CLIMATE CHANGE, FOOD SECURITY, NATIONAL SECURITY and ENVIRONMENTAL RESOURCES

GLOBAL ISSUES & LOCAL PERSPECTIVES

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Preface

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It is eschews pedantry and lays bars the issues in such clarity that conduces to learning. The book elaborates on contemporaneous climate change, food security, national security and environmental resources issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which climate change, food security, national security and environmental resources issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue climate change, food security, national security and environmental resources necessary in policy making process that will stimulate increase in food production and environmental sustainability.

Climate Change, Food Security, National Security and Environmental resources: Global issues and Local Perspectives is organized in four parts. Part One deals with Climate Change with Six Chapters, Part Two is concerned with Food Security with Nine chapters, Part Three deals with National Security with Five Chapters, while Part Four pertains Environmental Resources, has Five Chapters.

Ahmed Makarfi / Eteyen Nyong

April 2024

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Chapter 16

Anthropogenic Activities: Implications on the Population and Diversity of Fauna-Avifauna Species of old Oyo Forest

Adedoyin, S.O., Omifolaji, J.K., Jatto, S.O.S., Oluwagbemi, T., And Sale, F.A.

Abstract

Old Oyo National Park is one of the most important protected areas for biodiversity conservation in Nigeria. This study assessed the fauna and avifauna resources composition and diversity as well as profiled uncontrolled anthropogenic activities within Old Oyo Forest Region. We collected data using a combination of structured and open-ended questionnaire as well as participatory methods in villages around the Park: Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal Technique (PRAT). Our findings indicated that 46.3% farmland acquisitions were through communal system, while 60.3% land-use was mainly for agriculture. On the livelihood, hunting was mostly done (31.0%) in both wet and dry seasons. In the villages, our results indicated that majority (79.3%) of the respondents set fire, and were mainly done for clearing of farmland. We found that 74.3% illegal tree felling occurred mainly within 3000m around the Park boundary. Farming, hunting and the usage of fire were highly significant at ($P<0.01$). However, all human activities which included farming, hunting, use of fire and logging were significant at ($P<0.05$) level. Faunal resources diversity and composition were highest in Oyo-Ile range during wet season. However, Simpson's and Shannon-Wiener's Diversity Indices were higher in dry season than in wet season. For avifaunal resources, Simpson's Index (0.8946) and Shannon-Wiener's Index (2.413) were highest in Ogun-Tede range, and both indices were lowest in Oyo-Ile range. In dry season however, Simpson's Index (0.855) and Shannon-Wiener's Index (2.102) were highest in Ogun-Tede range, and these two indices (Simpson and Shannon-Wiener) were lowest in Marguba range. Results revealed presence of 30 avifaunal species and eight hundred and forty (840) individuals were recorded in the wet season. Also, Simpson's diversity index (0.95) was greater than the dry season (0.91), while Shannon-Wiener diversity in the wet season was greater than the one in the dry season (2.7). Based on the findings from this study, it is imperative to ensure the effective and efficient management of the buffer zone of Old Oyo Forest Region by overhauling outdated policies through the institutionalization of conservation activities and programmes which will in turn enhance effective, efficient and sustainable approaches to conservation and protection of faunal and avifaunal species in the study area.

Keywords: Diversity, Population, Faunal, Avifaunal, Anthropogenic activities, OONP

Introduction

United Nations Educational, Scientific and Cultural Organization (UNESCO) introduced the concept of a buffer zone; as it relates to protected area conservation, in 1976 as part of the organization's "Man and Biosphere Programme" (MAB) which aims to improve the relationship between humans and their environments through interdisciplinary research and management

(UNESCO, 2014). As part of the programme, UNESCO instituted the designation of the biosphere reserve, of which there are three parts: the core protected area, a buffer zone and a transition area. The buffer zone is an adjacent area to protected areas, on which land use is partially restricted to give an added layer of protection to the core of the biosphere (UNESCO, 2014). Buffer zones are environmental and ecological management tools to surround or shield a particular zone (core area) with the intention of insulating the important or threatened core area from anthropogenic impacts. The definition used by Shafer (1999), includes the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution. These are areas outside the boundaries of the core-protected area that are managed sympathetically to minimize the impacts of outside activities. Pressey (1997) stated that while doing all these things, buffer zones increase both the effective size of the protected area and the likelihood that all the life requirements of protected organisms will be provided in this larger area. A buffer zone is essentially a boundary imposed on a specific habitat for a predetermined, specific objective. According to Strayer et al. (2003), ecologists use the term boundary to refer to a wide range of real and conceptual structures and it may be counterproductive to insist that all ecologists agree on a single rigid definition of a boundary.

Ecological boundaries may differ in their origin and maintenance, their spatial structure, their function and their temporal dynamics. Therefore, these definitions are important when studying landscape ecology because this science deals with the spatially explicit relationships among patched types in complex mosaics (Turner, 1989; Forman, 1995 and Wiens, 1995). Ideally, the prioritized end-use objective for a buffer zone is protection. Putwain and Pywell (1997) advised that one can protect remaining semi-natural habitats by creating buffer zones between them and an adjacent, potentially damaging land use. They go further to state that part of ecosystem management would be the establishment of buffer zones

around protected areas, as Shafer (1999) pointed out, buffer zones can also provide more landscape needed for ecological processes such as fire.

Stephens (1998) illustrated that the advantages of buffer zones include increasing the available habitat area, decreasing the potential exposure to adverse impacts and absorbing the severity of impacts. Buffer zones may include areas ranging from almost full protection, to areas in the process of rehabilitation, and to those that may include small, low-density urban communities. The characteristics of development (urban edges) along, or in close proximity to sensitive habitats are complex and pose management challenges and the situation is exacerbated when these areas abut protected areas. Stephens (1998) further stated that boundaries of natural systems seldom coincide with those of privately owned property and it is therefore important to find a way of co-managing the urban fringe and natural areas in a way that benefits both the built and natural environment. Hansen and di Castri (1992) explained that the distinguishing feature of a landscape perspective is not just the recognition that a landscape is composed of elements of different quality, but the emphasis on relationships among patches- what happens between the elements in a mosaic. Differential movements or flows of nutrients, energy, organisms, or disturbances mediate these relationships across a landscape. Once formulated and then implemented, a buffer zone essentially becomes a boundary. Cadenasso et al. (2003) stated that boundaries are the zones of contact that arise whenever areas are partitioned into patches and that the understanding of how boundaries influence the functioning of ecological systems is poorly developed. Cadenasso et al. (2003) further stated that when, where and how boundaries affect ecologically important flows across heterogeneous space are not well known. An area where buffer zones have proven very effective is in the management and protection of biosphere reserves. Birckhead et al. (1997) stated that the biosphere reserve model rests heavily on the concept of buffer zones. Biosphere reserves are models whereby environmentally sound and sustainable development can be promoted in areas adjacent to the more strictly protected areas.

A buffer zone is an area lying between two or more other protected land area and serving to reduce the possibility of damaging interactions between them (Cunningham, 1996). Nature

conservationists distinguish two different ways of approaching the buffer zone serves only to avoid negative human impact on the core area. The socio-conservationists see the buffer zone as part of the socio-economic development of the entire area comprising conservation and non-conservation sub-areas. From the conservation point of view, Wind and Prins (1989) reported that buffer zones are areas outside the protected area that are designed to protect parks. While Sayer (1991) defined buffer zone as a zone, peripheral to a national park or equivalent reserve, where restrictions are placed upon resource use or special development measures are undertaken to enhance the conservation value of the area. From the conservation and communities point of view, Wild and Mutebi (1996) defined buffer zone as any area, often peripheral to a protected area, inside or outside, in which activities are implemented or the area managed with the aim of enhancing the positive and reducing the negative impacts of conservation on neighbouring communities on conservation.

Biodiversity is the wealth of all life on earth, which can be considered at three interlinked levels: genetic, species and ecosystem (Noss, 1990). Genetic biodiversity refers to the frequency and variety of genes and/or genomes within, and between, populations of the same species, and the information contained within these genes provides the basis for evolution through adaptation. Species biodiversity refers to the number and abundance of species in an area, and the extent to which species differ in their genetic make-up. It incorporates characteristics such as taxonomic uniqueness, size and structure, population dynamics, reproductive cycles and behavioural patterns. Ecosystem biodiversity is reflected in the definition of an ecosystem: a dynamic complex of plant, animal and micro-organism communities and their non-living environment, interacting as a functional unit. The interplay between species includes pollination, predation, parasitism and symbiosis, while the interaction between species and their non-living environment includes soil formation and photosynthesis. Ecosystems and human culture have influenced each other over the millennia, giving rise to productive landscapes that combine biological and cultural diversity.

Birds form an integral part of the ecosystem as they serve as mobile-links within the vast food chains and webs that exist (Nason, 1992) in terrestrial and aquatic ecosystems. Wild birds could be both prey and predator; serving as biological control; eating insects (Mols and Visser, 2002)

like grasshoppers and locusts which are agricultural pests, also birds of prey help to control populations of harmful rodents (Brown and Kotler, 2004) whilst vultures act as natural rubbish disposers by clearing up the carcasses of dead animals and human refuse (Prakash et al., 2003). They have several scientific, ecological, economic and cultural values (Diamond, 1987); they serve as pollinators of flowers. Birds like sunbirds help to pollinate flowers as they pass from one plant to another, seeking nectar, in the same way as bees carry out pollination. This enables man's vegetative food supplies to flourish (Nabhan and Buchmann, 1997; Narang et al., 2000). Birds serve as seed dispersal agents (Greenberg et al., 1995; Wenny and Levey, 1998). They convey exotic species, as they carry certain organisms from one place to another where they do not exist and in some cases, they become invasive (Gibson and Wheelwright, 1995). The droppings of some species of birds mainly seabirds serve as a source of fertilizer for farmers as the droppings popularly called 'guano' are rich in sulphate and phosphate (Croll et al., 2005).

In addition, the natural environment is still being destroyed at an alarming rate, all over the globe. There is increasing amounts of energy and money invested to arrest this spiral of degradation. In many of the conservation programmes and projects and projects, the zoning principle is applied in order to allow protection to be combined with human use, whereby important areas (often conservation areas and core zones) are surrounded by so-called buffer zones. The buffer zone surrounding Old Oyo National Park is poorly managed. The poor management has mounted pressure on the population of fauna and avifauna species in the area; anthropogenic activities have also increased due to its poor management. The study therefore aimed to highlight the species composition and diversity of fauna and avifauna resources as well as profile some uncontrolled anthropogenic activities within the study area and then recommend measures for its effective and efficient management.

Materials and Methods: Study Area

Old Oyo National Park (OONP) derives its name from the ruins of Oyo-Ile, (Old Oyo) the ancient political capital of Yoruba Empire. The abundance of cultural features in and outside the Park with a combination of ecological and biodiversity sites places the Park in a unique and advantageous position as a potential tourism destination. The Park has a total land mass of 2512 km^2 (making it

the fourth largest National Park in Nigeria) and is located in the South western part of Nigeria, specifically Northern part of Oyo State. OONP is geographically located between latitude 8º15' and 9º.00'N and longitude 3º35' and 4º42'E. OONP is considered as a mixed heritage site with outstanding natural and cultural values that if explored could serve as basis for its enlistment on the UNESCO world heritage list as the first mixed heritage site in Nigeria (Oladeji et. al., 2012).

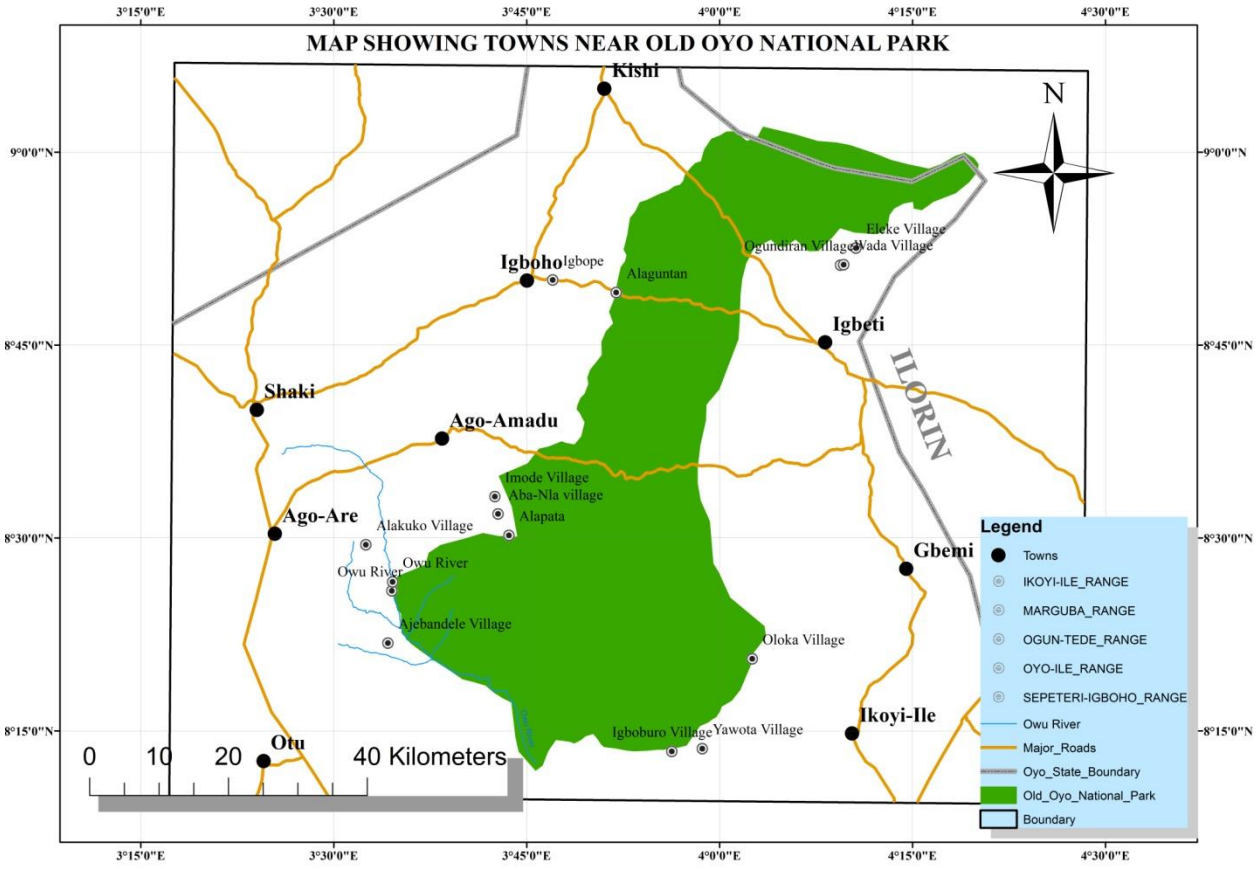

Figure 1: Map of Old Oyo National Park showing the surveyed buffer zone villages

Data Collection: Questionnaire administration: Proportionate stratified (ward by ward) random sampling design was used to select respondents who were mainly Park's field staff, administrative staff and heads of clans in the selected villages. To remove bias, the selection of respondents cut across such variables as religion, age, occupation, income, ethnicity, educational attainment,

nativity, family size and size of farmland. Data were collected using a combination of structured and open-ended questionnaire as well as participatory methods: Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal Technique (PRAT). A minimum of 10% sampling intensity was used in selecting respondents around the Park, which were also randomly selected. The questionnaire was designed to obtain information on socio-economic, anthropogenic activities and livelihood of the support-zone dwellers. The surveyed support-zone communities are shown in Figure 1 above. From the twenty-five (25) buffer zone communities identified, thirteen (13) were purposively selected based on proximity to the Park of less than 10 km representing 52 % sampling intensity (Table 1).

Faunal resources: A 3 × 2 km transect was laid in each of the five buffer zone ranges in the Park. The total effective study area was 30 km2. Each transect was allowed to rest for 4-5 days after the construction of transects before data collection began to reduce human disturbance and to allow wild animals to return to their initial home range. Each transect was traversed in both dry and wet seasons, from 7.00 am to 1.00 pm and from 4.00 pm to 7.00 pm (local time) with an average walking speed of 2.0 km/hr. Periods of walking were interspersed with periods of 'silent', 'watch' and 'wait' in order to increase the possibility of detecting animals that might hide or flee upon the approach or movement of observers. Each transect was traversed twice in a month for period of 12 months. The counts of individual faunal species identified considered only the species observed during the field study. Binocular (10 × 40) aided to observe and detect presence of animals. Animals sighted were identified according to the description of Jean and Pierre (1990). Five basic assumptions were made as recommended by Burnham (1980), Seber (1982) and Dunn (1993), which were: animals position directly over the transect line are not missed, animals are seen before they flee, none are counted twice, sighting of each animal or group of animals are done with certainty and all animals are distributed at random with respect to the transects.

Avifaunal resources: A total of ten (10) point counts were laid in the five ranges in the buffer zone. Each point count was more than 5 km apart to prevent double counting. Each point count was visited twice in a month between the hours of 7.00 am -12.00 pm and 4.00 pm and 7.00 pm (local

time). The observer stayed quietly for between 10-15 minutes in each count point to allow for human presence. Binocular (10 × 40) was used to observe bird species. Birds within and outside a fixed radius of 100 m were counted. Birds sighted were identified as described and classified by Serle et al., (1997). The following assumptions were made: birds do not approach observer or flee; birds behave independently of the others; birds are not counted twice; birds are identified correctly and distance estimates are correct.

Data Analyses: Questionnaire: All data collected through the use of questionnaire were subjected to frequencies, percentages, correlation and Analysis of variance (ANOVA) at $P<0.01$ and $P<0.05$ using Statistical Package for Social Sciences (SPSS) version 21 for Windows (IBM SPSS Inc., Chicago, USA).

Faunal and avifaunal resources: Ecological data obtained on fauna and avifauna resources were subjected to diversity indices analysis using PAST (Paleontological STatistics) Software Package for Education and Data Analysis (version 3.04) as recommended by Hammer et al., (2001). Diversity indices were calculated using the formulae below:

$$\text{Simpson Index (D)} = 1 - \sum_{s} Pi^2 \quad \ldots\ldots\ldots \{1\}$$

$$\text{Shannon Index (H)} = -\sum_{i=1} (Pi * \ln Pi) \quad \ldots\ldots\ldots \{2\}$$

Where: D = the Simpson's diversity index; H = the Shannon diversity index; P*i* = fraction of the entire population made up of species *i*; s = numbers of species encountered; ∑ = sum from species 1 to species s.

Results: A total of three hundred and sixty-seven (367) questionnaires were administered to randomly selected households in the purposively chosen communities in which three hundred (300) questionnaires were retrieved: Ajebandele (30), Alakuko (30), Imodi (20), Aba-Nla (20), Alapata (20), Igbope (30), Alaguntan (30), Ogundiran (20), Alada (20), Eleke (20), Oloka (20), Igboburo (20) and Yawota (20) as shown in Table 1 below.

The results in Table 2 on the livelihood (farming) of the respondents revealed that land acquisition in the study area was basically through communal (46.3%), while land-use in the area was mainly for agriculture (60.3%). Many of the respondents (66.7%) had their farms 3000 m away from the Park boundary. The commonly used methods for farm clearing were the combination of manual labour and tractor (42.0%). On the livelihood (hunting) of the respondents as shown in Table 3, hunting was mostly done (31.0%) in both wet and dry seasons; the hunting was usually done (29.0%) at a distance of 2000 m away from the Park boundary. The kill from the hunting expedition was mostly consumed (22.3%) and usually carried out on weekly and fortnightly (14.0%). Traps were the most frequently used (16.7%) hunting equipment in the study area. In Table 4, the results revealed that many of the respondents (79.3%) set fire and the main reason for doing that was

Table 1: Distribution of Respondents within the Buffer zone in the Study Area

Ranges and buffer zone villages	No. of respondents based on 10% sampling intensity
Ogun-Tede (180km^2):	
Ajebandele	35 (30)
Alakuko	33 (30)
Marguba (165km^2):	
Imodi	24 (20)
Aba-Nla	23 (20)
Alapata	25 (20)
Sepeteri-Igboho (225km^2):	
Igbope	36 (30)
Alaguntan	40 (30)
Oyo-Ile (270km^2):	
Ogundiran	27 (20)
Alada	23 (20)
Eleke	30 (20)
Yemoso (195km^2):	

Oloka	25 (20)
Igboburo	22 (20)
Yawota	24 (20)
Total	**367 (300)**

clearing of farmland (55.3%). Many of the respondents usually set fire once a year (34.0%) and the most preferred season of setting the fire was late dry season (31.3%). The fire was usually set at 4000 m to the Park boundary. The respondents agreed to the fact that they carried out illegal felling of trees (74.3%) around the Park as shown in Table 5 and this occurred mainly at 3000 m (46.0%) to the boundary. The main reason for this illegal felling according to the respondents was for income and construction (54.7%).

Table 2: Information on respondents' livelihood (farming)

Variables	Frequency	Percentage (%)
System of land acquisition:		
Communal	139	46.3
Inheritance	123	41.0
Private (leasing/rentage)	15	5.0
No response	23	7.7
Total	**300**	**100**
System of land-use:		
Agro-forestry	11	3.7
Agro-pastoralism	21	70
Pastoralism	9	3.0
Agriculture	181	60.3
Taungya	11	3.7
No response	67	22.3
Total	**300**	**100**

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Farm distance to the Park boundary:		
Less than 500 m	33	11.0
1000 m	9	3.0
2000 m	5	1.7
3000 m	200	66.7
Above 4000 m	30	10.0
No response	23	7.7
Total	**300**	**100**
Farm clearing methods:		
Bush burning	2	0.7
Manual labour	90	30.0
Tractors	6	2.0
Bush burning and manual labour	5	1.7
Bush burning and tractor	15	5.0
Manual labour and tractor	126	42.0
Bush burning, manual labour and tractor	30	10.0
No response	26	8.6
Total	**300**	**100**

Table 3: Information on respondents' livelihood (hunting)

Variables	Frequency	Percentage (%)
Preferred season for hunting:		
Dry season only	25	8.3
Both dry and wet seasons	93	31.0
No response	182	60.7
Total	**300**	**100**
Distance of hunting area to Park boundaries:		
Less than 500 m	1	0.3
1000 m	1	0.3

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2000 m	87	29.0
3000 m	6	2.0
4000 m	10	3.3
Above 4000 m	12	4.0
No response	183	61.0
Total	**300**	**100**
What do you do with the kills?		
Sell	2	0.6
Consume	67	22.3
Sell and consume	49	16.4
No response	182	60.7
Total	**300**	**100**
Frequency of hunting:		
Daily	3	1.0
Weekly	42	14.0
Fortnightly	42	14.0
Monthly	7	2.3
Rarely	21	7.0
No response	185	61.7
Total	**300**	**100**
Equipment used for hunting:		
Traps	50	16.7
Guns	19	6.3
Traps and guns	36	12.0
Traps, guns, knives and cutlasses	13	4.3
No response	182	60.7
Total	**300**	**100**

Table 4: Information on respondents on the use of fire

Variables	Frequency	Percentage (%)
Setting of fire:		

Yes	238	79.3
No	53	17.7
No response	9	3.0
Total	**300**	**100**
Reasons/purposes for setting fire:		
Hunting	3	1.0
Regeneration	25	8.4
Clearing farmland	166	55.3
Pests and insects control	2	0.7
Honey hunting	1	0.3
Demarcation of farm boundaries	18	6.0
Farmland clearing and pests and insects control	1	0.3
Regeneration and farm boundaries demarcation	22	7.4
All of the above	58	19.3
No response	4	1.3
Total	**300**	**100**
Frequency of setting fire per year:		
Once	102	34.0
Twice	64	21.4
Three times	50	16.6
No response	84	28.0
Total	**300**	**100**
Season/period of setting fire:		
Early dry season	46	15.3
Late dry season	94	32.3
Early raining season	79	27.3
Late raining season	13	1.3
Early dry season and late dry season	4	1.3
Early raining season and late dry season	4	1.3
No response	60	21.2
Total	**300**	**100**
Distance of fire to Park boundary:		
Less than 500 m	2	0.7
1000 m	4	1.3

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2000 m	62	20.7
3000 m	12	4.0
4000 m	5	1.7
Above 4000 m	133	44.3
No response	82	27.3
Total	**300**	**100**

Table 5: Information on respondents' logging activities

Variables	Frequency	Percentage (%)
Occurrence of logging activities:		
Yes	223	74.3
No	66	22.0
No response	11	3.7
Total	**300**	**100**
Distance of logging to Park boundary:		
Less than 500 m	38	12.7
2000 m	48	16.0
3000 m	138	46.0
No response	76	25.3
Total	**300**	**100**
Reasons for logging		
Fuel	9	3.0
Income	27	9.0
Building	25	8.3
Income and building	164	54.7
No response	75	25.0
Total	**300**	**100**

Results in Table 6a showed that only logging activities of the respondents was not significant at both ($P<0.01$) and ($P<0.05$) levels. Farming activities, hunting activities and the usage of

fire in the study area were all significant at (P<0.01). However, results in Table 6b revealed that all human activities in the study area, which included farming, hunting, use of fire and logging were significant at (P<0.05) level.

Table 6a: Information on the impacts of human activities in the study area

Variables	**Pearson correlation**	**1**
	N	**300**
Farming	Pearson correlation	0.226**
	Sig. (2-tailed)	0.000
	N	300
Hunting	Pearson correlation	0.219**
	Sig. (2-tailed)	0.000
	N	300
Fire setting	Pearson correlation	0.265**
	Sig. (2-tailed)	0.000
	N	300
Logging	Pearson correlation	0.248
	Sig. (2-tailed)	0.000
	N	300

** correlation is significant at the level 0.01 (2-tailed)

Table 6b: Information on the ANOVA of variables in the study area

Variables	**Df**	**F**	**Significant value**
Farming	3	13.398	0.021*
Hunting	2	36.054	0.000*
Fire setting	2	13.264	0.000*
Logging	2	13.786	0.010*

* correlation is significant at the level 0.05 level (2-tailed)

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Faunal resources: In Table 7a, Simpson's Index (0.7551), Shannon-Wiener's Index (1.494) and species evenness (0.8913) were highest in Oyo-Ile range during wet season. However, Simpson's Index (0.6075), Shannon-Wiener's Index (1.103) and species evenness (0.6027) were lowest in Ogun-Tede range. In Table 7b however, Simpson's Index (0.7929) and species and species evenness (0.8868) were highest in Oyo-Ile range. Shannon-Wiener's Index (0.7595) was highest in Sepeteri-Igboho range, while Shannon-Wiener's Index (1.242) in Marguba range was the least. In Table 8, number of species was higher in wet season than in dry season. In the same vein, number of individuals was more in wet season when compared to the number of individuals in dry season. However, Simpson's and Shannon-Wiener's Diversity Indices were higher in dry season than in wet season.

Table 7a: Wet season fauna species population and diversity in the study area

Diversity Indices	Ranges				
	OT	MARG.	SPT.	OI	YMS.
Taxa	5	5	5	5	5
Individuals	39	13	14	14	26
Dominance	0.3925	0.3609	0.3469	0.2449	0.3077
Simpson	0.6075	0.6391	0.6531	0.7551	0.6923
Shannon	1.103	1.264	1.27	1.494	1.407
Evenness	0.6027	0.7076	0.7122	0.8913	0.6808
Brillouin	0.9641	0.9412	0.9634	1.152	1.164
Menhinick	0.8006	1.387	1.336	1.336	1.177
Margalef	1.092	1.559	1.516	1.516	1.535
Equitability	0.6853	0.7851	0.7891	0.9285	0.7854
Fisher-alpha	1.524	2.975	2.782	2.782	2.445
Berger-Parker	0.4872	0.5385	0.5	0.3571	0.4615
Chao-1	6	8	8	5	6.5

*** OT = Ogun-Tede; MARG. = Marguba; SPT. = Sepeteri; OI = Oyo-Ile; YMS = Yemoso**

Table 7b: Dry season fauna species population and diversity in the study area

Diversity	Ranges

Indices	OT	MARG.	SPT.	OI	YMS.
Taxa	5	4	3	6	6
Individuals	33	6	11	13	23
Dominance	0.3039	0.3333	0.5702	0.2071	0.2098
Simpson	0.6961	0.6667	0.4298	0.7929	0.7902
Shannon	1.319	1.242	1.7595	1.672	1.651
Evenness	0.7479	0.866	0.7124	0.8868	0.8686
Brillouin	1.143	0.7979	0.5641	1.246	1.358
Menhinick	0.8704	1.633	0.9045	1.664	1.251
Margalef	1.144	1.674	0.8341	1.949	1.595
Equitability	0.8195	0.8962	0.6914	0.9329	0.9214
Fisher-alpha	1.639	5.245	1.359	4.322	2.639
Berger-Parker	0.3939	0.5	0.7273	0.3077	0.3043
Chao-1	5	7	3	6.333	6

*** OT = Ogun-Tede; MARG. = Marguba; SPT. = Sepeteri; OI = Oyo-Ile; YMS = Yemoso**

Table 8: Wet and dry seasons fauna species richness, evenness and diversity

Species	Seasons	
	Wet	**Dry**
Erythrocebus patas	41	8
Papio anubis	29	24
Canis adustus	2	-
Thryonomys swinederianus	6	5
Sylvicapra grimmia	6	1
Kobus kob	1	-
Cercopithecus aethiops	12	22
Hippotragus equinus	3	6
Chameleo gracilis	1	-
Potamochoerus porcus	2	1
Xerus erythropus	3	14
Cephalophus rufilatus	-	3
Phachochoerus aethiopicus	-	3
Number of species	**11**	**10**
Number of individuals	**106**	**87**

Simpson's Diversity Index (D)	**0.75**	**0.81**
Shannon-Wiener's Diversity Index (H)	**1.7**	**1.9**

Avifaunal resources: Table 9a showed that in wet season, Simpson's Index (0.8946) and Shannon-Wiener's Index (2.413) were highest in Ogun-Tede range, but both indices were lowest in Oyo-Ile range. In dry season however, Simpson's Index (0.855) and Shannon-Wiener's Index (2.102) were also highest in Ogun-Tede range, but these two indices (Simpson and Shannon-Wiener) were lowest in Marguba range as shown in Table 9b.

Table 9a: Wet season avifaunal species population and diversity in the study area

Diversity	**Ranges**				
Indices	**OT**	**MARG.**	**SPT.**	**OI**	**YMS.**
Taxa	14	11	9	8	8
Individuals	250	177	139	138	136
Dominance	0.1054	0.1172	0.1303	0.1445	0.1365
Simpson	0.8946	0.8828	0.8697	0.8555	0.8635
Shannon	2.413	2.268	2.118	2.004	2.036
Evenness	0.798	0.878	0.9241	0.9278	0.9571
Brillouin	2.302	2.148	1.997	1.895	1.924
Menhinick	0.8854	0.8268	0.7634	0.681	0.686
Margalef	2.354	1.932	1.621	1.421	1.425
Equitability	0.9145	0.9457	0.9641	0.9639	0.9789
Fisher-alpha	3.204	2.596	2.151	1.849	1.857
Berger-Parker	0.184	0.2034	0.2158	0.2246	0.1985
Chao-1	14	11	9	8	8

*** OT = Ogun-Tede; MARG. = Marguba; SPT. = Sepeteri; OI = Oyo-Ile; YMS = Yemoso**

Table 9b: Dry season avifaunal species population and diversity in the study area

Diversity	**Ranges**				
Indices	**OT**	**MARG.**	**SPT.**	**OI**	**YMS.**
Taxa	10	5	8	7	7
Individuals	159	93	131	120	128
Dominance	0.145	0.2149	0.159	0.1563	0.1526

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Simpson	0.855	0.7851	0.841	0.8438	0.8474
Shannon	2.102	1.574	1.959	1.902	1.913
Evenness	0.8186	0.9649	0.8869	0.9571	0.9673
Brillouin	1.986	1.481	1.847	1.794	1.81
Menhinick	0.7931	0.5185	0.699	0.639	0.6187
Margalef	1.776	0.8825	1.436	1.253	1.237
Equitability	0.9131	0.9778	0.9423	0.9775	0.9829
Fisher-alpha	2.369	1.131	1.878	1.621	1.591
Berger-Parker	0.2704	0.2903	0.2748	0.225	0.2109
Chao-1	10	5	8	7	7

*** OT = Ogun-Tede; MARG. = Marguba; SPT. = Sepeteri; OI = Oyo-Ile; YMS = Yemoso**

In Table 10, thirty (30) avifaunal species and eight hundred and forty (840) individuals were recorded in the wet season; while twenty-one (21) species and six hundred and thirty-one (631) individuals were recorded during dry season. Also, Simpson's diversity index in the wet season (0.95) was greater than the one in the dry season (0.91), while Shannon-Wiener diversity in the wet season was greater than the one in the dry season (2.7).

Table 10: Wet and dry seasons avifaunal species richness, evenness and diversity

Species	Seasons	
	Wet	**Dry**
Kaupifalco monogrammicus	22	36
Milvus migrans	33	32
Halcyon malimbica	5	4
Cypsiurus parvus	48	85
Tockus nasatus	72	22
Columba guinea	54	35
Streptopelia semitorquata	39	52
Coracias abyssinica	21	14
Centropus senegalensis	19	-

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Francolinus bicalcaratus	31	20
Petronia dentata	7	14
Ploceus cucullatus	113	133
Vidua macroura	9	10
Poicephalus senegalus	37	-
Halcyon senegalensis	32	-
Ardeola ibis	28	37
Stigmatopelia senegalensis	30	39
Merops pusillus	11	-
Pycnonotus barbatus	14	-
Lamprotornis chloropterus	12	-
Turdus pelios	21	15
Caprimulgus nigriscapularis	11	-
Bradornis pallidus	21	14
Nectarinia senegalensis	10	9
Nectarinia olivacea	17	13
Numida meleagris	30	21
Mesopicos geortae	17	-
Butastur rufipennis	20	13
Motacilla alba	14	-
Motacilla flava	42	13
Number of species	**30**	**21**
Number of individuals	**840**	**631**
Simpson's Diversity Index (D)	**0.95**	**0.91**
Shannon-Wiener's Diversity Index (H)	**3.2**	**2.7**

Discussion

Faunal resources in the study area: More fauna species and individuals were recorded in wet season when compared to dry season. This may not be unconnected to the abundance and

availability of food sources in wet season. This supports the view of Newton (1998) and Benton et al., (2003) that food abundance influences the distribution and size of wild populations. Movements could be purposeful for animals if they were in search of food, water and mates. It agrees with the assertion that wild animals are more distributed in areas with abundant food, water, space, mates and calmness (Adeola et al. 2017). Furthermore, individuals recorded in dry season may be lower in number when compared to individuals recorded in wet season. This could also be as a result of burning activity that was very pronounced during dry season which opened up the habitats and also reduced the vegetation quality. This is in accordance with the submission of Williams et al., (1999) that the cessation of rain following the wet season and the extended dry season leads to opening-up and a sharp decrease in the available vegetation cover which automatically influence fauna population. The reduced numbers of individuals in dry season is supported by Bowman (1998) and Yibarbuk et al., (2001) that late season fires are typically intense and result in the overall opening up of habitats, removal of shrubs and the rejuvenation of grasses.

However, our findings revealed that primate species (*Erythrocebus patas*, *Papio anubis* and *Cercopithecus aethiops*) dominated the fauna population recorded in the study area, corroborating studies carried out elsewhere in sub-Saharan Africa (Grubb et al., 2003; Oates, 2004). This may not be unconnected with the fact that primates are more of generalist feeders than specialist feeders; feeding on varieties of leaves, fruits, twigs, tree barks and human foods. Simpson's Index of diversity (0.81) and the Shannon-Wiener Index of diversity (1.9) had greater values in dry season. This indicates that there was greater evenness in the dry season within the species sample obtained when compared to the species sample obtained in wet season. The lower diversity index values in wet season may be attributed to less evenness or less equitability of the sample, particularly with regard to the large number of individuals of one species *Erythrocebus patas*. Simpson's Index, Shannon-Wiener's Index and species evenness were highest in Oyo-Ile range during wet season. This simply shows that fauna species were well distributed in this range and this may not be unconnected to quality vegetation and habitat as well as the size of the buffer zone (Oyo-Ile buffer zone is the largest- 270 km^2). This is in agreement with the submission of Williamson (1981) that for various taxonomic groups, the number of species increases with

increasing sample size or effort. Also, Simpson's Index, Shannon-Wiener's Index and species evenness were lowest in Ogun-Tede range. This may be due to the land-use system which was mainly agriculture. This system of land-use favoured the dominant species (primates) in the buffer zone, since they are generalist feeders. This then brought about an uneven distribution of fauna species across the study area. In dry season, Simpson's Index and species evenness were highest in Oyo-Ile range. This may not be unconnected to the size of the buffer zone. Shannon-Wiener's Index was highest in Sepeteri-Igboho range (the second largest buffer zone- 225 km^2) and this may be due to the competition for available resources (mainly food and water) within and among fauna species as well as a high predation which tend to be more intense in dry season. Shannon-Wiener's Index in Marguba range was the least, and this may not be unconnected to the fact that fauna species tend to concentrate where frequency of disturbance is minimal. Since there is probably less disturbance from within the Park, fewer animals migrate to the buffer zone. Another reason for this lowest value of Shannon-Wiener's Index could be the size of the buffer zone (165 km^2- the lowest).

Avifaunal resources in the study area: Distribution and population of avifaunal species in the study area showed that more species were recorded in wet season when compared to dry season. This may be due to the abundance and availability of food. Wet season is usually the period that different crops (mainly grains) are planted. Hence, the large number of avifaunal species. This is in agreement with the submission of Newton (1998) and Benton et al., (2003) that food abundance influences the distribution and the size of wild populations. Many of the avifaunal species were granivores. This is in consonance with the submission of Cirne and Lopez-Iborra (2005) and Hagy et al., (2008) that most species of avian granivores are beneficial and found in agro-ecosystems, especially because most species eat considerable quantities of grains as well as invertebrates during breeding season. However, the reduction in avifaunal species during dry season may be explained that some of these birds' species migrated to another ecological zone for breeding. Anthropogenic activities, land-use systems, environmental factors and food scarcity might have induced the decrease in the avifaunal population in dry season. This submission agrees with the earlier views of Beerens et al., (2011) and Sekercioglu et al., (2008).

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Avifaunal species in Ogun-Tede range were dominated by fewer species (*Ploceus cucullatus* and *Columba guinea*) in the wet season. This may not be unconnected with the land-use system in the area which suited granivores (since grains were the most planted crops) more than other avifaunal species, hence reducing the number of other birds species in the buffer zone. This is further revealed in the species evenness in Ogun-Tede range being the lowest. Avifaunal species evenness was highest in Yemoso due to the evenly distributed resources (water and food) in the buffer zone. In dry season, *Ploceus cucullatus* dominated other avifaunal species due to their generalist mode of feeding of this species. They are usually found around human habitation and feed on variety of food components such as grains, insects and worms. Simpson's and Shannon-Wiener's diversity indices were higher in wet season. Avifaunal species evenness was also higher in wet season when compared to the species evenness in the dry season. This indicates that there was greater evenness in the wet season sample obtained (due to food availability) when compared to sample obtained during dry season. Migration of avifaunal species during dry (early and late) season may be responsible for the reduced values of the diversity indices.

Human activities on the faunal and avifaunal resources in the study area: Proximity of buffer zone dwellers to the study area predisposes them to perpetrate all kinds of illegal activities such as farming, hunting, logging and fire setting. This was further amplified by Hames (1988) and Alvard (1994) that most hunting and extraction activities occur near human settlements; Begazo and Bodmer (1998) as well as Peres and Lake (2003) claimed that key access points to forests, such as roads or rivers also occur due to proximity. Farming activities within and around the study area were significant and this echoed the belief of the local people as being the sole owners of protected and adjacent land areas. This is in agreement with the findings of Rao et al., (2003), Hurst (1994) in Davies and Brown (2007). Furthermore, hunting around and within the distances (especially 2000 m) may pose threats on faunal and avifaunal species in the buffer zone. Hunting was done in both wet and dry season, with more of various species being killed and the kill was mainly consumed but could also be sold. This shows that many of the respondents hunt for alternative source of protein in their diets. This finding is supported by the findings of Adedoyin et al., (2024) that hunting is usually embarked upon for the alternative protein source, taste of the

delicacy or financial gain. Few of the respondents sell their kills which further re-echo that bushmeat is a delicacy around communities adjacent the protected areas. Hunting activities were significant within the study area and this is in consonance with the earlier views of Adedoyin et al., (2016), Lameed et al., (2015), Bowen-Jones and Pendry (1999) and Caspary (1999).

In addition, the uses of fire in the study area were prevalent. Fire was mainly used for farmland clearing, farm regeneration and farm boundaries' demarcation. This corroborates Bowman (1998), van Langeveldt et al., (2003) and Bond and Keeley (2005). Also, the frequency of setting fire was mainly once, while maintaining the approved distance of setting fire from the Park. The most preferred season for setting fire was during late dry season. This may be explained that late dry season fires help opening up of habitats, remove dead woods and rejuvenate grasses. This assertion is in agreement with the view of Bowman (1998) and Yibarbuk et al., (2001). The use of fire in the study area was significant, hence its colossal impacts on faunal and avifaunal resources within the study area. Almost all the respondents engaged in logging activities. The main reason behind this nefarious act was for income generation and building of structures. Although, illegal logging activities within and around the study area were not significant. This may not be unconnected to the fact that National Parks, Protected Areas and Nature Reserves are net producers (source areas) that supply the buffer or support zones of these areas. The buffer or support zones are the sinks for the fauna, avifauna, flora and entire biodiversity because their lives depend more or less on these. The proximity of sources to sink areas greatly affects biodiversity sustainability. This submission showed why natural renewable resources around land and area adjacent a protected area is the first point of call when the dwellers are in need. This further supported earlier view of Hart and Kingdom (2013) that sustainable use of resource in the conservation and protected forests of west and central Africa, where most of the two-third inhabitants rely is a major threat to biodiversity conservation.

Conclusion: In reality, the prioritized end-use objective of a buffer zone is protection. Human activities, such as farming, hunting, setting of fire and logging were so pronounced in the study area. This, on the other hand, is a threat to the continual perpetuation of biological resources (fauna, avifauna and flora) in the study area. Sustainability of biodiversity resources is driven by institutionalization of conservation activities and programmes, as well as capacity building at the

government, private sector and community levels. Therefore, it is imperative to ensure the effective and efficient management of the buffer zone of Old Oyo Forest Region by overhauling outdated policies. This will in turn enhance effective, efficient and sustainable approaches to conservation of natural resources in the study area.

Recommendations: Based on the findings from this study, we recommend the followings for the effective management of land adjacent Old Oyo Forest: Management of buffer zones of Old Oyo National Park should take account of regional policies guiding land-use and development; The Park Management should develop a good working relationship with the support zones dwellers; The Management of the Park should develop economic incentives and improved communal facilities by basing buffer zone management and planning on participation by local communities; Lifestyles and traditions of indigenous people should be recognized, while their rights are also incorporated into management policies; and Buffer zone should be made 4-5 km around the Park core boundaries to give room for the support zone dwellers activities; however, strict punitive measures should be taken on anyone who transgresses this demarcation.

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