content in the feeds.

The important finding from this study is that, with or without recreational aspects, the education and research aspect of the visit is more important. If the aim is to educate the public, zoo management should use educational methods that are presented as new innovations. However careful consideration must be given to designing and promoting holding facilities that will facilitate learning and viewing of the animals for further analysis and easiest description of the animals.

Management should thus focus their marketing communication strategies by highlighting the opportunity the zoos offer to have education, fun, relaxation, and spend quality time with other people. The focus should be placed on students, family or group activities that can be organized in the zoo. Other recreational activities should also be considered in the zoo like club, holiday programs and opportunities for children parties and friends of the zoo fun run/work. All these activities should result in attracting more visitors to the zoo, and they would ultimately lead to learning more about the animals and

conservation, and having educational research while doing so, thereby addressing the altruistic social orientation for ensuring the happiness of the visitors.

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Knowledge of Nigeria Wildlife Conservation Laws among Officials of Okomu and Old Oyo National Parks, Nigeria

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ABSTRACT
One of the key resources in effective management of National Parks is the knowledge base of the park managers. There is however little or no documented information about park official's knowledge of the laws they uphold in Nigeria. This study assessed the knowledge base of Nigeria wildlife laws among park officials in Okomu National Park (ONP) and Old Oyo National Park (OONP), Nigeria. Simple random sampling was used to administer structured questionnaire to 50 ONP and 130 OONP staff. Data were analysed using descriptive statistics. Majority (95.6%) had heard about wildlife laws and 68.9% understood the contents of the law. Majority (72.2%) knew the decree responsible for the establishment of national parks but could not distinctively identify the activities that constitute offences under this law. For effective park management, proper orientation, education, training and re-training on the wildlife laws should be organized for the park officials at regular intervals.

Keywords: Nigerian wildlife law, Okomu National Park, Old Oyo National Park

INTRODUCTION
Nigeria is rich in flora and fauna resources. According to Federal Ministry of Environment (FME) (2010), there are over 22,000 vertebrate and invertebrate species, including about 20,000 insect, 1,000 bird, 1000 fish, 247 mammals and 123 reptile species; and about 7, 895 plant species. All these animal and plant species occur in different numbers within the country's vegetation that range from the mangrove along the coast in the south to the sahel in the north (FME, 2010). Many human activities are seen to be threats to the existence of the flora and fauna resources in Nigeria (Olatunbosun, 2013) and the world at large. These constitute continuous pressure being exerted on forest resources causing fragmentation and degradation of wild animal habitats (Ijeomah, Augustine & Damilola, 2012). There is therefore an urgent need for biodiversity conservation.

National Park has become the most widely used category of protected areas in developing countries, for the conservation of fauna and flora resources. According to the International Union for the Conservation of Nature (IUCN) (2019), it is a large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities. More so, the highest competent legal authority of the country has taken steps to eliminate exploitation or occupation in the whole area and to enforce effectively the respect of ecological, geomorphologic, or scientific features which have led to its establishment (IUCN, 2019).
Currently, there are 7 National parks in Nigeria spanning across the six geo-political zones of the country. They are Chad Basin, Gashaka Gumti,

Kainji Lake, Kamuku National, Cross River, Old Oyo, and Okomu National Parks. The total area of land under these parks is about 2.4 million hectares (National Park Service (NPS), 2018). They were formally forest and game reserves first established in the early 1900s (FME, 2001). The National Parks supports more than 1340 species of animals among which is 274 species of mammals, making it the 8th highest in Africa (NPS, 2018).

Knowledge refers to familiarity, awareness or understanding of someone or something such as facts, information, descriptions or skills, which is acquired through experience or education by perceiving, discovering or learning. There are several ways to describe cases of knowledge, namely; acquaintance, competence and recognition of information as being correct (Ichikawa & Steup, 2018). Fumerton (2008) defined the acquaintance knowledge as a certain degree of skill or ability to recognize something upon re- encounter with a degree of accuracy. It has been suggested that, those managing protected areas often lack the adequate resources needed to effectively manage and enforce park rules and regulations (Jones *et al*., 2018; McCarthy, Shinjo, Hoshino, & Enkhjargal, 2018). One of the key resources in this regard is the level of awareness and knowledge base of the park managers. This will definitely impact conservation efforts. The Nigerian National Park Service (NNPS) is responsible for the management and regulation of use of the national parks, to preserve and conserve Nigeria's heritage particularly the flora and fauna, their habitats and the unique sceneries they provide. It seeks to meet the hopes and aspiration of Nigerians in preserving and protecting the natural heritage and the cultural relics that are in them for generations to come (NPS, 2018). In recognition of the need to protect Nigeria's biological and natural resources in National Parks, a number of legislations have been put in place. Of most relevance to national parks is the National Park Service Act of Decree No. 36, 1979, revised in 1999. Generally, wildlife laws in Nigeria which has its origin from the old western Nigeria wild animal preservation law of 1916 (Ayeni, 1992; Ayodele & Lameed, 1999) and were promulgated to implement the convention on international trade in endangered species of flora and fauna (CITES). The existing wildlife laws in Nigeria are The wild animal preservation law of 1916 {covered areas for protection (CAP) 132}, The wild animal law of 1963, The wild animal law of 1965, Wild animal preservation law 1970, The wild animal law amendment edict of 1975, Wild animal law of 1978, Kainji Lake National Park decree no. 46 of 1979, Endangered species decree of 1985 now CAP. E9, Laws of the Federation of Nigeria (L.F.N), 2010 and National Park decree no. 46 of 1999 now National Park Service Act CAP N65 Laws of the Federation of Nigeria 2004 (Ayeni, 1992).

These laws are instrumental to sustainable wildlife management as it sets the parameters for protection and use of wild animals (Morgera, 2011). Park officials are saddled with the responsibility of upholding the content of these laws in national parks. It is important that park officials, who are responsible for the protection of the parks' wild resources, be knowledgeable about the laws that concern the park and the wild resources it holds. Park officials especially park ranger were formerly poachers or rural dwellers of host communities who were employed as a form of alternative source of livelihood, having little or no formal education. It is important to properly orientate and educate them on the existing conservation/wildlife laws. An extensive search of literature revealed that there are little or no documented information about park official's knowledge of the laws. This study therefore assessed the knowledge of Nigerian wildlife conservation laws among parks officials in Okomu National park (ONP) and Old Oyo National park (OONP).

MATERIALS AND METHODS

Study area

The study was carried out in Okomu and Old Oyo National Parks, Southwest Nigeria. Okomu National Park (ONP) is a forest blocked within the 1,082km^{2}Okomu forest reserve in the Ovia South West Local Government Area of Edo State, Nigeria (NPS, 2018). It is the smallest of the seven National Parks in Nigeria. It is a rainforest ecosystem from the former Okomu Forest Reserve in 1935 on coordinates latitude 6˚ 20' 0"N and longitude 5˚ 16' 0"E and has a land area of 200 km^2. The Okomu River runs through the park and from it the park derived its name (NPS, 2018).

Old Oyo National Park derives its name from the ruins of Oyo-Ile, the ancient political capital of Yoruba Empire. It has a land area of 2,512km^2 in the Northern Oyo State, South West Nigeria and positioned between latitude 8°15' and 9° 00'N and longitude 3° 35' and 4° 42'E. Most of the park area is covered by plains, lowland, undulating from 300m-500m above sea level. The Southern part is drained by the Owu, Owe, and Ogun rivers while the Northern sector is drained by the Tessi River (NPS, 2018).

Data Collection and Analysis

Primary data were collected from officials in both parks using a semi-structured questionnaire, containing close and open-ended questions. The questionnaire covered issues on awareness of Nigeria conservation laws, frequency of studying the laws, knowledge of existing wildlife laws, decree responsible for national park establishment, what constitute offence according to the decree, amount/fine stipulated for killing elephants, the endangered species decree as well as the accompanied schedules. The close-ended questions provided respondents with a range of answers from which they can choose from. The open-ended section gave respondents freedom to provide answers to questions asked as they deemed fit. The two parks had a total of 431 staff consisting of 281 in OONP and 150 in ONP as at September 2018. Using Krejcie and Morgan (1970), a total of 194 respondents were sampled. Of these, 50 (from ONP) and 130 from OONP) were sampled and returned for analysis. This study was carried out between January and April 2019. Quantitative data collected in the course of this study were subjected to descriptive statistics which included frequency and percentages using SPSS Version 2.0. Thematic analysis was used in analyzing the qualitative data.

RESULTS

Awareness of Nigeria wildlife law among Okomu and Old Oyo National Parks' officials

The result of the awareness of Nigeria wildlife laws is presented on Table 1. The study indicates that 95.6% and 96.7% of respondents in both parks have heard of wildlife laws and affirmed the existence of wildlife laws in Nigeria respectively. Likewise, 86.1% claimed to have been informed about wildlife laws after employment in National Park. A total of 67.8% of respondents also indicated that they were educated on these laws by Park Management. Only half of the respondents (50.0%) were provided with documents containing the laws while a total of 68.9% of the respondents reported to understand the contents of the law.

Frequencies at which the Nigerian wildlife laws are studied among officials in Okomu and Old Oyo National Parks

More than ten percent (10.6%) of the respondents indicated that they studied wildlife laws always, 6.1% indicated that they studied them often, 38.8% indicated that they studied sometimes, 29.4% indicated that they rarely studied the laws and 13.9% of the respondents indicated that they never studied the laws (Figure 1).

Table 1: Awareness of Nigerian wildlife laws among Okomu and Old Oyo National parks' officials

Respondents answered…	Okomu National Park	Old Oyo National Park	Total
Awareness of wildlife laws	45 (90%)	127 (97.7%)	172 (95.6%)
Awareness of laws on wildlife in Nigeria	47 (94%)	127 (97.7%)	174 (96.7%)
Informed of the law on employment	40 (80%)	115 (88.5%)	155 (86.1%)
Education/training on the laws	35 (70%)	87 (66.9%)	122 (67.8%)
Provision of materials containing the law	28 (56%)	62 (47.7%)	90 (50.0%)
Understanding of the content of the law	29 (58%)	95 (73.1%)	124 (68.9%)

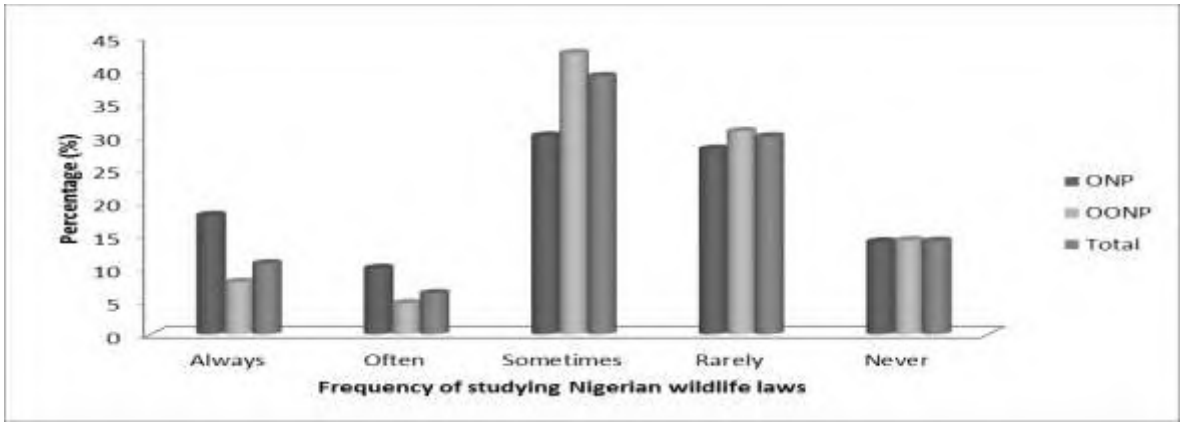

Figure 1: Frequencies at which the Nigerian wildlife laws are studied among officials in Okomu and Old Oyo National Parks

Knowledge of existing wildlife laws in Nigeria

Knowledge of existing wildlife laws is presented on Table 2. When respondents were asked to name any one of the wildlife laws, 34.4% got it right. Decree No 46 of 1999 was rightly identified by 77.8% of the respondents as the law which established the national parks in Nigeria. Majority (95.0%) of the respondents indicated that there are seven (7) National parks in Nigeria. Only 1.7% and 37.8% of the respondents identified "no option of fine" and "maximum of five-year imprisonment", respectively for killing an elephant. On the law controlling trade and traffic of endangered species, 47.2% of the respondents stated CITES and Endangered Species Decree of 1985.

Table 2: Knowledge of existing wildlife laws in Nigeria

Knowledge issues	Okomu National Park	Old Oyo National Park	Total
Name of any one of Nigeria wildlife laws	15 (30%)	47 (36.2%)	62 (34.4%)
Decree for the establishment of National Parks	45 (90%)	95 (73.1%)	140 (77.8%)
Number of National Parks in Nigeria	46 (92%)	125 (96.2%)	171 (95%)
Fine stipulated for killing an elephant in the park	2 (4%)	1 (0.8%)	3 (1.7%)
Maximum years of imprisonment for killing an elephant	16 (32%)	52 (40%)	68 (37.8%)
Law controlling trade/traffic of endangered species	28 (56%)	57 (43.9%)	85 (47.2%)

What constitutes offences in a National Park according to Decree 46 of 1999

According to the National Park Decree 46 of 1999, illegal entry, hunting, tree felling, and grazing are offences in the national parks while noise making and forest fire are not listed as offences. The offences (Table 3) as indicated by majority of the respondents are illegal entry (85.6%), hunting (67.8%), tree felling (65.6%), and grazing (64.4%). However, 20.0% and 37.2% of the respondents indicated noise making and forest fire, respectively as offences.

Table 3: What constitutes offences in a National Park from Decree 46 of 1999 according to respondents

Variable	Okomu National Park	Old Oyo National Park	Total
Illegal entry	41(82%)	113(86.9%)	154(85.6%)
Noise making	12(24%)	24(18.5%)	36(20%)
Grazing	30(60%)	86(66.2%)	116(64.4%)
Hunting	35(70%)	87(66.9%)	122(67.8%)
Tree felling	34(68%)	84(64.6%)	118(65.6%)
Forest fire	27(54%)	40(30.8%)	67(37.2%)

Classifications of animals in Schedules

Respondents were asked to classify some species of animals under schedule 1 and schedule 2 of the Endangered Species Act. This is presented on Table 4. Majority of the respondents rightly classified tree pangolin (54.4%), lion (62.2%), and white throated monkey (57.8%) into Schedule I. However, lower percentages were recorded for elephant (31.1%), buffalo (28.9%), great grey owl (43.3%), red flanked duiker (29.4%), yellow casqued hornbill (37.8%), buffon'skob (22.2%), roan antelope (20.6%) and oribi (14.4%). Under Schedule II, most respondents (53.9%) classified baboon rightly into the schedule while lower percentage (25.6%) was recorded for the Mona monkey.

Table 4: Animals in Schedules I and II of National Wildlife Species Protection Act

	Okomu National Park	Old Oyo National Park	Total
Schedule 1			
Tree Pangolin	25(50%)	73(56.2%)	98(54.4%)
Lion	26(52%)	86(66.2%)	112(62.2%)
Elephant	27(54%)	29(22.3%)	56(31.1%)
White Throated monkey	29(58%)	75(57.7%)	104(57.8%)
Buffalo	22(44%)	30(23.1%)	52(28.9%)
Great Grey Owl	17(34%)	61(46.9%)	78(43.3%)
Red Flanked Duiker	13(26%)	40(30.8%)	53(29.4%)
Yellow Casqued Hornbill	14(28%)	54(41.5%)	68(37.8%)
Kob	14(28%)	26(20%)	40(22.2%)
Roan Antelope	13(26%)	24(18.5%)	37(20.6%)
Oribi	14(28%)	12(9.2%)	26(14.4%)
Schedule II			
Baboon	18(36%)	79(60.8%)	97(53.9%)
Mona Monkey	16(32%)	30(23.1%)	46(25.6%)

DISCUSSION

The results of this study revealed that a higher proportion of the respondents (95.6%) have heard and 96.7% are aware that there are wildlife laws in Nigeria. It also revealed that the respondents were informed on employment, taught, educated and were provided with materials containing the laws. Despite that a large proportion (68.9%) of the respondents from both parks claimed to understand the contents of the laws, results showed otherwise as a large proportion could not provide the right answers to the questions asked on the contents of the law. In other words, the respondents seem to be aware of the existing wildlife laws but are not familiar with the contents of the laws.

Also, the results showed that most park officials seldom study the wildlife laws causing them to lack some information about these laws. They however seem to be aware of the law that is responsible for the establishment of a National Park (National park decree no 11 of 1999 now National park act CAP N65 2004) and the number of national parks in the country (7). The respondents were provided with options of what constitute offences in the park according to the National Park Decree 11 of 1999 but a large proportion could not differentiate the right from wrong.

A higher proportion of the park officials did not know the amount stipulated for the killing of an elephant, which is imprisonment with no option of fine, the maximum number of years of imprisonment for killing an elephant (5 years) nor could they correctly place animals in the right schedules based on their status. It was however observed that higher proportion of park officials from Old Oyo National Park knew the law that seeks to control trade and traffic of endangered species (Endangered Species Act CAP E9 2010) and could place listed animals in their right schedules more than park officials from Okomu National park. It was also observed that a lot of respondents left the section of species placement
into schedules unanswered. This may be because the respondents do not know what the schedules meant and how to place the species listed.

It is essential for park official's to be familiar with the content of the law, so they can carry out their duties in the context of the laws. This agrees with the famous aphorism by Sir Francis Bacon "knowledge is power" which is a popular proverb. It means true power comes from knowledge, knowing things gives power. This proverb motivates one to study and acquire knowledge (Sawant and Nolan, 2015). It also agrees with the idea on competence knowledge which implies ability, not just in recognition upon re-encounter but with specific skill and ability to do things (Stanley, 2011). Factors affecting knowledge base of the park officials in this study can be summarized in the following points: Individual input to study and understand the content of the laws; Government provision of materials containing the laws; adequate orientation and education on the wildlife laws on employment.

CONCLUSION

Park officials of Okomu and Old Oyo National Parks were not adequately familiar with Nigerian wildlife conservation laws. For effective park management of the parks, it is recommended that: government should provide copies of the law for all recruits of the park; proper orientation and education on the content of the laws should be given to the park officials at employment; proper orientation, education, training and re-training on the contents of the wildlife laws should be given to the park officials at regular intervals; park officials should be mandated to study the laws, frequent test should be administered to ensure park officials knowledge on the laws, and this can be a prerequisite for promotion.

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Active and Passive Management in Gashaka Gumti and Kainji Lake National Parks, Nigeria

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ABSTRACT
Numerous global environmental challenges and diverse ecosystems require different approaches to protected areas management due to various human activities to which they are subjected. Management approaches in Kainji Lake and Gashaka Gumti National Parks were studied through field observations and interview methods. Eleven management practices were identified in the two parks, these are: boundary demarcation; buffer zone management; controlled bush burning; creation of waterholes; creation of saltlicks; track, trail and road management; antipoaching patrol; research and monitoring; parachute patrol; erection of viewing hides and transboundary management. 84.21% of the management practices are active in Kainji Lake National Park while only 15.79% are passive. Active management constitutes 77.78% in Gashaka Gumti National Park while only 22.22% make up passive management. Higher levels of active management intervention is needed in the two parks to maintain specific biodiversity values and to improve services such as ecosystem restoration, game viewing and accommodation for tourists.

Key words: Active and passive management; interventions; biodiversity; conservation values

INTRODUCTION
Management, in general terms, refers to the direction or controlling of actions and activities. It is an expression that usually implies responsibility and accountability. There are many views regarding the management of protected areas. Although management of national parks is a form of control, ecological management is however necessary in many areas in order to preserve its biological diversity, especially when the area is inflicted by a variety of disturbance regimes. Searle (2000) advocated that any combination of approaches that ensures the most restoration and maintenance of wildness is viable. Methodologies used in protected area management differ from place to place and a park is usually managed in a way that retains natural or semi-natural features, and considered to be desirable. The management goal is to protect the 'ecological integrity' which needs to be based on a solid program of ecosystem science. Emergence of several global environmental challenges demand various approaches for the management of protected areas. Diverse ecosystems require different approaches because ecosystems are dynamic, changing due to various activities to which they are subjected. The management approach for any protected area is usually based on the objectives for establishing the area and the protected area category.

Active and passive management are two common management approaches to biodiversity protection in protected areas. According to Zoltan (2011), these two extremes biodiversity management approaches are linked to a range of ecosystem services including existence values.

Passive management emphasizes the protection of wilderness and its expansion through rewilding of abandoned lands, while active management promotes the maintenance of cultural landscapes, associated species and habitat diversity through farming, grazing, forestry and other activities. Bonner (1992), also submitted that management approaches in protected areas can either be passive or active. Active management otherwise referred to as intervention management of protected area means that enforcing prohibitions against various activities inimical to the area is not only done but pro-active steps are also taken to prevent or reverse change in an area. Protected area category is applied with respect to management objectives and this relates to the aims of management rather than the current status, so that several categories can be subject to wilderness restoration. While examining the two management types in protected area, Borza and Vancura (2009) stated that practically, active management is not usually suitable for every wild and wilderness area, giving example that active management interventions might be required to maintain specific defined biodiversity values areas. It can be a restoration intervention in a wild and wilderness area and may be time-limited to undo past damage while in others; changes have been so profound that continued, long term intervention will be needed such as the disappearance of some important species, control of invasive species and prescribed burning in certain habitats and conditions. Brooks, Mettermeier, da Fonseca, Gerlach Hoffman Lamorcux *et al.* (2006) submitted that regions of the world with highest species diversity require urgent attention through a more active type of management because most of these habitats persist as small fragments within a metric of human occurrence.

Passive management on the other hand refers to non-intervention method of managing protected areas; it is the management of the ecosystem that allows nature to take its course, leaving the biodiversity to regenerate on its own without any form of interference. Passive management is considered by a relatively small number of wild and wilderness area managers as the basic management tool. Passive management is not only legitimate; it is also cheaper to manage protected areas where the main objectives are ecosystem dynamics and wilderness. The management plan of protected areas provides opportunity to shift from passive to more active management. According to Bonner (1992), the first essential of active management is the definition of objectives to be achieved the protected area and this is always clearly stated in the management plans. Also, the values to be protected and the planned objectives for the management which is a major component of the protected area management plan mandates that management plans must include management activities to be undertaken to protect the values for which special protection of management is required. With global environmental challenges due climate change and its inherent problems, management of protected areas cannot be left without any form of intervention hence, compromises have to be based on scientific practices towards effective management in order to achieve conservation objectives.

Dudley (2008) stated that effective management may entail minimum levels of intervention, for example in large wilderness areas, or "intensive care", or in small habitat or species management areas. Effective management usually involves a wide range of stakeholders, including government agencies, Non-Governmental Organizations (NGOs), private entities, indigenous peoples and local communities. He further opined that implementing appropriate management for a protected area is fundamental for its effective conservation of biodiversity. The study therefore aimed at examining management style of two national parks in Nigeria (Kainji Lake and Gashaka-Gumti) with a view to characterize and differentiate between active and passive management within and outside the National Parks towards effective management of the protected areas.

MATERIALS AND METHODS

Study Area

The study covered two National Parks in Nigeria, Kainji Lake, the first and Gashaka-Gumti, the largest conservation enclave in Nigeria. The two National Parks are in category II of the International Union of Conservation of Nature (IUCN) categorization. They are managed by the Nigeria National Parks Service (NNPS).

Kainji Lake National Park

Kainji Lake National Park lies between Latitude $9^{0}40^{1}$ N and $10^{0}30^{1}$ and Longitude $3^{0}35^{1}$E and $05^{0}25^{1}$E, covering an area of 5,340 Km/Sq (Figure 1) It is composed of two non- contiguous sectors, Borgu and Zugurma separated by Kainji Lake and the hydroelectric dam complex. There are eight (8) ranges and a central squard in Kainji Lake National Park, these are Kali; Kemenji; Kulho, Ibbi, Worumakoto; Kuble Oli and Doro ranges with the central squad. The entire park is in two of the most sparsely populated areas of the country. The climate of the park had been divided into two distinct seasons, rainy and dry season. The wet season usually begin in May and last till November while the dry season commences from December to April. North East trade wind blowing across the Sahara which is characteristically cold, dry and dusty, predominate over the study area between November and March, this is known as the harmattan season. Relative humidity values vary directly with rainfall values but somewhat inversely with the values for evaporation.

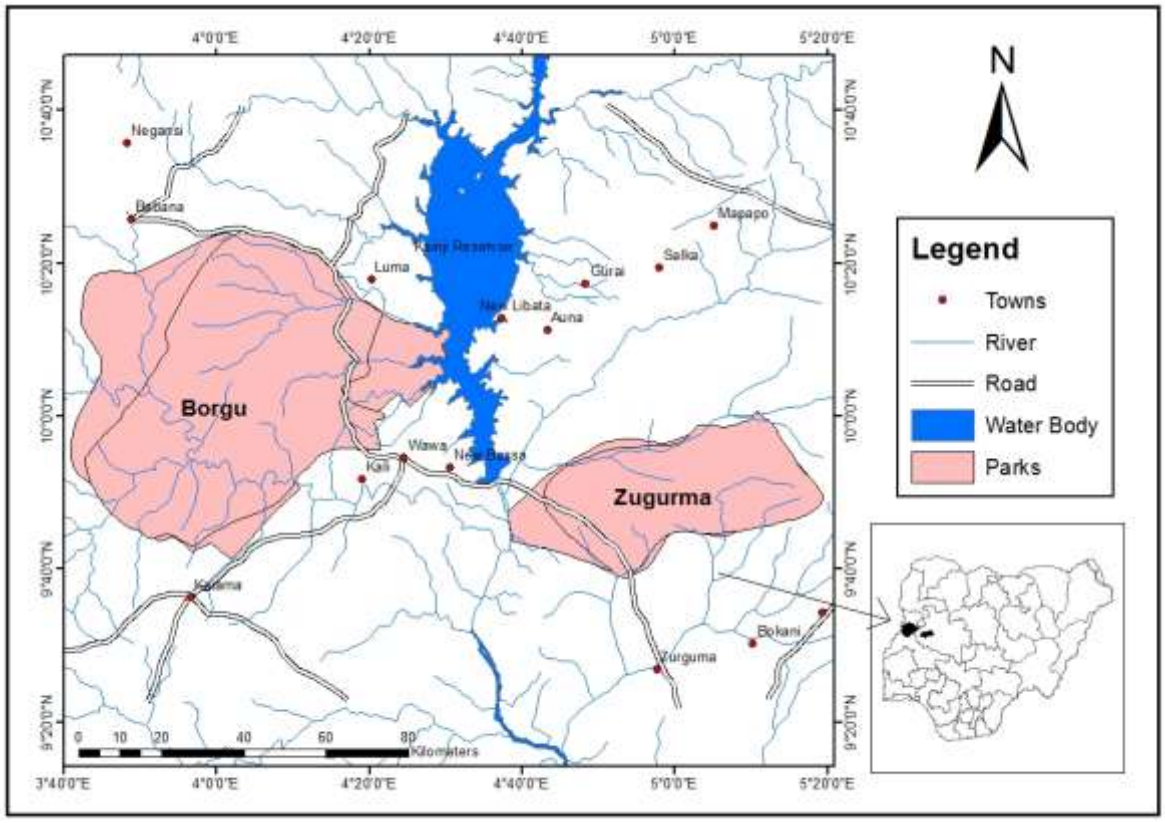

Figure 1: Map of Kainji Lake National Park showing Borgu and Zugurma sectors

Evaporation rates are higher during the drier months with the peak in March /April at the end of the dry season. Lowest evaporation occurs in August during the peak of the rains when relative humidity is at its highest. Drainage system is maintained by five rivers in the Borgu sector, these are Oli, the largest of the rivers, Timo, Menai, Sadoro and Doro rivers. Zugurma sector however is drained with rivers Manyara, Nuwa, Zurugi, Yampere and Lanser with the last two being seasonal.

The vegetation is typical Northern Guinea Savanna, and classified into seven sub-types according to Afolayan (1977) and Milligan (1979) which are *Burkea africana / Detarium microcarpum* woodland, *Afzelia africana* woodland, *Isoberlinia tomentosa* woodland, *Terminalia macroptera* woodland, *Diospyros mespiliformis* dry forest, *Acacia* 'complex''dry forest and Riparian forest and woodlands. Among the grasses which dominate the vegetation of Kainji lake National Park is *Andropogon*

gayanus, Andropogon tectorium, Hyparrhenia rufa. The shrub species include *Piliostigma thonnigii*, *Strichnos spinosa*, Gardenia sps and *Annona selegalensis.*

Fauna species of Kainji Lake National Park include Buffalo (*Syncerus caffer*), Roan antelope (*Hippotragus equinus*), Senegal kob (*Adenota kob*), Lion (*Panthera leo*), Leopard (*Panthera pardus)*, Nile crocodile (*Crocodilus niloticus*), Monitor lizard (*Veranus niloticus*), Python (*Python sabae*) among others. Over 180 species of birds have been recorded including such nationally uncommon species as Pink-backed pelican (*Pelecanus rufescens*), African darter (*Anhinga rufa*), Little bittern (*Ixobroychus minutes*, Secretary bird (*Sagittarius serpentarius*) Spotted thick knee (*Berhinus capensis*), Long-tailed nightjar (*Caprimulgus climacurus*), Abyssinian ground hornbill (Bucorvus abyssinicus) and Red-shouldered cuckoo strike (*Campephaga phoenicia*). Rare palearctic migrants such as *Falco Subbuteo* and Common cuckoo (*Cuclus canorus*) have been recorded in this park. The shores of Kainji Lake are wintering grounds for hundreds of palearctic water birds. Twenty eight (28) of the forty two species of the Sudan- Guinea Savanna that occur in Nigeria have been recorded at this site (Birdlife, 2001)

Gashaka Gumti National Park

Gashaka-Gumti National Park is located in the mountainous region of northern Nigeria, adjacent to the international border with Cameroon and immediately to the north of Mambilla plateau. It derived its name from two of the region's oldest and most historic settlements, Gashaka and Gumti villages in Taraba and Adamawa states in the country. (Dunn, 1999). It lies between longitude $11^0\,11^1$ and $12^0\,13^1$ East and latitude $06^0\,55^1$ and $08^0\,05^1$ North (Figure 2) covering an area of 6,731 Km Sq. Gashaka Gumti has five (5) ranges and a central squad, they are Gamgam; Mayo Selbe; Toungo; Fillinga and Gumti ranges with the central squad.

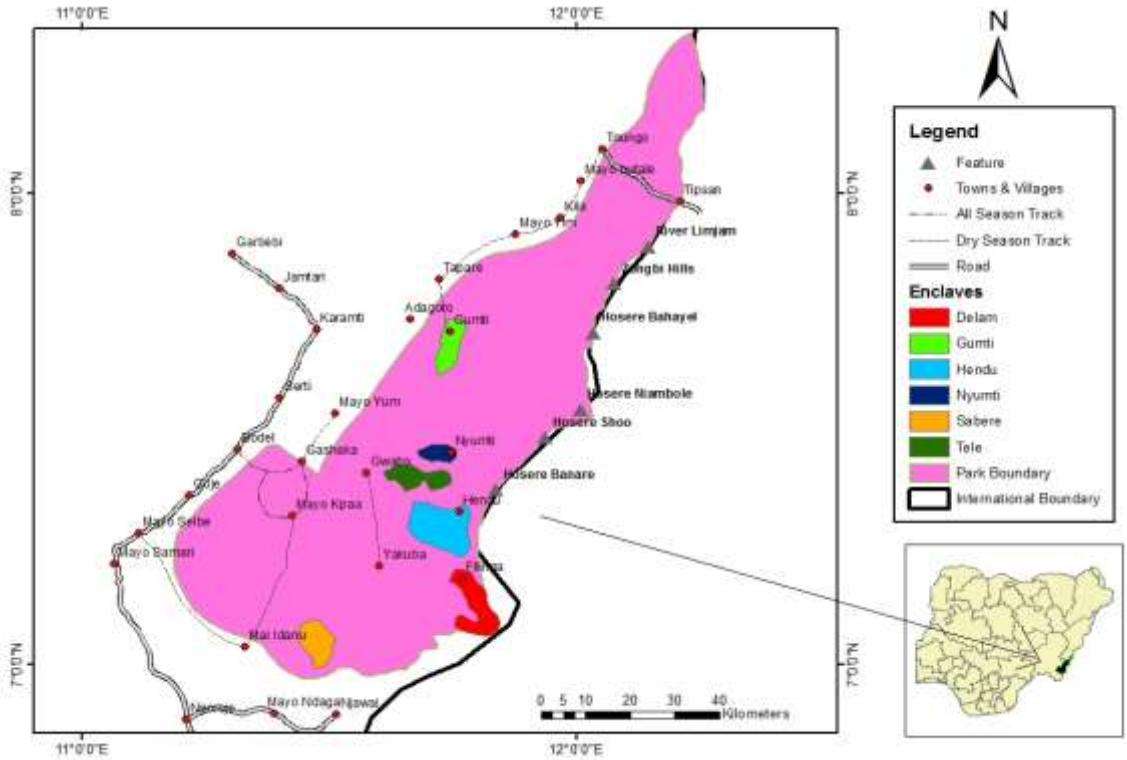

Figure 2: Map of Gashaka Gumti National Park and the surrounding villages

Gashaka Gumti National Park experiences two marked seasons, dry season (November to March) and the rainy season which is from April to October (Chapman & Chapman 2001,

Ogunjemite 2008). Gashaka Gumti area exhibits a climate typical of the Guinea savanna zone although this varies considerably with respect to latitude and altitude. Four major rivers form the drainage system of Gashaka Gumti National Park; Rivers Kam (Mayo Kam), the park's largest river, Gashaka, Gam-gam and Yim which is in the northern sector (Toungo). The major rivers of Gashaka Gumti act as reservoirs of biodiversity, offering ideal and safe habitat to the endangered hippopotamus (Hippopotamus amphibius), crocodile (*Crocodilus niloticus*) otters (*Lutra lutra*) and a great number of fish life (Dunn, 1999).

The vegetation of Gashaka Gumti is diverse and composed of four distinct vegetation zones Chapman and Chapman (2001) and Akinsoji (2003), these are:

Savanna woodland: this is divided into: southern guinea savannah woodland, the northern guinea savannah woodland occurring in the southern and the northern part of the park respectively and the scrub savannah.

Lowland rainforests: Emergent and sub emergent tree species with tangles of climbers and secondary colonizers occur here. It is mostly found at the middle altitude with elevations of about 300 meters to about 600 meters within the Park, they are referred to as gallery forests when they occur along river valleys and found to be extensive.

Montane forests: this occur at elevations above 600 meters, and it is found occurring at the same time with

Montane grassland: this is found at the altitudes above 1300meters above sea level in the park, it is created over time by frequent burning of the plateau.

The various vegetation types are home to different populations of rare and endangered fauna species such as chimpanzees (Pan troglodytes), colobus (Colobus sp) , Golden cat (*Felis aurata)*, African civet (*Civettictis civetta*), buffalo, *Syncerus caffer*, waterbuck, (*Kobus defassa)*, baboons (*Papio anubis*), western hartebeest (*Alcelaphus buselaphus*), giant eland (*Taurotragus derbianus*); Kobs (*Kobus kob),* red river-hog *Potamochoerus porcus*; giant forest hog (*Hylochoerus meinertzhageni)*

Data Collection and Analysis

A combination of field observation and interview methods were employed to elicit information on the management style adopted in the two protected areas. This was done through visits to the all the ranges of the two parks over a period of four seasons, two wet seasons and two dry seasons. An interview guide based on activities on management of the parks was prepared and used for the interview. It covers burning regimes, schedule of anti-poaching patrol, grading of jeep tracks, buffer zone and boundary management of the parks amongst others. Experienced park officers and rangers in Ecology, Research and Monitoring (ERM) unit of each of the park were designated and involved in data collection. The park protection unit was closely followed during patrols, burning exercises and other activities to have first-hand information on management practices in both parks. Within the ranges, the various activities carried out in managing the parks were noted. Data obtained were descriptively presented.

RESULTS

Active and Passive management

Results showed that eleven (11) major management practices were identified in the two parks, eight (8) active management practices were identified in Kainji Lake National Park, these include buffer zone management; erection of viewing hides; creation of waterholes; reinforcement of anti-poaching with the use of parachute for monitoring illegal entry and activities from the air, research and monitoring, communities conservation awareness through enlightenment, track and road maintenance as well as controlled bush burning. Three (3) other practices were passive in Kainji Lake National Park, these are boundary demarcation, creation of salt licks and transboundary management because it does not share boundary with any other protected area.

However, seven (7) practices were active in Gashaka Gumti National Park and four (4) were passive. Active management activities in Gashaka Gumti National Park are control of illegal activities through anti-poaching patrols, research and monitoring, communities' conservation awareness through enlightenment, tract and road maintenance, buffer zone management, controlled bush burning and transboundary protected area management.

Waterholes creation, creation of saltlicks, erection of viewing hides and parachute patrol due to the mountainous terrain of were passive in Gashaka Gumti National Park.

Active management practices in the two parks are more than passive with 84.21% and 77.78% active management as against 15.79% and 22.22% passive management in Kainji Lake National Park and Gashaka Gumti National Park respectively as shown in Table 1.

Table 1: Management practices in Kainji Lake and Gashaka Gumti National Parks

Management Practice	**Kainji Lake**	**Score**	**Gashaka Gumti**	**Score**
Boundary demarcation	**X**	**1**	√	**2**
Buffer zone management	√	**2**	√	**2**
Controlled bush burning	√	**2**	√	**2**
Creation of salt lick	X	1	X	1
Creation of artificial waterholes	√	**2**	X	**1**
Track, trail and road management	√	**2**	√	**2**
Anti-poaching patrol	√	**2**	√	**2**
Research and Monitoring	√	**2**	√	**2**
Parachute patrol	√	**2**	X	**1**
Erection of viewing hides	√	**2**	X	**1**
Transboundary management	X	1	√	2
% Active management		84.21%		77.78%
% Passive management		15.79%		22.22%

Key: √ = Active management = 2

X = Passive management = 1

Creation of Waterholes

The two National Park had natural waterholes while only Kainji Lake had constructed/artificial. Kainji Lake National Park had the highest waterholes with a total of 41, 35 natural and 6 artificial/constructed (Table 2). A total of 32 natural waterholes were identified in Gashaka Gumti National park, there were however no created/artificial waterholes. This could probably be due to the terrain of Gamgam which was mountainous, however only natural waterholes were observed in Gashaka Gumti National Park.

Table 2: Waterholes in the Kainji Lake and Gashaka Gumti National Parks

Park	**Natural**	**Artificial**	Total
Gashaka Gumti	32	Nil	32
Kainji Lake	35	6	41

DISCUSSION

Five management practices were similar in the two Parks; both parks carry out the same management activities for vegetation and habitat improvement with exception of a few activities that are peculiar to each of the park because of location and terrain. This may be as a result of the parks being under the same

administration, the Nigeria National Park Service. The higher percentage of active type of management is in agreement with Borza and Vancura (2009) who reported that certain areas require active management interventions to maintain specific biodiversity values.

Artificial waterholes were created at strategic points in both Borgu and Zugurma sectors of Kainji Lake National Park to mitigate drought and prevent animals from moving too far before getting water during the dry season.

Burning is an annual management practice in the two national parks. The study showed that two burning regimes were established for managing the wild during the peak of the dry season. This is to prevent wild fire which may be destructive to the vegetation and the animals as well as to allow and enhance visibility during game viewing when tourists visit the parks.

Saltlicks and waterholes are areas of importance for management of the parks because of the concentration of game at these points for essential minerals and water during the dry season. Due to the fact that poachers often seize the opportunity of animals around salt lick and waterholes to hunt, protection efforts were observed to be intensified around salt lick areas in Gashaka Gumti National Park, tents were pitched by park wardens and rangers around this area to give added protection to the resources. Animals whose activities were observed around this area include Warthog, Buffalo, Waterbuck, Kobs, Red flanked duikers and Kobs. Although saltlicks were not created in any of the park, the additional protection given to this area in Gashaka Gumti National park was recorded as a management effort towards effective protection. Saltlicks areas were not given additional protection in Kainji Lake National Park

Increasing population of dwellers around support zones of the parks put further threats on the animals in search of water especially during the dry season. Creation of waterholes was therefore accorded one of the topmost priorities among management practices in Kainji Lake National Park to prevent animals from straying too far from the park and buffer zones in search of water especially in the Zugurma sector although the waterholes were not limited to Zugurma sector, This management practice was in response to the recommendation in the 2006 management plan of Kainji lake National Park to create waterholes for animals. Waterhole creation was not an active practice in Gashaka Gumti National Park probably due to the many rivers which are available for animals.

Park tracks and trails were observed to be graded once a year especially after rains. In Gashaka Gumti National park, the road networks for park protection and game viewing were maintained during the study period. Information gathered from park engineering section revealed that accessible roads within the park are annually graded for easy accessibility by tourists. New jeep tracks were opened, of note is the one along Mayo Kam, the biggest drainage of Gashaka Gumti National Park and were observed graded throughout the period of the study. New culverts and bridges were constructed during the study period in Gashaka Gumti National Park. This was to allow easy access into the ranges during the raining season; trails within the arboretum were also observed maintained during visits to the park. Kainji Lake National Park also maintains the tracks and trails but this was not on annual basis.

Protection activities in the parks were given utmost priority as poaching and illegal activities were threats most prevalent in the parks. Patrol is rotated among protection staff, and this is carried out from the various beats, posts, ranges, sector and the central squad as the case may be. A patrol team usually consists of at least three to seven park rangers keeping surveillance on the protected areas within a particular jurisdiction for a week after which another team takes over. Shifting among protection staff is done for patrol activities however, the peculiarity of each range and the season determines intensity of patrol activities. It was gathered that illegal activities within the park is higher in the dry season hence surveillance of the parks was more intense during this period. Anti-poaching patrol is an active management activity in the two parks. Monitoring of illegal activities from the air with the use of parachute was an advantage that

Kainji Lake has over Gashaka Gumti National park. This patrol activity was also possible due to the terrain of Kainji Lake which is different from the mountainous type of Gashaka Gumti.

Research and monitoring activities are active management practices in the parks. Both Kainji Lake and Gashaka Gumti National Parks have research units which oversee all research being carried out both by researchers from institutions in the countries and those from other countries. Viewing hides for observation of animals during game viewing and research purposes is active in Kainji Lake National Park but was not active in Gashaka Gumti National Park. This could be attributed to the mountainous terrain of the park which already makes it possible for animals to be observed without having to climb.

Transboundary management of the park is active in Gashaka Gumti National Park due to the shared boundary it has with Faro National Park. The unique montane ecosystems of Gashaka Gumti, Faro and Tchabal Mbabo National Parks with associated fauna and flora are the focus for which the transboundary project was launched. The transboundary arrangement aimed at protecting resources in the region which include the Nigerian - Cameroon chimpanzee, hyena, and the unique montane forest which acts as pleistocene refugia to the high-level biodiversity of the region which include forest, savanna and other endemic plants and animal species. The border between these parks was observed to be under surveillance and patrol in order to guard against inimical activities threatening these resources.

Among the activities observed for the transboundary management of Gashaka Gumti and Faro National Parks is the working alongside local communities to boost conservation efforts of the area for effective protection, increased community awareness in the border area and the park guards working with traditional authorities and community groups.

CONCLUSION

The study has shown that both active and passive approaches of management are practiced in Kainji Lake and Gashaka Gumti National Parks with active approach of management being higher than the passive. The two parks are of great biological and sociological importance and their design and planning for delivery of conservation objectives were in accordance with international standards. Although indication from knowledge and experience in protected area management has shown that passive and non-intervention management is a cheaper way of managing areas designated for research and wilderness which are among the objectives for category 11 protected areas. However, active management is needed for improvement of services such as game viewing, accommodation for tourists and ecosystem restoration.

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Correlation between Flora Diversity and Abundance of Bat (*Eidolon helvum)* in Bowen University, Iwo, Nigeria

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ABSTRACT
The study was conducted in Bowen University Campus Iwo, Osun State, Nigeria. Systematic sample stratification was used to stratify the bat- occupied and unoccupied zones based on the presence of roost trees occupied by bats and to identify all tree samples to species level and enumerated. Many parts of the University Landscape represented the main bat trees occupied as bat roost site. Some other factors that describe the physical appearance of the trees were also observed such as diameter at breast height (DBH), Canopy cover, tree height, number of branches and bark condition. Correlation between bat abundances and available food resources is at $p > 0.005$. High population index of bats at the site determine their life cycle and simultaneously design a conservation strategy. Observation is on negative impact of bats on trees resulting from suppression of flowering/fruiting and defoliation. The Biodiversity of the study site is solemn in bats conservation management.

Keywords: Reconnaissance survey, systematic sample, roost site, correlation, bat conservation.

INTRODUCTION
Bats including the straw colour fruit bat (*Eidolon helvum*) are one of the most important, yet least understood groups of animals in the world. They have been in existence for more than fifty million (50) years and are known to play a vital role in both natural and managed ecosystem. A quarter of nearly 1,000 different species of this animal is known today. This means they are diverse. Bats traditionally are not viewed as charismatic except in the most extreme desert and Polar Regions. (Vivian, 2007). Myths and superstition of centuries have made bats among the world's least appreciated wildlife species. Decades of unwarranted human fear, misinformation and persecution of bats at their roost site have pressed populations into severe decline nearly everywhere in the World and endangered many species (Bat Conservation International, BCI, 2004). Conversely, the moral, ethical and aesthetic justification for bats conservation made the species to be ecologically and economically important (BCI, 1989). The (*Eidolon helvum*) which is the subject of this study inhabits forest and savannah and found up to an elevation of 2000m in Ruwenzori Mountains (Kingdon, 1974).

It is gregarious and prefers to roost in tall trees, but has been found in lofts, rocks and caves (Nowak, 1991). In this country, bats select trees of particular species for roosting and feed mostly at night (Okon, 1974). Among the common trees used for roosting are *Eucalyptus saligna* (Myrtaceae), *Cocos nucifera* (Palmae), *Elaeis guineensis* (Palmae) and tree species of Ficus (Moraceae) (Jones, 1972). Bats can display fidelity to roosting areas, and often roost colonially in order to reduce thermoregulatory costs, reduce predation risk, reduce costs of rearing young through cooperative breeding, and

increase information exchange (Kerth *et al.*, 2001; Kunz, 1982; Kunz & Lumsden, 2003). Roost-switching behavior also is displayed by many bat species, where members of a colony regularly switch between a pool of suitable roosts within an area (Lewis, 1995, O'Donnell & Sedgeley 1999). Hence, suitable roost sites are expected to have specific physical attributes, with the persistence of bats in urban landscapes predicted to be dependent in part on the maintenance of suitable roosting habitat, which includes many suitable roost trees. Harvesting of roost trees, mostly in site where uncontrolled and illegal logging are rampant has contributed to species population decline.

Most rural African protein source of meat comes from wild animals ranging from rats, squirrels, monkeys; antelopes, birds and bats are not left out. One of the forest resources believed to be easily accessed by the resource poor rural dwellers is bush meat. It connotes to be wild animal protein being hunted for human consumption bat inclusive. Bush meats also serve as cheap protein source to the rural people that may not be able to afford meats from domestic animals (Branch, 2000). When bats choose their roost sites, they select trees of various heights and sizes and their colonies can number up to one million. As expected of bat the individual of each species perch upside down. In the western coast of West Africa, precisely Ivory Coast, bats migrate from the tropical forest zone where they live between June and December, to the interior of Niger basin where it appears in January and stay till May (Happold, 1987).

In West Africa, over 120 species of fruits-and nectar- eating bats are found. With particular reference to Ghana, there are about fifteen (15) fruit- eating bats feeding on a wide range of trees in the forest landscape (Kankam & Oduro, 2009). The bat feeds on leaves, flowers and large proportion on fruits on different families of tropical forest plant species. As for Eidolon helvum it feeds on the following fruits both cultivated and wild plants such as *Musa sapientum* (Musaceae), Carica papaya (Caricaceae) *Mangifera indica (*Anacardiaceae*), Kigelia eathiopica* (Bignoniaceae) and *Terminalia Speceis* (Fujita & Tuttle, 1991). As an index part of their economic value, they are being hunted in most of West African countries as a source of "Lean Meat". The meat is usually consumed at home while some are occasionally sold at the local market. Anthropogenic activities contribute to population decline of wildlife species bats inclusive. This major hunting of bats in Ghana takes place at the peak period of dry season (Kamins *et.al.*, 2011).

MATERIALS AND METHODS

Study Area

Bowen University Campus is fully residential located on a 640 hectares site in Iwoland on a geographical coordinate's longitude 7^0 62^1N and latitude $4^0 14^1$E. Iwo itself is in Osun state about 46.6 km south west of Ibadan the largest city in Nigeria. The University is a private one owned and operated by the Nigerian Baptist Convention. It is housed within the old 1,300 acres (6 km^2) Campus of the former Baptist College, a teacher – training institution on a beautiful hill on out-skirts City of Iwo. The Campus is renowned for its large residential fruit bats roost sites.

Sampling Procedure

Reconnaissance survey was conducted through random sampling techniques to stratify the campus into bat-occupied and unoccupied zones based on the presence or absence of roost trees occupied by bats. Eleven sample plots of 20m x20m size were systematically distributed in each stratum many parts of the study area represented the main bat roost site. Each plot was sub-divided into tree belt transects for effective coverage of the area. All trees found to be greater than and seen to be greater than 10 cm and above at diameter at breast height (DBH) in all plots were identified to the species level and counted. Some factors that describe the physical appearance of the trees (DBH, Tree height or basal area, number of branches and bark condition) were also observed.

Data Analysis

Data collected were analyzed using different statistical tools. Vegetation sampling analysis was carried out by using statistical direct computer package. Descriptive statistical analysis using t-test tables, charts and histogram were employed. The impact of bats on trees was analyzed using the DBH measurements to calculate the basal area of plant species. The canopy cover was calculated by using the formula of Hall and Swaine, 1981 given below:

$= D^{2}/4$ where D is the average crown diameter…….(equation one)

RESULTS

Observation of the flora species influence revealed that seven flora species belonging to seven families were recorded in the bat occupied zone within the study site as presented in Table 1. The highest number 14 or 46.6% of the trees sample is *Mangifera indica*, followed by 5 or 16.6% of Tectonia *grandis* and Rhapidophyllum species respectively are shown in Table 2.

Table1: Flora species available at the study site.

S/N	**Botanical Name**	**Family**	**Common Name**	**Local Name**
1	*Mangifera indica*	Anacardiaceae	Mango	Mongoro
2	*Cassia fistula*	Fabaceae	Pudding pie	Aridan-toroo
3	*Tectonia grandis*	Verbenaceae	Teak	Igi gedu
4	*Rhapidophyllum spp.*	Arecaceae	Ornamental palm	Igi Agbon
5	*Irvingia gabonensis*	Irvingiaceae	Bush mango	Ooro
6	*Terminalia catappa*	Combretaceae	Tropical almond	Igi furutu
7	*Vitex doniana*	Lamiaceae	African oak/vitex	Oori nla/Oori

Table2: Frequency and percentages of flora species identified

S/N	**Tree Species**	**Frequency**	**Percentage**
1	*Mangifera indica*	14	46.67
2	*Cassia fistula*	3	10.00
3	*Tectonia grandis*	5	16.67
4	*Rhapidophyllum spp*	5	16.67
5	*Irvingia gabonensis*	1	3.33
6	*Teminalia catappa*	1	3.33
7	*Vitex doniana*	1	3.33
	Total	30	100

The preponderance of *Mangifera indica* is closely correlated to the abundance of bats which has a significant coefficient at ($p > 0.005$) Table 3. There is a high frequency of tree species used as bat roost site. Thus, indicating a close correlation between flora species and bats.

The study reveals that bats mostly feed on *Mangifera indica* (Mango trees) during the dry season and feed on any other species including shrubs at the off season of mango (Figure 1).

Table 3: Diameter at breast height (DBH) and height of the floral species.

Site	Tree species	DBH	Height(m)
A	*Mangifera indica*	4.25	12.0
	Cassia fistula	1.4	10.0
	Cassia fistula	1.6	10.5
B	*Mangifera indica*	3.6	7.50
	Mangifera indica	4.2	12.0
	Mangifera indica	4.0	10.75
C	*Mangifera indica*	3.1	6.0
	Rhapidopyllum spp	3.0	6.0
	Rhapidopyllum spp	3.01	8.0
D	*Terminalia catappa*	1.52	9.70
	Mangifera indica	1.05	1.50
	Rhapidopyllum spp	2.21	6.50
	Irvingia gabonensis	1.2	5.0
E	*Tectonia grandis*	1.80	10.0
	Tectonia grandis	1.70	14.0
	Tectonia grandis	1.93	12.0
F	*Mangifera indica*	3.25	8.0
	Mangifera indica	2.78	7.50
	Mangifera indica	3.60	7.0
G	*Tectonia grandis*	0.85	9.75
	Tectonia grandis	1.95	8.25
H	*Vitex doniana*	1.64	9.20
I	*Mangifera indica*	2.80	6.0
	Mangifera indica	3.40	7.0
	Mangifera indica	4.60	8.40
J	*Rhapidopyllum spp*	1.87	5.0
	Rhapidopyllum spp	5.8	4.0
	Cassia fistula	3.30	6.0
K	*Mangifera indica*	2.60	6.5
	Mangifera indica	2.25	7.0

DBH- Diameter at breast height

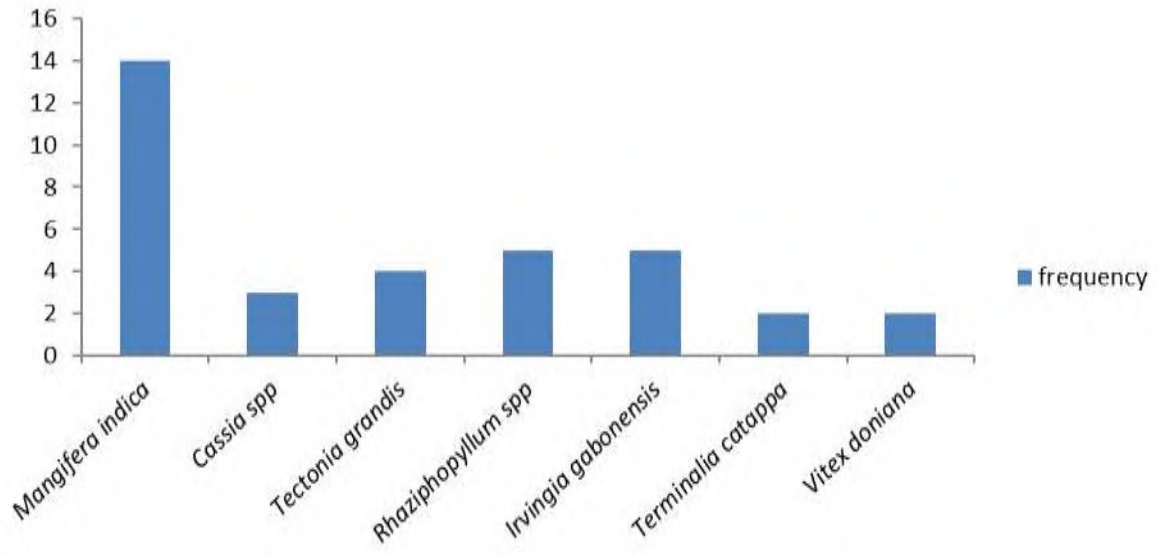

Figure 1: Flora species used as roosting site by bats

There is a high mean basal area of each flora species found at the study site. Data analysis reveals that the mean basal area of the tree cover domicile by bats in the study site is 8.29 M^2/ha for *Mangifera indica*, followed by 7.94 M^2/ha for *Rhapidophyllum* species, 2.14 M^2/ha for *Tectonia grandis*, and 1.13 M^2/ha for *Irvingia gabonensis.* The mean basal area of the tree cover by bats in M^2/ha shows that *Mangifera indica has* a total land area of 8.29 M^2/ha, followed by *Rhapidophyllum species* that is of total land area of 7.94 M^2/ha while Irvingia gabonensis has the least land area of a mean size of 1.13M^2/ha. The study reveals that *Mangifera indica* and *Rhapidophyllum species* are in abundance which support the abundance of bats represented in Figure 2.

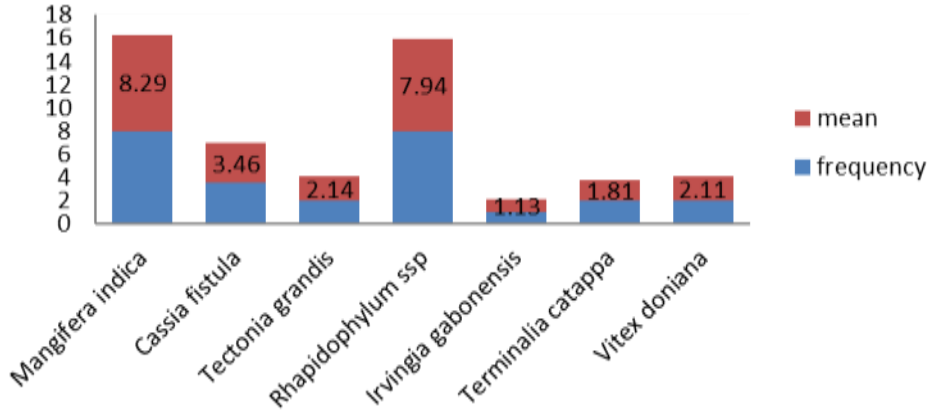

Figure 2: Mean basal area of the floral cover

DISCUSSION

The results obtained from the data analysis have shown that Bats population in Bowen University, Iwo has advanced and that more trees house bats in the Campus. It was recorded that seven families of sampled flora species contained bats. The average trees height in the Bowen University Campus is relatively found and seen to be greater than 10 cm and above at diameter at breast height (DBH) in all sampled plots. This is a great indicator that there are presence of some factors in the study site favourable to bats population, such as tree height, percentage of canopy cover, absence of predators, and absence of intense bat hunting as corroborated with the study of Akande (2002), that population ecology of bats depends on the aforementioned parameters. This support to the largest concentration of bats recorded from the tallest trees. The study also reveals that bats mostly feed on *Mangifera indica* (Mango trees) during the dry season and feed on any other species including shrubs at the off season of mango. This corroborates findings of (Ayoade *et al.*, 2012, Olaniyan, 2016) that fruit bats feed on several fruits of shrubs and trees which made them prolific dispersers of seeds in the forest landscape.

CONCLUSION

The habitation by bats was observed throughout the study site. The floral diversity of the site tallies with the abundance of bats as a result of food resources available to them throughout the year. The bats were found feeding on flowers and nectar of many indigenous trees such as *Mangifera indica, Cassia fistula, Tectonia grandis, Rhapidophyllum species, Irvingia gabonensis, Terminalia catappa* and *Vitex doniana* which they help to pollinate and make use of as roosting site. Consequently, the high population of bats in the site could be used to determine their life cycle and simultaneously design a conservation strategy.

Anthropogenic activities seem not to have impacted significantly on the site due in impact to the control of such activities by the Nigeria Baptist convention that has the title of the land. The study shows a negative impact of bats on Mango trees through suppression of flowering/fruiting and defoliation. The population index of bats needs to be under monitoring to determine their population growth within the site.

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Contributions of Bushmeat Trade to Livelihoods in Maiduguri Borno State, Nigeria

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ABSTRACT
Bushmeat trade (BT) is an important enterprise in many parts of the world, as it is associated with alleviating livelihood challenges. This study examined the contributions of BT to the livelihood of bushmeat traders in Maiduguri Bushmeat Market, Borno State. Structured questionnaire was used to obtain information on income from bushmeat trade. Fifty (50) bushmeat traders were sampled in July 2017. This study revealed that bushmeat trade in the study area was male dominated (84%) and that 82% of respondents were between 21-50 years. BT was the primary source of income among 57% respondents. Most respondents (38%) earned monthly income between ₦40,000.00 and ₦49,999.00 from BT. It is recommended that policies which will encourage sustainability of trade and captive breeding of bushmeat species be formulated to enhance the livelihood contributions of this important commodity without its negative effects on wildlife populations.

Keywords: Enterprise, income, policies, sustainability, traders

INTRODUCTION
Wildlife has been reported to be central to the livelihood of the poor, who are widespread in Equatorial Africa (Trench, 2000), as they depend on it as an important source of income and food. According to Chamber and Conway (1992), livelihood comprises the capabilities, assets and activities required for peoples' means of living, while Ellis (2000), stated that livelihood comprises of the assets, activities and access that together determine the living gained by the individual or household. Bushmeat can be defined as any non domesticated, terrestrial mammal, bird, reptile and amphibian and insect harvested for food (CBD, 2008). Utilisation of wild animals as bushmeat in West Africa is particularly well documented by various Researchers (Ajayi, 1973; 1974; 1979; Asibey 1974; 1977; 1978; Jeffery, 1977; Martin, 1983; Sale, 1981; Ntiamoa-Baidu, 1987). The bushmeat trade is important mostly among developing economies as it contributes substantially to the livelihoods of almost 150 million people living in the tropical forests (Robinson & Bennett, 2000) and according to Wilkie *et al*. (1992) it supports the fast growing informal economy in parts of Africa. Bushmeat trade has emerged as one of the important avenues for the improvement of livelihood of many impoverished people around the world. It has been able to reduce the incidences of unemployment, food insecurity and poverty amongst among many others (Lindsey *et al*., 2015). Ntiamoa-Baidu (1997) stated that bushmeat trade is one of the major avenues for income generation from wildlife and that trade in bushmeat and other wild animal products help to fuel rural economies and provide income for rural dwellers, who often

have very few other avenues for earning income and for whom income from wild products is essential for the provision of everyday needs. This probably is one of the most important reasons why trade in bushmeat has emerged as a major source of income to many people in developing countries especially in Africa. Biodiversity Support Programme, (2001) observed that bushmeat is an economically important food and trade item for as many as 30 million poor rural and urban people in the Congo Basin of Africa. Trade in bushmeat contributes significantly to household incomes in both rural and urban communities of West and Central Africa involving many groups of people and generating employment (Ntiamoa-Baidu, 1997). He also reported the presence of several levels of participants, from hunters to middlemen and meat processors in several rural and urban communities in Africa. Thus, the consumption of bushmeat is popular among the urban and rural dwellers in Africa (Asibey, 1977; Ajayi, 1979) and Ajayi (1992) reported that about 380 avian species, over 21 species of reptile and amphibian have been utilized for bushmeat in Nigeria. Much research has been carried out regarding bushmeat consumption and harvesting, also, studies have been published on bushmeat consumption and preference in the study area (Ojo *et al.,* 2011), information on the contributions of bushmeat trade to livelihood of traders in the study area is sparse, hence, the need for this study. This study aims at examining the contributions of bushmeat trade to livelihood of bushmeat traders in Maiduguri Bushmeat Market (MBM), Borno State. The objectives of this study are to investigate ways by which bushmeat consumption, income generation and employment affect the lives of bushmeat traders in the study area.

MATERIALS AND METHODS

Study Area

This study was conducted in the Maiduguri Bushmeat Market (MBM), along Baga Road, Maiduguri, the Capital of Borno State. The study area is located between latitude 110 05' N and 110 4 0' N and longitude 130 05' E and 130 2 5' E within the Sahel savannah,. The climate is hot and dry for most part of the year. The mean annual rainfall is between 500-1000mm with relative humidity and temperature of 42-49% and 20-50^{O}C respectively (BOSG, 2008). Maiduguri is ecologically located in the sahelian savannah with mainly grasses and few drought resistant trees including shrubs. The natural vegetation with a sparse flora comprising scattered shrubs, deciduous trees and grasses. *Acacia senegal* (gum Arabic), *Phoenix dactylifera* (Desert date palm), *Adansonia digitata* (Baobab tree), *Faidherbia albida* (Gao tree) are some of the tree species found here.

Data Collection and Analysis

Data for the study was obtained through the administration of a set of structured questionnaire on fifty respondents who were randomly selected among bushmeat traders in MBM. The owners of the first fifty (50) stalls encountered in the MBM out of the fifty two stalls in the market, were selected as respondents for the study. Where the stall owner wasn't around, questionnaire was dropped and retrieved on the later date. Where the respondent could not read, assistance by a literate native who understood the native language and recorded the responses was sought for the interpretation of the questionnaire. Data obtained from this study were analysed using descriptive statistics in the form of frequency, percentages, and tables.

RESULTS

Table 1 show that 86% of the respondents were male while 14% were females. Majority of respondents, (68%) were from31-40 old and the least represented age group among respondents in the study area being <20 years old. While none of the respondents have acquired any tertiary education, most respondents (58%) acquired quoranic education and secondary education was the least obtained level of education (4%) among respondents. Study also shows that 90% of the respondents have been married and 92% of respondents were household head, while the most predominant household size among respondents as shown in the study is of 6-10 individuals, being 58% and the least represented household size being >15 individuals (12%) of respondents.

Consumption of Bushmeat among Respondents

The study in Table 2 show that 84% of respondents consumed bushmeat in at least one form, while majority (52%) of respondents were influenced to consume bushmeat because of its availability to them. However, 92.86% of respondents who

consumed bushmeat used it as food, while and pet were 35.71% and 4.76% respectively. respondents that have used bushmeat as medicine

Table 1: Demographic characteristics of respondents (n=50)

Variables	Frequency n=50	Percentage n= (100%)
Gender		
Male	42	86.00
Female	08	14.00
Age		
< 20	01	2.00
21-30	03	6.00
31-40	34	68.00
>41	12	24.00
Education		
None	08	16.00
Quranic	29	58.00
Primary	11	22.00
Secondary	02	4.00
Tertiary	00	0.00
Marital status		
Never Married	05	10.00
Married	45	90.00
Household headship		
Yes	46	92.00
No	04	8.00
Household size		
<5	14	28.00
6-10	21	42.00
11-15	09	18.00
>15	06	12.00

Table 2: Consumption of bushmeat among bushmeat traders in Maiduguri (n=50)

Consumption of Bushmeat	Frequency	Percentage (%)
Yes	42	84.00
No	08	16.00
Major influence		
Availability	26	52.00
Price	10	20.00
Taste	8	16.00
Cultural Preference	6	12.00
Pattern of consumption		
Pattern	**Yes**	**No**
Food (n=42)	39 (92.86%)	3 (7.14%)
Medicine (n=42)	15 (35.71%)	27 (64.29%)
Pet (n=42)	2 (4.76%)	40 (95.24%)

Result in Table 3 shows that 50% of respondents have been involved in bushmeat trade between 5-10 years, most (66%) of respondents inherited the bushmeat trade from their parent. Study also

reveals that 68% of respondents underwent training period setting up their own trading posts. The main source of initial capital among respondents was loan (72%), with most respondents generating monthly income of between ₦40,000.00 - ₦49,999.00 and 92% of respondents not interested or presently involved in another income generating venture.

Table 3: Characteristics of bushmeat traders (n=50)

	Frequency	Percentage (%)
Experience in bushmeat trade (years)		
< 5	14	28.00
5-10	25	50.00
10-15	11	22.00
Mode of entry		
Inheritance	33	66.00
Availability	17	34.00
Pre- employment training		
Yes	34	68.00
No	07	32.00
Source of initial capital		
Personal savings	10	20.00
Loan	36	72.00
Gift	04	8.00
Income from bushmeat trade (₦/month)		
<18,000.00	03	6.00
18,000.00- 29,999	09	18.00
30,000.00-39,999.00	17	34.00
40,000.00-49,999.00	19	38.00
>50,000.00	02	4.00
Involvement in / willingness to seek other employment		
Yes	4	8.00
No	46	92.00

DISCUSSION

Bushmeat trade in the study area was observed to be male dominated (84%), this is in contrast with the findings of Falconer (1992) reported the involvement of more females in the bushmeat trading in Kumasi, Ghana. However the predominance of male among bushmeat traders in the study area may be as a result of the lifestyle of the local residents of the North East of Nigeria whose practice of their religion made for the restriction of the movement of females and the result supports the findings of Ali *et al.* (2008) that male also dominated trade in fresh fish in the study area. Majority of the respondents (82%) were between 21 and 50 years old, this is consistent with the observation of Infield (1988), who observed that men from an early age to their fifties were involved in selling bushmeat in Cameroun. Educational status of most respondents was low, as only 26% of respondents have acquired any form of formal education. This is corroborated by Ali *et al*. (2008) that reported that most of the fresh fish traders in the study area have also not acquired formal education of any sort. Most of the respondents (84%) depended solely on bushmeat trade as their source of income to maintain their household while others (16%) stated that they engaged in activities like farming, hunting, trading in other commodities and transport to augment household finances. Which they mentioned as payment of school fees for their children, health care clothing etc. Similarly,

Asibey (1977), Infield (1988), Steel (1994) and Ntiamoa- Baidu, (1997) all observed that bushmeat trade was the main source of livelihood for most people around Korup National Park in Cameroun; Gabon and Ghana. Most respondents had households of between six and fifteen individuals (42%) 6-10 individuals and (18%) 11-15 individuals), this is consistent with the finding of Ali *et al*. (2008) who observed that most fish sellers in the same market had households of between 7-15 individuals. With monthly income of most of them (72%) being less than N15,00.00 94% of respondent agreed that bushmeat trade is a profitable source of income to them also agreeing with the Muir, (1994) who that observed 60% of respondents agreed that bushmeat trade in a market in Zimbabwe was profitable.

CONCLUSION

Study revealed that most bushmeat traders were male and were within the active years of 18 to 50. The most prevalent household size among the bushmeat traders was between 6 and 10 individuals, with most of them being head of the household. Most bushmeat traders also found the trade profitable enough to make it their only source of income. 38% of the bushmeat traders earned between fifteen thousand to nineteen thousand nine hundred and ninety-nine naira (₦15, 000.00 ₦19, 500.00) monthly from bushmeat trade. Since trade in bushmeat is perceived as a veritable source of income by the traders, it is recommended that policies to make for sustainability of the trade and conservation of wild animals should be put in place. These may include training in game farming, enforcement of 'bag limit' for hunters, closed seasons period when hunting will be prohibited and more efficient patrol by Protection staff of conservation areas in the State should be considered by policy makers and Government.

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Composition of Fish Species caught during sport fishing in Ibuya Pools and Ikere Gorge – Lake, Old Oyo National Park, Nigeria

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ABSTRACT:
Large water bodies are usually a big asset to nature tourism. The Old Oyo National Park takes advantage of the Ibuya Pools and Ikere Gorge-Lake to handle most of its water recreational activities. The study was conducted in ten sampling stations, five each at Ibuya Pools and Ikere Gorge-Lake. The study revealed that 2,391 fish was caught in Ibuya Pools and only 592 were obtained in Ikere Gorge-Lake. The rich fish diversity obtained in Ibuya Pools was significantly higher ($p \leq 0.05$) than in Ikere Gorge-Lake. The physico–chemical parameters (temperature - 28.0^{o}C; Dissolved Oxygen - 6.70 mg/lit.; Hydrogen-Ion Concentration -7.05 and Total Dissolved Solids -375.50 ppm) were within the tolerable ranges at the two study sites.

Keywords: Baits, composition, diversity, National Park.

INTRODUCTION

Sport fishing, was described by Olorunpomi (2015) as fishing for pleasure or competition. These enable fish anglers spend their leisure hours gainfully at the various vacations destinations and actively engage in sport fishing to keep the body fit (Olorunpomi, 2015). This is different from commercial fishing, which is fishing for profit and subsistence fishing, which is fishing for survival. Sport fishing is usually carried out with a rod, reel, line, hook, and any one of a wide range of baits, natural or artificial (Olorunpomi, 2015). This plays a vital role in water – based tourism which is an example of a nature tourism involving traveling to locations such as natural/artificial lakes or dams, reservoirs, water parks beaches, waterfalls, and so on (Ayodele, 2017).

Nature tourism, ecological tourism or alternative tourism as it is sometimes called, is the practice of travelling to relatively undisturbed or uncontaminated natural areas to study, admire or enjoy the scenery, its flora and fauna components as well as any existing historical – cultural manipulations in the area (Olorunpomi, 2015). Sport fishing is as old as over two hundred years in the world; it has being practiced in countries such as north and south of America, Europe, Asia and Australia. This is a means of recreation over two centuries ago (Cowx, 2002). Eyo and Ahmed (2010) stated that in Africa, sport fishing is undergoing gradual development and at a faster rate too, as a means of leisure and recreation. This has been embraced by various governments of the countries, particularly in Nigeria.

Sport fishing has been accepted worldwide and its adoption has led to the formation of sport fishing associations or recreational fishing associations to develop fishing for sport and boost the economy of each region. Such associations include the American Sport Fishing Association (ASFA), Australian National Sport Fishing Associations (ANSA), East African Sport Fishing Association (EASFA), European Anglers Alliance (EAA), Polish Anglers Associations (PAA) and Sport Fishing Asian Forums (SAFs) (Olorunpomi, 2015).

Natural baits are nature given baits found naturally in the wild. Samples are obtained from the wild which are commonly used each time for sport fishing by fish anglers. These are of fauna and or flora origins. Animal baits may include varieties of worms, snails, fish, frogs, maggots, grasshoppers, ants, flies and various animal's intestines were used as either live or dead baits in sport fishing to catch fish (Berners, 2008; Olorunpomi, 2015). The plant baits origin may include several varieties of cooked yam, beans, sweet potatoes maddened with red oil and crimson. When these are used as baits, it attracted fish to it and they are often caught by the hooks or rods (Horrox & Ormrod, 2006; Olorunpomi, 2015). The synthetic forms made as camouflage to resemble the natural baits are the artificial baits used by the fish anglers. These are produced in the factories and turned out into the fishing market for sales to the fish anglers. The artificial baits range severally from artificial worms, snails, fish, frogs, maggots, fleas and varieties of lures. They are used as camouflages to catch fish in sport fishing (McCully, 2000; Olorunpomi, 2015).

Ibuya Pools are series of pocket pools found along the course of River Ogun in the heart of the Old Oyo National Park joined by many rivers tributaries such as the Rivers Tessi, Ayinta, Wawa, Woro and Owu etc. drains into the Ikere Gorge – Lake. Obot, Nchor, Eniang, Waari and Stopfords (2010) reported that the water quality status at Ibuya Pools was observed to be intact. In their studies, they concluded that there were no forms of pollution or stressor noticed to have negative effect on the aquatic lives of the river system. The Ikere Gorge –Dam is an expanse of water formed by a man-made Lake on River Ogun in the southern part of Old Oyo National Park. This was created by Ogun – Osun River Basin Authority, Water Resources and Rural Development in the year 1982/83. The Lake was impounded mainly to provide water for irrigational purposes to develop agriculture and fisheries resources to boost food sufficiency in the nation. This in turns is capable to be used for all water – based tourism and recreation, a treasure asset, when fully harnessed to boost the ecological tourism of the Old Oyo National Park.

Materials and Methods:

The study was conducted on the Ibuya Pools and Ikere Gorge – lake, both on the course of River Ogun within the Old Oyo National Park (Figures 1 and 2). The park is located between Latitude 8º 15′ - 9º00′ N and Longitude 3º35′ - 4º41′ E. It has a total land mass of 2,512 square kilometres and is situated within the southern guinea savannah belt of Nigeria (Geerling, 1973).

Five sampling stations were located in each of Ibuya Pools and Ikere Gorge – Lake where fish samples from sport fishing activities were collected fortnightly for a period of twenty – two months. This cut across two periods of wet and dry seasons. Ten numbers of standard rods, hooks and lines and reels with the specifications "Daiwa Ball Bearing Carbon Components ST750B, Long Cast Spool: 6lb (2.7kg) – 210yds (190m); 8lb (3.6kg) – 140yds (130m)'' sampling gears were used throughout the study. Five natural baits and their reciprocals (synthetic artificial baits) of earthworms (*Lumbricus terrestris*), snails (*Viviparous viviparous*), fish (*Alestes baremose*.), frogs *(Hyperolius guttulatus*) and maggots (House fly larvae - *Musca domestica*) were employed in the study. The artificial baits are in synthetic forms which were manufactured in the fishing materials industries and procured from markets stalls in Lagos. Measurements of the total length (head tip to the tail end) and standard length (head tip to the pedicle of the tail) of the morphometric features of some selected sampled fishes were taken and recorded to aid the identification process. Also, counting of rays and spines of some selected sampled fishes based on their meristic features were carried out during the study. These were used to classify the fish species obtained in the study into their binomial nomenclatures (FAO, 1995a). Fish samples were

preserved in ten per cent formalin solution (FAO, 1995b).

Selected water quality parameters were analyzed of water samples taken in each of the sampling stations. These include parameters like temperature (t^o), Dissolved Oxygen (DO), Hydrogen ions concentration (pH) and Total Dissolved Solids (TDS). These were monitored using dry mercury bulb thermometer (Temperature –t^oC), pH – meter model Aquatic Ecosystem Inc. Florida (Hydrogen ions concentration – pH), Oxy Guard Handy MK11 meter (Dissolved Oxygen – DO) and Ultra Violet Visible Absorption Spectrometer in the laboratory (Total Dissolved Solids – TDS). Fish composition, abundance and diversity were found based on the test carried out using PAST statistical package version 3. Descriptive statistical tools such as pie – charts, frequencies and percentages were used to describe the data. The classification used based on the aquatic ecological survey by Slack, Shield, Knight and Cooper (1992) was adopted and used in this study.

The efficiency of baits as catch – per – unit effort of fish caught for effective sport fishing anglers was established for the two study sites. A simple equation was derived to calculate the frequency of catch obtained based on efforts over time in accordance to Slack *et al*. (1992).

FC = TFC x TT ……..(i) Where:

FC = Frequency of Catch,

TFC = the total fish catch in each sampling point and

TT = the overall total time used in the sport fishing operation.

Therefore: CPUE = FC x 20 min. …… (ii) Where:

CPUE = the catch – per – unit effort,

FC x 20 = frequency of fish catch multiplied by 20 minutes time set to test each of the fish bait (natural/artificial) in the fishing operation.

The various types of fishes caught were identified using the basic taxonomic keys (FAO, 1990).

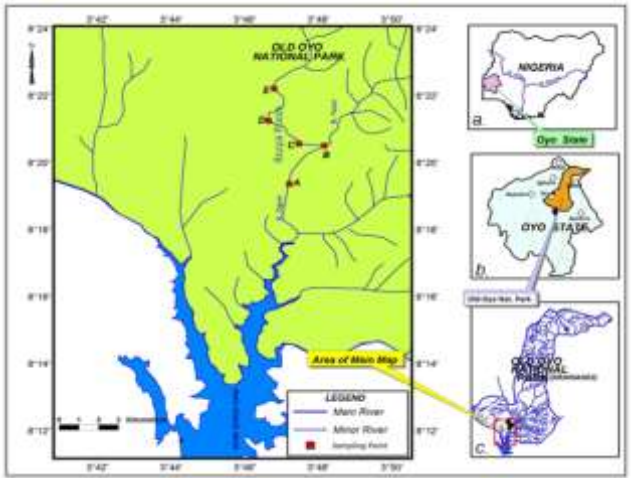

Figure 1: The five major locations in Ibuya Pools where sport fishing was carried out.

Source: Olorunpomi, 2015.

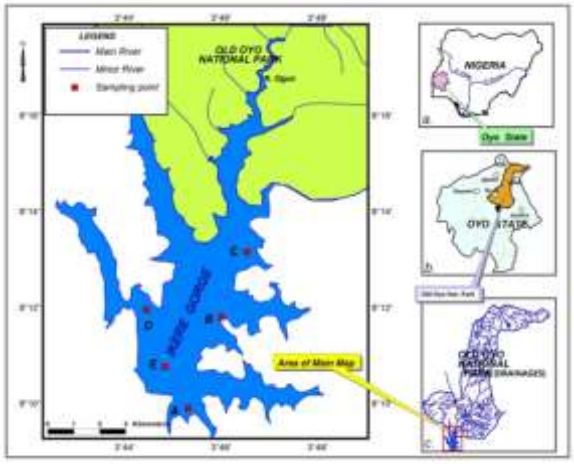

Figure 2: The five locations in Ikere Gorge - Lake where sport fishing was carried out.

Source: Olorunpomi, 2015.

RESULTS

The fish species caught in both Ibuya Pools and Ikere Gorge -Lake at Old Oyo National Park are as listed in Table 1. The checklist comprised of 45 fish species belonging to 34 genera and 17 families. Four fish species had been found during the study which have not been identified or come across by past studies. Though, these were not new to fisheries science in the ecological region. These additional fish species found were used to update the existing checklist in the Park. These species are *Parachanna obscura, Brycinus nurse, Raiamas nigeriensis,* and *Chiloglanis niger* respectively. The percentage composition of fish species caught in Ibuya Pools and Ikere Gorge – Lake are recorded in Tables 2 and 3.

Table 1: Fish – species caught during the sport fishing study in Ibuya Pools and Ikere- Gorge Lake, River Ogun, at Old Oyo National Park.

S/no	Family/species	S/n	Family/species
1.	**Bagridae**	**8.**	**Cyprinidae**
	Auchenoglanis occidentalis		*Labeo cubie*
	Bagrus bayad		*L. petersii*
	Chrysichthys nigrodigitatus		*L. senegalensis*
	Clarotes laticeps		**Raiamas nigeriensis*
	Parauchenoglanis fasciatus		
		9.	**Distichodontidae**
2.	**Centropmidae**		*Distichodus rostratus*
	Lates niloticus		
		10.	**Gymnarchidae**
3.	**Channidae**		*Gymnarchus niloticus*
	**Parachanna obscura*		
		11.	**Hepsetidae**
4.	**Characidae**		*Hepsetus odoe*
	Alestes baremose		
	A. brevis	**12.**	**Malapteruridae**
	A. chapter		*Malapterurus electricus*
	A. dentex		
	A. macrocephalus	**13.**	**Mochokidae**
	**Brycinus nurse*		**Chiloglanis niger*
	Hydrocynus brevis		*Synodontis schall*
	H. forskalis		
	Micralestes accutidens	**14.**	**Mormyridae**
			Gnathonemus petersii
5.	**Cichlidae**		*Mormyrops deliciosus*
	Chromidotilapia guntheri		*Mormyrus rume*
	Hemichromis bimaculatus		
	H. fasciatus	**15.**	**Osteoglossidae**
	Oreochromis niloticus		*Heterotis niloticus*
	Pelmatochromis guntheri		
	Sarotherodon galilaeus	**16.**	**Schilbeidae**
	Tilapia mariae		*Eutropius niloticus*
	T. zilli		
		17.	**Tetraodontidae**
6.	**Citharinidae**		**Tetraodon fahaka*
	Citharinus citharus		
7.	**Clariidae**		
	Clarias angullaris		
	C. gariepinus		
	Heterobranchus bidorsalis		
	H. longifilis		

***** Additional fish **s**pecies that have not been recorded by past studies.

Table 2: Percentage composition of fish species obtained during the sport fishing study in Ibuya Pools.

Families / Species	Total Number	Total Weight	Percentage (%)	*Slack *et al*–classification
Bagridae				
Auchenoglanis occidentalis	85	0.30	3.56	A
Bagrus bayad	80	0.68	3.36	A
Chrysichthys nigrodigitatus	12	0.08	0.50	A
Clarotes laticeps	99	1.56	4.14	A
Parauchenoglanis fasciatus	1	0.01	0.04	VR
Total	277	2.63	11.59	
Centropmidae				
Lates niloticus	93	4.19	3.89	A
Total	93	4.19	3.89	
Channidae				
Parachanna obscura	9	0.08	0.38	A
Total	9	0.08	0.38	
Characidae				
Alestes baremose	271	1.36	11.33	A
A. brevis	72	0.16	3.01	A
A. chapter	37	0.05	1.55	A
A. dentex	160	0.38	6.69	A
A. macrocephalus	37	0.07	1.55	A
Brycinus nurse	13	0.10	0.54	A
Hydrocynus brevis	57	0.34	2.38	A
H. forskahlis	106	1.38	4.43	A
Micralestes accutidens	66	0.11	2.76	A
Total	819	3.95	35.25	
Cichlidae				
Chromidotilapia guntheri	53	0.08	2.22	A
Hemichromis bimaculatus	29	0.24	1.21	A
H. fasciatus	21	0.04	0.88	A
Oreochromis niloticus	33	0.99	1.38	A
Pelmatochromis guntheri	32	0.03	1.34	A
Sarotherodon galilaeus	38	0.61	1.59	A
Tilapia mariae	19	0.03	0.79	A
T. zillii	72	0.06	3.01	A
Total	297	2.08	12.42	
Citharinidae				
Citharinus citharus	7	0.07	0.29	A
Total	7	0.07	0.29	
Clariidae				
Clarias anguillaris	108	2.38	4.52	A
C. gariepinus	152	4.26	6.36	A
Heterobranchus bidorsalis	59	1.06	2.47	A
H. longifilis	52	1.61	2.17	A
Total	371	9.31	15.52	
Cyprinidae				
Labeo cubie	17	0.09	0.71	A
L. petersii	12	0.05	0.50	A
L. senegalensis	8	0.04	0.33	A
Raiamas nigeriensis	2	0.003	0.08	VR
Total	39	0.18	1.63	
Distichodontidae				
Distichodus rostratus	1	0.12	0.04	VR
Total	1	0.12	0.04	
Gymnarchidae				
Gymnarchus niloticus	21	0.50	0.88	A
Total	21	0.50	0.88	
Hepsetidae				
Hepsetus odoe	120	2.28	5.02	A
Total	120	2.28	5.02	
Malapteruridae				
Malapterurus electricus	124	0.25	5.19	A
Total	124	0.25	5.19	
Mochokidae				
Chiloglanis niger	22	2.29	0.92	A
Synodontis schall	15	0.04	0.63	A
Total	37	2.33	1.55	
Mormyridae				
Gnathonemus petersii	116	0.29	4.85	A
Mormyrops deliciosus	9	0.13	0.38	A
Mormyrus rume	16	0.28	0.67	A
Total	141	0.70	5.90	
Osteoglossidae				
Heterotis niloticus	13	0.11	0.54	A
Total	13	0.11	0.54	
Schilbeidae				
Eutropius niloticus	9	0.02	0.38	A

Total	9	0.02	0.38	
Tetraodontidae				
Tetraodon fahaka	13	0.05	0.54	A
Total	13	0.05	0.54	
Grand Total	2,391	28.84	100.00	

≥ 5 = Abundance	≥ 3 ≤ 4	= Rare	≥1 ≤ 2	= Very Rare	0 < 1	= Very-Very Rare
A = Abundance	R	= Rare	VR	= Very Rare	VVR	= Very-Very Rare

* Slack *et al*. (1992).

Table 3: Percentage composition of fish species obtained during the sport fishing study in Ikere Gorge – Lake

Families / Species	Total Number	Total Weight (Kg)	Percentage (%)	*Slack *et al*–classification
Bagridae				
Auchenoglanis occidentalis	40	0.12	6.76	A
Bagrus bayad	23	0.15	3.89	A
Chrysichthys nigrodigitatus	2	0.01	0.34	R
Clarotes laticeps	42	0.56	7.09	A
Parauchenoglanis fasciatus	0	0.0	0.00	VVR
Total	107	0.84	18.07	
Centropmidae				
Lates niloticus	14	0.31	2.36	A
Total	14	0.31	2.36	
Channidae				
Parachanna obscura	0	0.00	0.00	VVR
Total	0	0.00	0.00	
Characidae				
Alestes baremose	64	0.16	10.81	A
A. brevis	31	0.05	5.25	A
A. chapter	0	0.00	0.00	VVR
A. dentex	43	0.10	7.26	A
A. macrocephalus	0	0.00	0.00	VVR
Brycinus nurse	5	0.05	0.84	A
Hydrocynus brevis	24	0.11	4.05	A
H. forskalis	16	0.09	2.70	A
Micralestes accutidens	26	0.03	4.39	A
Total	209	0.59	35.30	
Cichlidae				
Chromidotilapia guntheri	10	0.12	1.69	A
Hemichromis bimaculatus	3	0.002	0.51	R
H. fasciatu	14	0.03	2.36	A
Oreochromis niloticus	5	0.003	0.84	A
Pelmatochromis guntheri	7	0.007	1.18	A
Sarotherodon galilaeus	11	0.044	1.86	A
Tilapia mariae	7	0.023	1.18	A
T. zillii	25	0.088	4.22	A
Total	82	0.31	13.85	
Citharinidae				
Citharinus citharus	1	0.01	0.17	VR
Total	1	0.01	0.17	
Clariidae				
Clarias anguillaris	16	0.19	2.70	A
C. gariepinus	25	0.41	4.22	A
Heterobranchus bidorsalis	7	0.10	1.18	A
H. longifilis	6	0.05	1.01	A
Total	54	0.75	9.12	
Cyprinidae				
Labeo cubie	1	0.01	0.17	VR
L. petersii	0	0.00	0.00	VVR
L. senegalensis	0	0.00	0.00	VVR
Raiamas nigeriensis	0	0.00	0.00	VVR
Total	1	0.01	0.17	
Distichodontidae				
Distichodus rostratus	0	0.00	0.00	VVR
Total	0	0.00	0.00	
Gymnarchidae				
Gymnarchus niloticus	1	0.12	0.17	VR
Total	1	0.12	0.17	
Hepsetidae				
Hepsetus odoe	25	0.11	4.22	A
Total	25	0.11	4.22	
Malapteruridae				
Malapterurus electricus	38	0.7	6.41	A
Total	38	0.7	6.41	
Mochokidae				
Chiloglanis niger	8	0.01	1.35	A
Synodontis schall	0	0.00	0.00	VVR
Total	8	0.01	1.35	
Mormyridae				

Gnathonemus petersii	38		0.04		6.41	A
Mormyrops deliciosus	8		0.12		1.35	A
Mormyrus rume	6		0.08		1.01	A
Total	52		0.24		8.78	
Osteoglossidae						
Heterotis niloticus	0		0.00		0.00	VVR
Total	0		0.00		0.00	
Schilbeidae						
Eutropius niloticus	0		0.00		0.00	VVR
Total	0		0.00		0.00	
Tetraodontidae						
Tetraodon fahaka	0		0.00		0.00	VVR
Total	0		0.00		0.00	
Grand Total	592		4.00		100.00	

≥ 5 = Abundance	≥ 3 ≤ 4	= Rare	≥1 ≤ 2	= Very Rare	0 < 1	= Very Very Rare
A = Abundance	R	= Rare	VR	= Very Rare	VVR	= Very Very Rare

*****Slack *et al.* (1992).

Diversity indices of fish species in the study sites

The Diversity Indices or Species Abundance Relation Test of fish species carried out in the study is shown in Table 4. The Shannon diversity index for Ibuya Pools was 3.40 while Ikere Gorge – Lake had 3.20; Margalef value was 7.20 in Ibuya Pools and Ikere Gorge – Lake had 6.22. The species evenness was higher in Ibuya Pools (0.48) than in Ikere Gorge – Lake (0.55), while Simpson's Dominance of fish species was 0.94 for both study areas.

The T – test analysis of the diversity of fish species in the two study areas is presented in Table 5. The result showed that the diversity of fishes in Ibuya Pools was significantly higher (t – test = 0.0001): that is 99.99 per cent higher than in Ikere Gorge – Lake. However, the Kolmogorov – Smimov test revealed that there was significant difference (p≤ 0.05) in the diversity of fishes in the two areas.

Table 4: Diversity Indices or Species Abundance test of fish species in Ibuya Pools and Ikere Gorge-Lake.

	Ibuya	Lower	Upper	Ikere Gorge - Lake	Lower	Upper
Taxa_S	62.00	62.00	62.00	45.00	45.00	45.00
Individuals	4782.00	4782.00	4782.00	1184.00	1184.00	1184.00
Dominance_D	0.06	0.05	0.06	0.06	0.06	0.07
Simpson_1-D	0.94	0.94	0.95	0.94	0.93	0.94
Shannon_H	3.40	3.36	3.43	3.20	3.14	3.25
Evenness_e^H/S	0.48	0.47	0.50	0.55	0.51	0.57
Brillouin	3.37	3.33	3.39	3.12	3.06	3.17
Menhinick	0.90	0.90	0.90	1.31	1.31	1.31
Margalef	7.20	7.20	7.20	6.22	6.22	6.22

Table 5: T-test Analysis of fish diversity in the two study sites.

Tests for equal means

IBUYA	IKERE GORGE		
N:	62	N:	62
Mean:	77.129	Mean:	19.097
95% conf.:	(45.86 108.4)	95% conf.:	(10.772 27.421)
Variance:	15161	Variance:	1074.5
Difference between means:	58.032		
95% conf. interval (parametric):	(25.998 90.066)		
95% conf. interval (bootstrap):	(23.887 85.79)		
t :	3.5862	p (same mean):	0.00048367
Uneq. var. t :	3.5862	p (same mean):	0.00061895
Monte Carlo permutation:	p (same mean):	**0.0001**	

P<0.05

The comparison of the total number of fish catch in kilograms at Ibuya Pools n = 2,391 (28.84kg) forming 87.82 per cent and Ikere Gorge – Lake n = 592 (4.00kg) forming 12.18 per cent is presented in Figure 3.

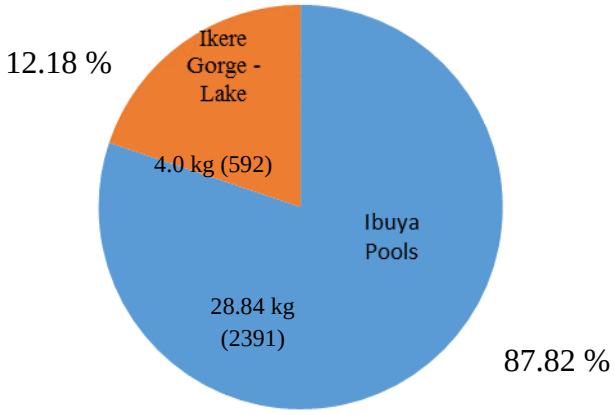

Figure 3: Comparison of the total number of fish – catch in (Kg) at Ibuya Pools and Ikere Gorge – Lake.

The comparison of the summary of the total number of fishes caught by the natural (n = 1342: 56.13%), artificial (n = 1049: 43.87%) baits in Ibuya Pools and natural (n = 326: 55.07%), artificial (n = 266: 44.93%) baits in Ikere Gorge – Lake are presented in Figures 4 and 5 respectively.

The physico – chemical conditions at the two study areas were within the tolerable ranges 27.10 – 28.90°C, mean 28°C for Temperature (t°); 6.50 -6.90mg/lit., mean 6.70mg/lit. for Dissolved Oxygen (DO); 363 – 388ppm, mean 375.50ppm for Total Dissolved Solids (TDS) and 6.6 – 7.5, mean 7.05 for Hydrogen – ions concentration (pH).

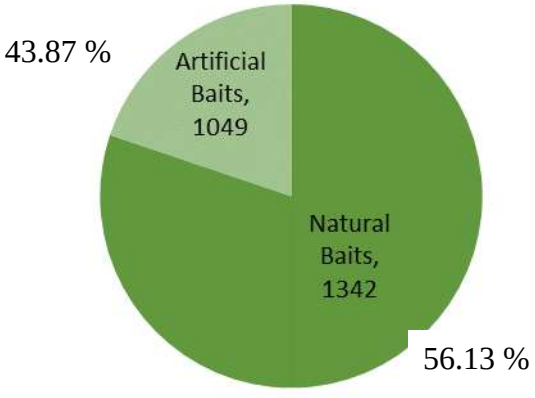

Figure 4: Comparison of the summary of the total number of fish caught by the natural and artificial baits during this study in Ibuya Pools.

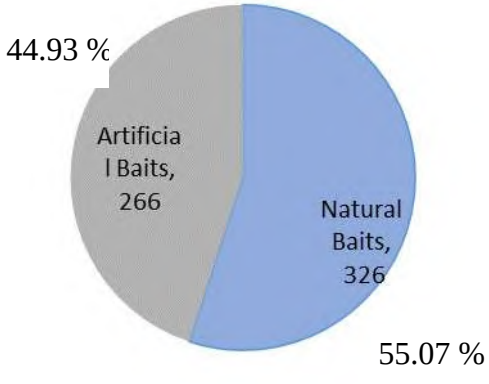

Figure 5: Comparison of the summary of the total number of fish caught by natural and artificial baits during this study in Ikere Gorge - Lake.

Features of some selected specimen obtained during the study are presented in Tables 6 and 7.

While the efficiency of catch – per – unit effort of natural baits and artificial baits in the two study areas are shown in Tables 8 and 9.

Table 6: Meristic features of some selected fish caught during the sport fishing study in Ibuya Pools and Ikere Gorge - Lake.

Families / Species	No of Fishes	D Fin	A Fin	C Fin	P Fin	V Fin
Bagridae						
Auchenoglanis occidentalis	10	i(6)	(12)	i(1)	iii(3)	i(3)
Bagrus bayad	10	ix(8)	(12)	(32)	i(16)	(14)
Chrysichthys nigrodigitatus	10	i(9)	(14)	i(19)	i(7)	(4)
Clarotes laticeps	10	i(2)	i(8)	(18)	iv(4)	ii(7)
Parauchenoglanis fasciatus	1	ii(2)	(6)	ii(12)	iii(3)	(6)
Centropmidae						
Lates niloticus	10	v(36)	i(24)	(32)	(28)	i(14)
Channidae						
Parachanna obscura	9	xiv(14)	(8)	(18)	(6)	(4)
Characidae						
Alestes baremose	10	i(18)	i(22)	(28)	(12)	(6)
A. brevis	10	i(12)	iii(8)	(24)	(6)	(4)
A. chapter	10	i(14)	(16)	(30)	(7)	(4)
*A. dentex**	10	i(16)	i(17)	(19)	(8)	(6)
A. macrocephalus	10	i(15)	i(18)	(28)	(7)	(6)
Brycinus nurse	10	i(10)	i(8)	(18)	(8)	(5)
Hydrocynus brevis	10	i(14)	i(10)	ii(24)	(6)	(4)
H. forskahlis	10	i(12)	i(8)	ii(26)	(6)	(6)
Micralestes accutidens	10	i(8)	i(6)	(16)	(6)	(4)
Cichlidae						
Chromidotilapia guntheri	10	xvi(14)	ii(9)	(26)	(10)	i(8)
Hemichromis bimaculatus	10	xiv(12)	i(8)	(24)	(9)	i(6)
H. fasciatus	10	xiii(10)	i(6)	(22)	(8)	i(5)
*Oreochromis niloticus**	10	xvii(14)	iii(10)	(27)	(10)	i(8)
Pelmatochromis guntheri	10	xiv(10)	i(6)	(18)	(8)	i(6)
Sarotherodon galilaeus	10	xvi(12)	ii(6)	(26)	(9)	i(7)
Tilapia mariae	10	xv(11)	ii(6)	(24)	(8)	i(6)
T. zillii	10	xiv(10)	iii(6)	(22)	(8)	i(5)
Citharinidae						
*Citharinus citharus**	7	i(26)	i(26)	ii(29)	i(14)	i(12)
Clariidae						
Clarias angullaris	10	(82)	(38)	(14)	(8)	(7)
*C. gariepinus**	10	(75)	(32)	(10)	(6)	(5)
Heterobranchus bidorsalis	10	(56)	(24)	(8)	i(6)	(5)
H. longifilis	10	(64)	(34)	(12)	v(8)	(6)
Cyprinidae						
Labeo cubie	10	i(30)	i(19)	(32)	(9)	(12)
L. petersii	10	i(24)	i(16)	(28)	(8)	(10)
L. senegalensis	8	i(28)	i(18)	(34)	(12)	(10)
Raiamas nigeriensis	2	i(16)	i(10)	(26)	(8)	(6)
Distichodontidae						
Distichodusro stratus	1	iii(8)	(8)	(34)	(10)	(8)
Gymnarchidae						

Gymnarchus niloticus	10	(164)	(32)	(0)	(8)	(6)
Hepsetidae						
Hepsetus odoe	10	i(8)	i(16)	(28)	(10)	(8)
Malapteruridae						
Malapterurus electricus	10	(0)	i(12)	(26)	(8)	(6)
Mochokidae						
Chiloglanis niger	10	i(6)	ii(6)	i(16)	i(5)	(7)
Synodontis schall	10	v(5)	(0)	(24)	ii(0)	(4)
Mormyridae						
Gnathonemus petersii	*10*	*xvi(14)*	*i(10)*	*(22)*	*(12)*	*(10)*
Mormyrops deliciosus	*9*	*(166)*	*(18)*	*(26)*	*(14)*	*(8)*
Mormyrus rume	*10*	*(42)*	*(18)*	*(28)*	*(9)*	*(5)*
Osteoglossidae						
Heterotis niloticus	10	(62)	(84)	(26)	(12)	(8)
Schilbeidae						
*Eutropius niloticus**	9	i(6)	i(28)	i(26)	i(12)	i(8)
Tetraodontidae						
Tetraodon fahaka	10	(14)	(6)	(22)	(14)	(10)

Roman Figures represent numbers of Spines. Numerals represent numbers of Rays. D Fin = Dorsal Fin; A Fin = Anal Fin; C Fin = Caudal Fin; P Fin =Pectoral Fin; & V Fin = Ventral Fin. *Species that had differences in spines and rays counts during the laboratory studies.

Table 7: Morphometric features of some selected fish caught during the sport fishing study in Ibuya Pools and Ikere Gorge - Lake.

Families / Species	No of Fishes	TL	SL	HL	BL	BG
Bagridae						
Auchenoglanis occidentalis	10	180	150	60	90	70
Bagrus bayad	10	240	200	50	190	100
Chrysichthys nigrodigitatus	10	225	205	70	140	90
Clarotes laticeps	10	250	200	50	195	95
Parauchenoglanis fasciatus	1	250	220	60	230	80
Centropmidae						
Lates niloticus	10	220	200	70	150	130
Channidae						
Parachanna obscura	9	230	195	45	185	60
Characidae						
Alestes baremose	10	235	200	50	90	70
A. brevis	10	140	120	40	80	50
A. chapter	10	130	110	40	70	45
A. dentex	10	248	222	60	80	70
A. macrocephalus	10	300	240	50	70	60
Brycinus nurse	10	150	130	40	60	50
Hydrocynus brevis	10	220	150	60	140	100
H. forskahlis	10	210	175	50	160	90
Micralestes accutidens	10	92	80	25	60	40
Cichlidae						
Chromidotilapia guntheri	10	185	163	40	90	40
Hemichromis bimaculatus	10	200	170	40	80	45
H. fasciatus	10	120	105	40	60	30
Oreochromis niloticus	10	196	171	30	100	40
Pelmatochromis guntheri	10	85	70	40	50	40
Sarotherodon galilaeus	10	205	185	45	95	40
Tilapia mariae	10	170	145	40	80	40
T. zillii	10	220	180	45	90	45
Citharinidae						
Citharinus citharus	7	199	156	70	100	90
Clariidae						
Clarias angullaris	10	230	215	65	80	120
C. gariepinus	10	220	195	62	62	130
Heterobranchus bidorsalis	10	193	175	60	120	90
H. longifilis	10	230	210	60	130	120

Cyprinidae						
Labeo cubie	10	210	190	80	80	70
L. petersii	10	205	173	40	100	90
L. seneqalensis	8	190	170	40	120	100
Raiamas nigeriensis	2	140	110	45	80	50
Distichodontidae						
Distichodus rostratus	1	180	145	40	140	100
Gymnarchidae						
Gymnarchus niloticus	10	360	310	60	305	110
Hepsetidae						
Hepsetus odoe	10	237	178	50	182	120
Malapteruridae						
Malapterurus electricus	10	235	200	50	160	140
Mochokidae						
Chiloglanis niger	10	146	127	80	110	100
Synodontis schall	10	210	155	45	135	90
Mormyridae						
Gnathonemus petersii	10	139	110	40	90	60
Mormyrops deliciosus	9	340	290	60	180	80
Mormyrus rume	10	240	190	70	140	80
Osteoglossidae						
Heterotis niloticus	10	230	220	60	150	
Schilbeidae						
Eutropius niloticus	9	148	127	60	80	90
Tetraodontidae						
Tetraodon fahaka	10	180	150	40	100	90

All measurements are in millimeters (mm): TL = Total Length; SL = Standard Length; HL = Head Length; BL = Body Length; & BG = Body Girth.

Table 8: Efficiency of natural and artificial baits in the catch – per – unit effort of fish in the study in Ibuya Pools.

	IBUYA POOLS				
Baits	Total Time Set	Total Fish Catch	Frequency of Fish Catch	No. of Fish Catch/20mins.	Total Sampling Occasion
Natural Earthworm (A^1)	920	609	0.66	13.2	46
Artificial Earthworm (A^2)	920	441	0.45	9.0	46
Natural Snail (B^1)	920	110	0.12	2.4	46
Artificial Snail (B^2)	920	89	0.10	2.0	46
Natural Fish (C^1)	920	208	0.23	4.6	46
Artificial Fish (C^2)	920	180	0.20	4.0	46
Natural Frog (D^1)	920	113	0.12	2.4	46
Artificial Frog (D^2)	920	92	0.10	2.0	46
Natural Maggot (E^1)	920	302	0.35	7.0	46
Artificial Maggot (E^2)	920	247	0.27	5.4	46

Table 9: Efficiency of natural and artificial baits in the catch – per – unit effort of fish in the study in Ikere Gorge – Lake

IKERE GORGE – DAM					
Baits	Total Time Set	Total Fish Catch	Frequency of Fish Catch	No. of Fish Catch/20mins.	Total Sampling Occasion
Natural Earthworm (A^1)	920	125	0.14	2.8	46
Artificial Earthworm (A^2)	920	111	0.12	2.4	46
Natural Snail (B^1)	920	36	0.04	0.8	46
Artificial Snail (B^2)	920	24	0.03	0.6	46
Natural Fish (C^1)	920	41	0.04	0.8	46
Artificial Fish (C^2)	920	36	0.04	0.8	46
Natural Frog (D^1)	920	34	0.04	0.8	46
Artificial Frog (D^2)	920	23	0.03	0.6	46
Natural Maggot (E^1)	920	90	0.10	2.0	46
Artificial Maggot (E^2)	920[	72	0.10	2.0	46

DISCUSSION

This study was conducted to determine the species composition, abundance and diversity; and as well compare the sport fishing catches between the Ibuya Pools and Ikere Gorge –Lake at Old Oyo National Park. The significantly higher fish diversity of fishes obtained in Ibuya Pools over Ikere Gorge – Lake could be explained as a result of Ibuya Pools enjoys maximum protection under conservation area and relatively undisturbed ecosystem compared to Ikere Gorge – Lake which is at the buffer zone of the Park and is opened to severe exploitations by licensed commercial fishermen authorized by the Ogun – Osun River Basin Authority, Water Resources and Rural Development. These observations made on the two study sites were similar to that recorded by Ayodele and Ojo (1998) and Olorunpomi (2015). Fish caught such as high classed fishes like the Elephant Pike fish (*Lates niloticus*), African bonytongue fish (*Heterotis niloticus*), Mudfish (*Clarias angullaris*), Catfish (*Heterobranchus bidorsalis*), Electric fish (*Malapterurus electricus*), Grasscarp fish (*Distichodus rustratus*), mentioned just a few, obtained during the sport fishing operations in Ibuya Pools suggested that the site is very rich in fisheries resources and therefore will be viable for the development of sport fishing for ecotourism in Old Oyo National Park. This result was similar to the observations made by Olorunpomi (2015). The overall 45 species of fishes obtained during the study at both study sites demonstrated fish diversity and richness of aquatic fisheries resources most especially in Ibuya Pools of the Park because of the effectiveness of conservation efforts. This result obtained in Ibuya Pools was similar to the findings of Marta *et al.* (2001) in Portugal, in their works on Guardiana River Basin which enjoys maximum protection and the site is being utilized for human recreational activities. This is a welcome development and a good attribute for the effective take off of sport fishing that will take care of the curiosities of fish anglers' tourists who may plan their vacation's visit to the Old Oyo National Park. The efficiencies of natural baits performed better than the artificial baits in the study. This suggested that fish species in aquatic environment preferred natural baits, perhaps due to their natural perceived odors either death or alive. This finding in the study was in agreement with the observations made by Marta *et al*. (2001) and Olorunpomi (2015). Though further laboratory studies were carried out on the examinations of the meristic and morphometric features of some selected sample specimens to properly classify them into their binomial nomenclatures, the results recorded in the study was in consonant with the guidelines keys laid down by FAO (1990), FAO (1995a), and FAO (1995b) respectively.

Although low catches of fish species observed in Ikere Gorge – Lake which may not support active sport fishing, suggests other usefulness of the destination to water sports and recreational activities. The expanse of the water fill will provide for tourist leisure's and comforts in Old Oyo National Park. Such additional recreational

activities may include boating/Lake Cruise, safari and regalia. The operators' business may include renting of boats/outboard engines for Lake Cruise, selling of games, toys, sport fishing equipment, rods, reels, hooks, baits and other related materials that the holiday makers may require at the eco-tourism destination. Sport fishing is viable and should be developed and encouraged in Ibuya Pools of the Old Oyo National Park. Where undersized fishes are caught, and they are not severely wounded to cause threat to their lives, the sport fishing anglers should be encouraged to release them back to the wild (Ibuya Pools).

CONCLUSION

Findings from the present study indicated low fish catch in the Ikere Gorge – Lake. This informed that the activity of sport fishing may not be viable in the water body. The results in the Ibuya Pools proved otherwise. This therefore demonstrated clearly that sport fishing is viable in that site of the Park. The development and management of sport fishing like stocking and restocking practices can now be embarked upon by the management of the Old Oyo National Park. Subsequently, this may be opened to tourists and visitors to accrue the receipts of the much-needed revenue for the Park.

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Microbial Load in the Gut of Agama Lizards and Wall Geckos

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ABSTRACT

The aim of this study was to examine the differences in the microorganisms and microbial load present in the gut of some lizards from two locations. Ten samples each of the male and female rainbow lizard (*Agama agama africana*) and wall gecko (*Hemidacty lusfrenatus*) were purchased and their morphometric parameters taken while three representative samples were tested for their microbial load and the microorganisms they carry. It was observed that the Total Viable Count (TVC) of the male (1.70Cfug^{-1}), the Total Fungal Count (TFC) of the female agama lizards (0.23Cfug^{-1}) and the Total Coliform Count (TCC) of both male and female agama lizards (0.70 Cfug^{-1} and 0.63Cfug^{-1} respectively) in Abeokuta was greater than that of Ibadan at $p \leq 0.05$ while the wall geckos showed no significant difference. This work revealed that location can be a determinant factor of the type and number of microorganisms present in the gut of lizards.

Keywords: Lizards, microbial load, microorganisms, morphometric, samples

INTRODUCTION

Reptiles are animals with back bone (vertebrates), their skin is made up of either scales or bony plates and in some of them, and it is a combination of both scales and the bony plates. Such animals include lizards, tortoises, chameleons, snakes, crocodiles, tuatara e.t.c. The tuatara is one of the known large reptiles; it looks like a lizard and commonly found on the island off the coast of New Zealand. It is the last survivor of a whole group of ancient reptiles (EMBL Reptile Database, 2003). About 6000 different kinds of reptiles are known to live in the entire world. They are of diverse sizes, shapes and habits because reptiles have gone through many changes since their ancestors lived millions of years ago. Lizards are extremely varied in form. There are long, slender snake-like racers; earthworm-like burrowers; stumpy-tailed short-bodied rock dwellers; long-tailed varieties capable of running swiftly on sand, earth and the surface of water; lumbering monsters living on land or in trees; spiny pancake-shape species; slick-skinned agile tree climbers and burrowers and still other too varied and numerous to describe (Ogundimu, 2019).

Geckos are small when compared to an average agama lizard; they are common reptiles classified to the family Gekkonidae and are mostly found in warm climates throughout the world (Keller *et al*., 2002). These small wall geckos found in houses are non-venomous and not harmful to humans, there is no record of any harmful report of geckos found on the wall of houses. There is an assumption that gecko exctreta contains bacteria that could have varied effect on the environment. When they are warm, they can be active, but when they are cold, they are sluggish or inert. They develop a horny scale cover on the surface of their skin and this helps to prevent the loss of body water. Respiration is by lung, but improved by the development of ribs into a bellows like device that expands and contracts the pleural cavity (Gordan, 1995). Geckos are

distinct among reptiles in their vocalizations, making chirping sounds in social interactions with other geckos. Many species of wall geckos have suction toe pads that enable them to climb smooth vertical and even horizontal surfaces with ease (Keller *et al*., 2002). A number of reptiles, lizards inclusive have been incriminated as the source of bacteria pathogens (Oboegbulem & Iseghohimhen, 1985). More than 1000 Salmonella serovars have been isolated from reptiles (Mitchell, 2006). Agama lizards and geckos are commonly found both in rural and urban area in Nigeria; they have been observed to have association with human in a number of ways. Agama lizards are commonly seen around farm houses and animal pens with free access around the vicinity of residential houses, animal pens, animal feeds and water sources (Ogunleye, Ajuwape, Alaka, & Adetosoye, 2013); this instigates the suspicion of this animal capable of disease transmission possibly through their faeces which may be loaded with the pathogens. The insight into the role of Agama agama lizards in disease transmission can be traced to the 1950s when Salmonella Agama was first characterized as a new serotype of Salmonella enterica from faeces of agama lizard (Agama agama) in Nigeria (Collard & Sen, 1960).

In Nigeria, particularly, just about every house has its population of geckos which are insectivorous found particularly around light sources and storage areas. This creates an opportunity for them to be vectors in disease transmission through their simple life processes of feeding and excretion as most of the food material (insects) ingested by these geckos harbour some enteric pathogens. Most often they station themselves along walls and windows sills where there is sufficient light to attract insects (Nwachukwu, Duru, Nwachukwu & Anomodu, 2014). Although they are mostlyactive at night, their presence is recognized by their faeces (Chan, Chero, Young, & Bureng, 1990). Agama lizards on the other hand are prominently seen to have close association with human especially outdoors on walls and fences and particularly around bins while wall geckos are more closely seen indoors. Lizards have been known to eliminate bacteria pathogens such as Salmonella through their digestive tract without any apparent clinical symptoms, but rather serving as potential sources of contamination as well as infections to the environment and man and animal (Shinohara *et al.,* 2008; Carvalho, Junior, Andrade & Jayme, 2013). This paper therefore aims at assessing the microbial load in the gut of the study lizards (wall gecko, male and female agama lizards) from the different locations (Ibadan and Abeokuta), occurrence of pathogens and to debunk some of the most widely held misconceptions about lizards as insignificant primary host of zoonotic diseases.

MATERIALS AND METHODS

The study was conducted in Abeokuta and Ibadan, Southwest Nigeria. Abeokuta is the capital city of Ogun State and is situated at 7°9’39”N and 3°20’54”Eon the Ogun River; 64 miles north of Lagos by railway, or 81 miles by water. Itoku market is one of the oldest markets in Abeokuta located a few distance away from the famous Olumo rock. The market is well known for the sale of adire (tie and dye) fabrics however there are other segments of the market where tradomedicinal materials are sold. Ibadan (the town at the junction of the savannah and the forest), the capital of Oyo State, is the third largest city in Nigeria by population (after Lagos and Kano), and the largest in geographical area and is situated at 7°23’47”N and 3°55’0”E. Bode market is one of the popular markets in Ibadan majorly known for the sale of both plant and animal parts for traditional medicine.

METHOD

The method of Chan *et al.,* (1990) was used. A reconnaissance survey was first made to the two markets to find out their availability but the samples were only available on request. Ten unmutilated samples of male and female rainbow lizard (*Agama agamaafricana)* and wall gecko (*Hemidactylusfrenatus*) was purchased each from Itoku market in Abeokuta and Bode market in Ibadan a day apart making 30 samples each from both locations. This number of samples was purchased for morphometric parameters and released while three representative samples each of these lizards (9 from Abeokuta and 9 from Ibadan altogether 18 samples) was taken to the laboratory at the

Institute of Agriculture, Research and Training, Moor Plantation. The samples were demobilized with chloroform, pinned down and dissected. The entire gut (from the neck region to the anal region) was severed and removed and the gut content squeezed outand mixed with some minced gut tested for their microbial load count. Smear was prepared on grease-free slides and this was then heat-fixed. The smear was stained thinly for 30secs with crystal violet and after grams iodine was flooded on the smear and this remained for 30secs. The smear was then decolourized with acetone until the purple dye no longer flows from the smear, this was washed with water and counterstained with safranin for 30secs. The smear was washed with tap water, blotted dried and then examined under oil immersion. Two results were obtained from this test and these are the Gram reaction and cell shape of each of the bacterium. The organism that retained the purple colouration was Gram positive and those that were able to take up the red colour was the Gram negative.

Plate Count Agar was used to determine total viable count, Eosin Methylene Blue Agar and MacConkey Agar was used to determine the presence of coliforms and gram negative organisms while Potato Dextrose Agar and Yeast Extract Agar was used to determine the presence of fungi and yeasts in the sample. After sterilization, the media were placed in a water bath set at 45°C to maintain the media in molten state. 1g of the sample was weighed into a test-tube containing 9mls of sterile distilled water and serially diluted to the dilution factor (10^{-6}). 1ml of the dilution factor (10^{-6}) was dispensed into labelled petri dishes. Pour plate method was used as the medium (Plate Count Agar, Eosin Methylene Blue Agar, MacConkey Agar, Potato Dextrose Agar and Yeast Extract Agar) was poured respectively into separate petri dishes as labelled and allowed to solidify. Each petri dish was duplicated. After solidifying, the plates were inverted and incubated in an incubator set at 37°C for 24 hours for the plates containing Plate Count Agar, Eosin Methylene Blue Agar and MacConkey Agar while the plates containing Potato Dextrose Agar and Yeast Extract Agar were incubated at 28°C - 30°C for 3 – 5 days. However, the yeast isolates were incubated for 24 – 48 hours. After 24 hours of incubation, the plates containing Plate Count Agar, Eosin Methylene Blue Agar, MacConkey Agar and Yeast Extract Agar were counted to estimate total viable count and total coliform count. However, plates containing 30 – 300 colonies were counted using the colony counter. The total viable count was determined using the expression:

$$\text{Total Viable Count (TVC)} = \frac{\text{Number of microbial colonies x Volume inoculated}}{\text{Dilution factor}}$$

At 72 hours of incubation, the Potato Dextrose Agar plates were also counted and recorded.

The characterization of the isolates was done based on the morphological, physiological and biochemical characteristics of the isolates.

RESULTS

Total Coliform Count (TCC) which gives the total number of bacteria present, Total Fungal Count (TFC) gives the total number of fungi present, Total Yeast Count (TYC) gives the total number of yeast present and Total Viable Count (TVC) gives the quantitative estimate of the concentration of microorganisms in the sample organism. The count represents the number of colony forming units (cfu) per gram (g) of the sample. Table 1below shows the result of the microbial load (number and type of microorganisms present and/or contaminating the sample organism) of lizards from the two locations (Ibadan and Abeokuta) and values of TVC, TCC, TFC and TYC obtained per sample. An inoculum of approximately 10^5cfu/g in sterile wet samples over 72 hours period of observation, with viable microorganisms count between $0.1x10^5$ and $1.8x10^5$.

Table 2 and 3below shows the types of microorganisms present in the samples from the two locations. A total number of 30 representative microorganism from a total of 163 was obtained from the samples analyzed out of which 22 bacteria, 6 fungi and 2 yeast isolates. Out of the 163 microorganisms obtained from all the samples in both locations, *Micrococcus luteus* (11) was the most prevalent bacteria followed by *Staphylococcus aureus*; *Streptococcus faecium* and *Escherichia coli* (10 each); *Pseudomonas aeruginosa* and *Proteus*

vulgaris (9 each); *Serriatia marcescens* and *Aerobacter aerogenes* (7 each); *Bacillus cereus*, *Bacillus subtilis* and *Streptococcus bovis* (6 each); *Pseudomonas fluorenscens* and *Pseudomonas putida* (5 each); *Micrococcus acidophilus*, *Proteus morganii* and *Staphylococcus pneumonia* (4 each); *Bacillus macerans* and *Pseudomonas putida* (3 each); *Pseudomonas fragi* (2) and *Staphylococcus faecium*, *Klebsiella aerogenes*, *Micrococcus mecerans* and *Streptococcus mutans*(1 each). *Aspergillusterreus* (9) was the most prevalent fungi followed by *Aspergillusniger* (5); *Fusarium compactum* (4); *Aspergillus fumigatus* (3) and *Penicilliumchrysogenum* and *Fusarium oxysporum* (1 each). *Saccharomyces cerevisiae* (10) was the most prevalent yeast followed by *Saccharomyces elegans* (6). Samples from Abeokuta had the highest number of microorganisms (94) in comparison with those from Ibadan (69). The total number of bacteria, fungi and yeast from Ibadan was 50, 10 and 9 respectively while the total number of bacteria, fungi and yeast from Abeokuta was 72, 15 and 7 respectively. Four (4) bacteria (*Staphylococcusfaecium, Staphylococcus pneumonia, Klebsiella aerogenes, Micrococcus mecerans, Streptococcus mutans*) and 2 fungi (*Penicilliumchrysogenum, Fusarium oxysporum*) found in Lizards of Abeokuta was absent in those of Ibadan.

Table 1: Result of Microbial load

Sample code	**Abeokuta location**				**Ibadan location**			
	TVC	TCC cfug-1	TFC	TYC	TVC	TCC cfug-1	TFC	TYC
Agama lizard 1	$1.6x10^5$	$0.8x10^5$	$0.3x10^5$	$0.6x10^5$	$1.0x10^5$	$0.4x10^5$	$0.2x10^5$	$0.5x10^5$
Female lizard 1	$1.8x10^5$	$0.5x10^5$	$0.2x10^5$	$0.5x10^5$	$1.4x10^5$	$0.3x10^5$	NIL	$0.3x10^5$
Wall gecko 1	$0.8x10^5$	$0.4x10^5$	$0.1x10^5$	$0.3x10^5$	$0.6x10^5$	$0.2x10^5$	$0.1x10^5$	$0.4x10^5$
Agama lizard 2	$1.8x10^5$	$0.6x10^5$	$0.5x10^5$	$0.4x10^5$	$1.3x10^5$	$0.4x10^5$	$0.3x10^5$	$0.4x10^5$
Female lizard 2	$1.4x10^5$	$0.7x10^5$	$0.2x10^5$	$0.5x10^5$	$1.1x10^5$	$0.5x10^5$	NIL	$0.3x10^5$
Wall gecko 2	$0.7x10^5$	$0.6x10^5$	$0.2x10^5$	$0.5x10^5$	$0.4x10^5$	$0.3x10^5$	$0.2x10^5$	$0.4x10^5$
Agama lizard 3	$1.7x10^5$	$0.7x10^5$	$0.6x10^5$	$0.6x10^5$	$1.2x10^5$	$0.3x10^5$	$0.1x10^5$	$0.3x10^5$
Female lizard 3	$1.4x10^5$	$0.7x10^5$	$0.3x10^5$	$0.5x10^5$	$1.5x10^5$	$0.3x10^5$	$0.1x10^5$	$0.5x10^5$
Wall gecko 3	$0.6x10^5$	$0.4x10^5$	$0.2x10^5$	$0.6x10^5$	$0.6x10^5$	$0.2x10^5$	$0.3x10^5$	$0.4x10^5$

KEY: TVC= Total Viable Count, TCC= Total Coliform Count, TFC= Total Fungal Count, TYC= Total Yeast Count, $cfug^{-1}$=Colony forming unit per gram

Table 4, 5 and 6 below shows the results of the comparison of the microbial load by species, sex and locations. Table 4 shows that the Total Coliform Count (TCC) was significantly higher in lizards collected from Abeokuta (0.63×10^5) than the count for female lizards collected from Ibadan (0.37×10^5). The Total Fungal Count (TFC) of 0.23×10^5 was significantly higher than that for female lizards in Ibadan. However, there was no significant difference in the Total Viable Count (TVC) and Total Yeast Count (TYC) found in female lizards collected from Ibadan and Abeokuta. Similarly, Table 5 shows that TVC and TCC was significantly

higher for Agama lizards collected in Abeokuta (1.70 x 10^5 and 0.70 x 10^5) than the respective counts in Agama lizards collected in Ibadan with counts of 1.17 x $10^5$and 0.37 x 10^5 respectively. Table 6 however shows that there was no significant difference in the TVC, TCC, TFC and TYC counts between wall gecko collected in Ibadan and Abeokuta respectively. This study further illustrates that there is no significant difference in the microbial load between wall geckos collected from Ibadan and Abeokuta; the study however established the influence of location in the TVC, TCC and TFC between the in Ibadan.

study lizards with those in Abeokuta having higher loads of the microbes than those in Ibadan. The TCC and TFC values for female lizards in Abeokuta (0.63 x 10^5 and 0.23 x 10^5) was significantly higher than their respective values of 0.37 x 10^5 and 0.03 x 10^5 for TCC and TFC respectively in female lizards in Ibadan. In the same vein TVC and TCC load for agama lizard in Abeokuta (1.70 x 10^5 and 0.70 x 10^5) was significantly higher than the TVC and TCC values of 1.17 x 10^5 and 0.37 x 10^5 respectively for agama lizards.

Table 2: Micro-organisms identified in lizards for Abeokuta location

Sample code	**Micro-organisms isolated**
Agama lizard 1	*Staphylococcus aureus, Micrococcus luteus, Serriatia marcescens, Proteus vulgaris, Bacillus cereus, Pseudomonas fluorenscens, Pseudomonas aeruginosa, Staphylococcus faecium, Escherichia coli, Aspergillus fumigates, Fusarium compactum.*
Female lizard 1	*Micrococcus luteus, Proteus morganii, Staphylococcus aureus, Pseudomonas putida, Bacillus subtilis, Staphylococcus pneumonia, Klebsiella aerogenes, Saccharomyces cerevisiae, Proteus vulgaris, Serriatia marcescens, Escherichia coli.*
Wall gecko 1	*Staphylococcus pneumonia, Staphylococcus aureus, Escherichia coli, Micrococcus mecerans, Pseudomonas putida, Micrococcus acidophilus, Bacillus subtilis, Pseudomonas aeruginosa, Aerobacter aerogenes, Saccharomyces elegans, Aspergillusterreus, Penicilliumchrysogenum.*
Agama lizard 2	*Staphylococcus aureus, Micrococcus luteus, Proteus vulgaris, Pseudomonas aeruginosa, Pseudomonas putida, Streptococcus bovis, Streptococcus faecium, Escherichia coli, Bacillus cereus, Aspergillusniger, Fusarium oxysporum.*
Female lizard 2	*Micrococcus acidophilus, Proteus morganii, Bacillus macerans, Streptococcus faecium, Escherichia coli, Saccharomyces cerevisiae, Aspergillusniger, Fusarium oxysporum.*
Wall gecko 2	*Streptococcus bovis, Pseudomonas fluorenscens, Bacillus cereus, Staphylococcus aureus, Micrococcus luteus, Escherichia coli, Aerobacter aerogenes, Streptococcus faecium, Pseudomonas putida, Serriatia marcescens, Saccharomyces elegans, Aspergillusterreus.*
Agama lizard 3	*Staphylococcus aureus, Streptococcus mutans, Pseudomonas aeruginosa, Streptococcus faecium, Aspergillusniger, Saccharomyces cerevisiae, Fusarium compactum.*
Female lizard 3	*Pseudomonas fluorenscens, Micrococcus luteus, Proteus vulgaris, Bacillus mecerans, Aerobacter aerogenes, Staphylococcus pneumonia, Streptococcus faecium, Aspergillusniger, Serriatia marcescens, Saccharomyces cerevisiae, Aspergillusterreus.*
Wall gecko 3	*Staphylococcus pneumonia, Streptococcus bovis, Staphylococcus aureus, Pseudomonas fragi, Serriatia marcescens, Micrococcus luteus, Aerobacter aerogenes, Escherichia coli, Saccharomyces elegans, Aspergillusterreus, Penicilliumchrysogenum.*

Table 3: Micro-organisms Identified in Lizards for Ibadan location

Sample code	**Micro-organisms isolated**
Agama lizard 1	*Bacillus cereus, Micrococcus acidophilus, Serriatia marcescens, Pseudomonas putida, Pseudomonas aeruginosa, Aerobacter aerogenes, Aspergillus fumigatus, Saccharomyces cerevisiae.*
Female lizard 1	*Pseudomonas fluorenscens, Staphylococcus aureus, Proteus vulgaris, Bacillus subtilis, Streptococcus faecium, Saccharomyces cerevisiae.*
Wall gecko 1	*Bacillus subtilis, Micrococcus luteus, Proteus vulgaris, Escherichia coli, Serriatia marcescens, Streptococcus bovis, Aspergillusterreus, Saccharomyces elegans.*
Agama lizard 2	*Bacillus cereus, Micrococcus acidophilus, Pseudomonas aeruginosa, Proteus morganii, Streptococcus faecium, Saccharomyces cerevisiae, Aspergillusniger, Aspergillus fumigatus.*
Female lizard 2	*Pseudomonas aeruginosa, Pseudomonas fluorenscens, Proteus vulgaris, Bacillus subtilis, Streptococcus faecium, Saccharomyces cerevisiae.*
Wall gecko 2	*Bacillus macerans, Micrococcus luteus, Proteus vulgaris, Escherichia coli, Pseudomonas fragi, Streptococcus bovis, Aspergillusterreus, Fusarium compactum, Saccharomyces elegans.*
Agama lizard 3	*Bacillus cereus, Micrococcus luteus, Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus faecium, Aspergillusterreus, Saccharomyces cerevisiae.*
Female lizard 3	*Pseudomonas aeruginosa, Micrococcus luteus, Proteus vulgaris, Bacillus subtilis, Aerobacter aerogenes, Streptococcus faecium, Aspergillusterreus, Saccharomyces cerevisiae.*
Wall gecko 3	*Micrococcus luteus, Staphylococcus aureus, Proteus morganii, Escherichia coli, Streptococcus bovis, Aerobacter aerogenes, Aspergillusterreus, Fusarium compactum, Saccharomyces elegans.*

Table 4: Comparison of microbial load in Female agama lizard by location

Parameter	N	**Abeokuta**	**Ibadan**	T-Value	Sig P	Remark
TVC	3	1.53	1.33	1.11	0.33	N.S
TCC	3	0.63	0.37	2.83	0.05**	S
TFC	3	0.23	0.03	4.24	0.01*	S
TYC	3	0.50	0.37	2.00	0.18	N.S

* Significant at (P≤0.01), ** Significant at (P≤0.05)
NS = Not Significant, S = Significant

Table 5: Comparison of microbial load in Male agama lizard by location

Parameter	N	**Abeokuta**	**Ibadan**	T-Value	Sig P	Remark
TVC	3	1.70	1.17	5.06	0.01*	S
TCC	3	0.70	0.37	5.00	0.01*	S
TFC	3	0.47	0.20	2.53	0.08	N.S
TYC	3	0.53	0.33	1.45	0.24	N.S

* Significant at (P≤0.01), ** Significant at (P≤0.05)
NS = Not Significant, S = Significant

Table 6: Comparison of microbial load in Wall gecko by location

Parameter	N	**Abeokuta**	**Ibadan**	T-Value	Sig P	Remark
TVC	3	0.70	0.53	1.89	0.13	N.S
TCC	3	0.47	0.23	3.13	0.53	N.S
TFC	3	0.17	0.17	0.00	1.00	N.S
TYC	3	0.47	0.04	0.76	0.53	N.S

* Significant at (P≤0.01), ** Significant at (P≤0.05)
NS = Not Significant, S = Significant

DISCUSSION

The focus of this study is to identify the role lizards play as possible carriers of zoonotic diseases. Studies on the microbial load and microorganisms present in the gut of lizards has shown that they are reservoirs of harmful pathogenic bacteria which mostly depend on their environment and/or location as well as their feeding habit. From the result of this study, *Micrococcus luteus*, *Staphylococcus aureus*, *Streptococcus faecium*, *Escherichia coli*, *Pseudomonas aeruginosa, Proteus vulgaris*, *Serriatia marcescens* and *Aerobacter aerogenes*were the most prevalent bacteria found in their gut which are capable of causing serious infections in humans depending on the level of exposure. However, transmission of these bacteria is most likely to occur through contact with water and foodstuffs as these lizards are known to frequent barns and storage areas in a bid to get their own food. Abeokuta had the highest number of bacteria and fungi isolates while Ibadan had higher yeast isolates. This result is in line with the findings of Singh *et al. (*2013) which stated that the environment (location) of Lizards is a determinant factor of the type of microorganism present. The isolation of the bacteria organisms from the study by Ajayi, Ogunleye, Happi and Okunlade (2015) confirmed the epidemiologic importance of possible disease transmission from lizards to poultry and possibly to humans, especially due to free access of these Agama agama lizards to the poultry houses, as well as their sources of food and water. Singh *et al.* (2013) also reported that it is widely accepted that potentially enteropathogenic and zoonotically important bacteria may be present in the intestine of geckos (common house lizards), and thus the gecko has been seen as potential threat in the spread of enteric diseases. He further stated that not all intestinal bacteria present in these lizards are excreted in their faeces. The bacterial population in gecko droppings may vary significantly under different environments as droppings collected from geckos living at different places had significant difference in bacterial population of droppings. However, it is important to note that most of the organisms obtained from this study are of the family Enterobacteriaceae. This group of organisms consists majorly of gram negative organisms that produce endotoxins. These toxins reside in the cell wall of the organisms. When ingested and the toxins released into the bloodstream, it causes serious health risk if proper treatment is not done.

CONCLUSION

The microorganisms and microbial load found in the gut of the study lizards varied depending on their location even though the differences were not significant. This may be due to the fact that lizards were not readily available at both markets as at when needed. The lizards were collected upon completion of the adequate number required for the study. The ecological role of these lizards in insect and pest control cannot be overemphasized, as it can be described as a symbiotic relationship; on one hand beneficial and on the other harmful. However, these relationships are essential to many organisms and the ecosystem at large, providing balance that can only be achieved by such interactions. Proper storage of food items should be done to avoid these lizards coming in contact with them, especially in the process of

drying, when going about their normal feeding habit. Further research is required to expound bacteria of public health concern that are present on the tongue and in the faeces of lizards which are the major food/water contaminants and precautionary measures to take so as not to hinder them from performing their ecological roles and creating imbalance in the ecosystem.

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