



Large Mammals Abundance and Diversity a Tool for Sustainable Tourism: A Case Study of Idanre Forest Reserve Southwestern Nigeria

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ABSTRACT: This study investigates the quantity and variety of big animals as a tool for sustainable tourism: a case study of the Idanre Forest Reserve in southern Nigeria. The goal of this study was to examine the distribution and abundance of big mammals in the Idanre forest reserve in order to build a management plan for sustainable ecotourism and to offer information on the sighting rate of these species in the study area. The line transect approach was employed to collect data on the variety and abundance of animals in the study region. A total of 40 transect lines of 1000 m were randomly set, and each transect was broken into 200 m parts. Each compartment received 20 transects at random. In all, 40 transect lines were randomly put in the reserve's two divisions, and the forest reserve was separated into compartments for the purposes of this research study. The GPS 2011 Utility software was used to determine the starting and finishing sites of transects. Transect lines were walked three times per week for three months throughout both seasons (May, July, and September for the rainy season and November, January, and March for the dry season). The findings indicated that seventeen (17) mammals were counted in the research region. The White-throated Monkey has the greatest proportion of frequency of observation (19%), followed by the Mona Monkey (13%). The African Tree Pangolin has the lowest percentage frequency of observation. Within the research region, opportunistic sightings of Chimpanzee, Forest Elephant, Forest Buffalo, and Bushbaby have occurred. According to the Simpson diversity, it was greater in the dry season (0.9101) than in the rainy season (0.9066).

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INTRODUCTION

Ecotourism fauna oriented tourism to promote preservation [1] (Ijeomah *et al.*, 2012) may frequently provide a sustainable resource for producing local community's money without bargaining, or with a manageable influence on, ecosystem protection [2] (Idowu, *et al.*, 2011). Ogunjimate *et al.*, (2013), [3] on the other hand, challenge the popular belief that ecotourism is ecologically benign because ecotourists are ecologically sensitive, citing examples where ecotourism has had significant negative impacts on species and biodiversity, even when used as quiet, non-

consumptive recreation, such as hiking [4] (Kiss, 2004). More research and evaluation of how wildlife responds to the long-term consequences of tourism is needed to improve forest reserve management in response to such concerns [5] (Reed and Merenlender, 2008). Large-bodied animals are easier to spot in woodland areas and are hence a popular tourist attraction. The growing removal of fauna and flora resources over time, particularly as a result of anthropogenic activity, is a major concern that conservation agencies across the world are addressing. Large-scale forest removal, mineral exploitation, and industrialisation are all threatening tropical forests. In Nigeria, for example,

184 animal and plant species, as well as key natural places such as old growth forests and wetlands, are reported to be endangered [6] (Boo, 2011). Furthermore, around 20.4 million hectares (50.4 million acres) of tropical forest are killed or severely damaged each year in countries such as Amazonia, Central America, Malaysia, Indonesia, and Borneo. The Nigerian rainforests have not been spared from these massive devastations. At the moment, natural habitat loss in Nigeria is accelerating, resulting in the depletion of the country's biodiversity [7] (NEA, 2015). South Western Nigeria, on the other hand, has a high population density and a dense agricultural land-use area. As a result, biodiversity decline may be occurring at a far faster rate than elsewhere in Nigeria. Increased demand for primates and mammals for study, as well as trade in wood and non-timber species, are indirect causes of biodiversity loss in various sections of the nation. Agricultural development, logging, and poaching inside and around the Idanre forest reserve have resulted in a significant loss in bird species. Avian species have become increasingly intolerant of stresses on their habitats in recent years [8] (Manu, 2007).

Large-bodied animals are easier to spot in woodland areas and are hence a popular tourist attraction. These are non-human primates, whose likeness to humans attracts a lot of attention from tourists. Their regular activities enable humanity to regress to the primal period of man. It is necessary to examine the distribution and number of these animals in order to properly manage them for tourist development. The protection and management of these animal populations necessitates an accurate understanding of the population status in a given location (Robitaille, and [9] Aubry, 2015). The purpose of this study was to analyze the distribution and abundance of big mammals in the Idanre forest reserve in order to build a management plan for sustainable ecotourism and offer information on the sighting rate of these species in the study area. As a result, this research project will give baseline data on the big animals in the study region, which will contribute in the development of sustainable tourism strategies.

LITERATURE REVIEW

Ecotourism Development

Traveling to relatively untouched natural places for educational, recreational, inspiring, and scientific objectives is referred to as ecotourism. It might be for the goal of studying nature in its purest form, admiring breathtaking landscapes, watching wild creatures, plants, and flowers, or appreciating rare geological formations, geomorphological, or cultural places [10]. Marguba (2006) described "Ecologically sustainable tourism with a major focus on experiencing natural settings that develops environmental and cultural awareness, appreciation, and conservation," according to. Large-bodied animals are easy to spot in woodland

surroundings, making them a popular tourist attraction. Ecotourism may be a source of funding for the development or upkeep of natural or culturally significant locations, as well as a stimulus for local economic growth and a source of required foreign exchange and national advantages. Ecotourism, in particular, is seen by environmentalists as one of the most promising techniques for generating cash for conservation and explaining its necessity. There are various situations where ecotourism is said to give the economic basis for park protection, in addition to providing a source of cash for parks and conservation.

Numerous interest groups are anxious about Africa's big mammalian fauna [11] (Mendoza and Palmqvist, 2013), because Africa continent is home to the world's last great community of large animals [12] (Eisenberg, 2010). However, grassland communities, particularly in the West African Subregion, have received a lot of attention [13] (Akinyemi and Oduntan, 2004). Aside from primate populations, nothing is known about rainforest mammalian species [14] (Oates *et al.*, 2008). Data on the distribution and abundance of big mammals is critical for understanding their importance as an ecological driving force and for tourist development. This data is particularly important for evaluating conservation hotspots, eco-tourism potential for game watching, the nature and degree of wildlife-human conflicts, and local people's sustainable bush meat harvesting (Naughton – Trevee, 2018) [15]. The size criteria for big animals has been varied, ranging from [16] loss or change due to human activities in Nigeria is a serious challenge for wildlife conservation (Ogunjemite *et al.*, 2007) [17]. There is little question that Nigeria's forest ecosystems have been degraded and mismanaged on a vast scale. Ecological catastrophes and climate change have resulted in soil fertility loss and drastically reduced biological production [18] (Oduwaiye *et al.*, 2012). About 75% of Nigeria's natural wildlife habitat has been gone [19] (Oduwaiye *et al.*, 2012). This has had negative impact on animal resources within these biological systems, leaving just a few residual populations in protected places such as forest reserves. Forest reserves are relatively large areas of land or sea where one or more ecosystems have not been materially altered by human exploitation and occupation, where animal and plant species, geomorphological sites, and habitat are of special scientific, educational, or recreational interest, or which contain a beautiful natural landscape. The three forest reserves chosen include remains of the principal rainforests of the south western Nigeria eco zone, and they are the region's best hope for long-term survival of the region's surviving biological diversity. According to [20] Oduwaiye *et al.*, (2012), these forest reserves are home to a diverse array of fauna and flora species. These chosen locations provide an excellent opportunity to achieve the nation's tourism goals. Imenko Afon game reserve is one of the most popular tourist attractions in south western Nigeria. The wildlife

reserve, which is conveniently located near several of the region's bustling towns, has the potential to draw tourists from these areas for weekend getaways in a tranquil rain forest setting. The forest reserves of Ohumbe and Eggua, in particular, provide a diverse selection of supplementary sites that might help increase ecotourism. Ecotourism may prove to be a viable alternative to Nigeria's sole reliance on petroleum resources for revenue [21] (Marguba, 2016).

It's easy to feel gloomy about the destiny of Mother Nature on our globe. The human population is increasing, and our resource use is increasing as well [22] (Warton *et al.*, 2012). True wilderness regions are few and far between, yet the human impact is everywhere [23] (Heil, *et al.*, 2007). Human actions have wiped off many species, and a huge number of well-known taxa are threatened or endangered [24] (Steadman 1995). (Hoffmann, *et al.*, 2010). The loss of tiny and less visible species, such as invertebrates, is larger than the loss of vertebrates, and their extinction goes largely unreported [25] (Jenkins and Jopa, 2019). (Mittermeier, *et al.*, 2017) [26]. Unfortunately, even when a species' endangerment is identified and recovery attempts are planned, political posturing and misplaced priorities cause taxa to fade into obscurity (Mace *et al.*, 2005) [27]. What should we do in light of all this negative news? As citizens of the world, we must adjust our own behaviors in order to live sustainably, and we must demand that our policymakers implement plans to safeguard and restore biodiversity and functional ecosystems. Our responsibility as scientists, on the other hand, is to ensure the quality of science-based decision-making through peer review and to offer policymakers with neutral facts and expert interpretation. Animal behaviorists (a wide term that encompasses behavioural ecologists, comparative psychologists, and others) have recently become more prominent.

A Review of ICDP Assessments on Biodiversity Conservation and Local Development, the development of parks and protected areas, the formation of natural reserves, and the adoption of integrated conservation and management strategies are all common ways to preserve biodiversity projects for development (ICDP). In terms of human conservation, they differ in their strictness consumptive applications. The essential aspect of the national parks concept, for example, is that local livelihood is believed to clash with conservation: national parks have clearly defined borders that exclude livelihood activities and seldom assist local economic growth. People are created to be used Park resources, as well as plants and animals, are intended to stay in the park. Despite the fact that national Parks remain an essential conservation strategy, although they have proven difficult to execute in the past many circumstances, particularly in underdeveloped countries where enforcing boundaries is difficult owing to due to a lack of government

resources, insufficient management capabilities, remote locations, and incompetent management legal frameworks [28] (Brandon, 1998). Furthermore, by altering community boundaries and land use control, national parks have contributed to the marginalization and poverty of rural communities that have been excluded from parks [29] (Mucina and Rutherford, 2008), as well as negatively affecting the rules that govern the use of resources by community members, resulting in conflicts over natural resources outside the park [30] Mucina and Rutherford, 2008). Furthermore, because many national parks have been proposed on lands or in waterways that are legally or habitually owned and administered by local people, declaring these sites off-limits to human usage has frequently proven difficult, unlawful, or impossible. Challenges in social and political life Governments have frequently been unable to build national parks, even when they have the resources to do so. With the help of a large number of donors. In nations where isolated communities are subjected to systemic discrimination, it has been politically difficult to spend money on addressing social and economic disparities. At the same time, there are a lot of impoverished individuals who have a lot of needs. The necessity to design solutions that allow for both economic growth and environmental protection and development for local people has led to the creation of biosphere reserves, where people have the right to exploit biological resources within certain spatial boundaries zones. Consumptive resource usage is forbidden in core zones, although buffer zones enable individuals to do so to employ resources in a way that ensures the core zone's protection. Despite the promises of this technique, local people have frequently continued to consume resources in the core zone or advocated for the expansion of buffer zones into the core region, limiting its success. Furthermore, it has not offered incentives to local communities to prevent external threats to biodiversity. As a result of these flaws, conservationists began to create new ways based on the notion of making livelihood activities dependent on and therefore directly related to biodiversity, i.e., livelihoods drive conservation rather than being compatible with it. Because people are provided with possibilities to directly profit from biodiversity, they are likely to be motivated to prevent external threats to biodiversity. There has been a lot of discussion about whether ICDPs genuinely help to conserve the environment and if they are beneficial for local people [31] (Pienaar, 2014). Assessments of the connections between community-based ecotourism and biodiversity protection have proven problematic due to a paucity of data. In this regard, most techniques to determining conservation success rely mainly on biological markers of success, which entail analyzing biological factors at a specific location. Although much work has gone into creating biologically based approaches, just handfuls are practical and cost-effective, particularly for use in the ICDP.

The Role of Large Mammals in Nature Tourism

Ecotourism is becoming more popular as a mode of transportation. It has experienced unprecedented expansion in recent years and is expected to continue to do so well into the next century [32] (Dharmaratne, Sang, and Walling, 2000) [33]. Ceballos-Lascura'in (1996) discovered that citizens in developed countries are increasingly interested in visiting and spending money in less disturbed natural areas to view nature and wildlife. Nature and wildlife viewing are extremely popular in East Africa. Large mammals are a common reason for tourists to travel to East Africa. Protected areas in East Africa offer the best chances to see large mammals (Dharmaratne *et al.*, 2000) [34]. Over 55 protected areas encompass 44,000 km² (8%) of Kenya's territory (Okello, Wishitemi, and Mwinzi, 2001) [35]. Kenya has clearly demonstrated that it has not only conserved wildlife but also solidified the economic foundation for its nature-based tourist economy.

Ceballos-Lascura'in (1996) [36] estimated that the worldwide value of nature-based tourism in Kenya was \$1 trillion in 1988. Kenya's exchequer and several local economies now rely on wildlife-based tourism to generate cash. Wildlife-based tourism is extremely profitable, contributing over \$350 million to the Kenyan economy each year, or nearly 12% of the country's GDP (Okello *et al.*, 2001) [38]. Tourism revenue topped half a billion dollars in 1994, more than double coffee sales (\$214 million) in the same year (Okello *et al.*, 2001) [39]. By 1998, Kenyan tourism had surpassed traditional agricultural exports of coffee, tea, and horticultural output as the country's top earner of foreign money. Despite the problems posed by recent terrorist attacks, tourism is nevertheless a booming sector. It is critical to protect the well-being of the wildlife that feeds the tourism sector because of the significant economic benefits it brings.

MATERIALS AND METHOD

Official partition maps suggest a total land area of 540.45 km² at 6°51'28"N 5°06'20"E, whereas the Idanre forest reserve has a total land area of 527.1 km² [40] Isichei (Isichei, 1995). A lowland rainforest may be found in the reserve, with heights varying from 10 to 400 meters above sea level. Throughout the Idanre reserve, there are inselbergs and high woods [41] (Okosodo, *et al.*, 2016). The forest's average elevation, however, is just about 177 meters. The average annual temperature in the area is between 25 and 26 degrees Celsius, with lows of 19 degrees Celsius and highs of 33 degrees Celsius. Annual precipitation varies between 1200mm and 2200mm. The forests are part of the Nigerian lowland forest ecoregion, which runs from Benin's eastern border to the Niger River in the west and is part of the Congolian subdivision of the Guinea-Congolian belt (Mengistu, 2007) [42]. *Mansonia altissimas*, *Nesogordonia papaverifera*, *Pterygota* spp.,

Sterculia spp., *Triplochiton scleroxylon*, *Antiaris africana*, *Ficus* spp., *Milicia excelsa*, *Brachystegia* spp., *Cyclocodiscus gabunensis*, and *Gossweilerode* are some relatively dominant plant species where intact natural forest vegetation still (Okosodo, *et al.*, 2016) [43]. Mixed deciduous forest is the dominating plant type in the region. Human activities such as logging and farming, on the other hand, have long affected land cover and natural forest vegetation. In the hilly areas, an equally large area has become fallow, dominated by the invasive weed *Chromolaena odorata*, suggesting recent removal, and the vegetation has progressively returned into secondary regrowth and isolated undisturbed forest. Secondary forest, secondary bush, plantain plantations, cocoa plantations, and other forms of agricultural crop land have replaced the reserve's original forest cover.

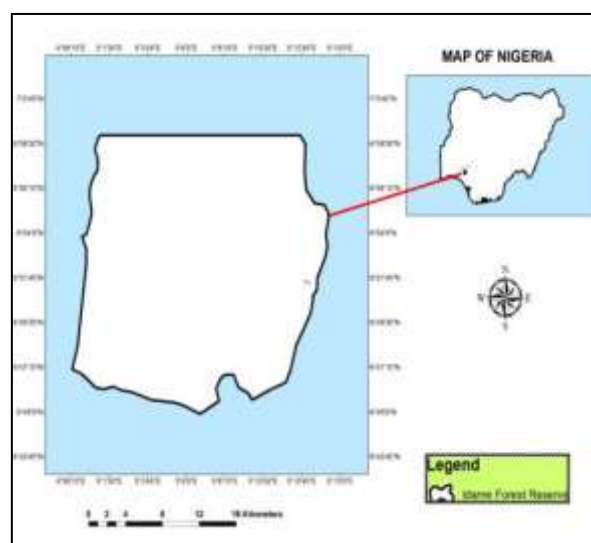


Figure 1: Map of the study area (source: Awoku and Ogunjemite, 2019)

Data Collection

The line transects approach described by (Sutherland, 2009) was used to collect data on the variety and abundance of animals in the study region. A total of 40 transect lines of 1000 m were randomly set, and each transect was broken into 200 m parts. Each compartment received 20 transects at random. In all, 40 transect lines were randomly put in the reserve's two divisions, and the forest reserve was separated into compartments for the purposes of this research study.

GPS 2011 Utility (GPSU, 2012) was utilized to determine the starting and finishing positions of transects. Transect lines were walked three times per week for three months throughout both seasons (May, July, and September for the rainy season and November, January, and March for the dry season). The survey was done between 0600 hours and 10.00 hours, and 1600 hours to 1800 hours. The survey was not conducted after 10.00 hours in the morning to limit the influence of day light. We walked carefully at 1-1.5 km/hr on bush pathways or hunter routes at each survey

location, documenting the animal species we encountered, as well as the time, GPS positions, and mode of detection (heard or seen) (White and Edwards 2000). We noted the height (HT) of the tree, the height (HT) of the person from the ground, the sighting distance, and the number of individuals observed as much as possible when an animal was spotted in a tree. Each survey was 1.5km long, and the pathways were roughly linear. We recorded encounter rates based on a one-kilometer stroll. During our foot surveys, we attempted to record the monkeys' vocalizations with a Zoom H2N digital recorder and a Sennheiser ME66/K6 super-cardioid microphone. We also collected and photographed signs of anthropogenic disturbance (e.g., spent shotgun cartridges, hunters' footprints, gunshots, hunters' camps, burnt logs, felled trees) as we went, and approximated the date of occurrence. These are presented as *n s* frequencies rather than indices of occurrence; for example, herds of cattle that traverse a forest leaving countless footprints are difficult to quantify. Data on bird species was also gathered in the research area's two sections.

Statistical Analysis

Prior to both descriptive and quantitative analyses, Data from the field survey were input into an excel (version 15) spread sheet (tables, frequency and percentage frequency, graph, pie and bar charts). The PAST Model version 3 computer program was used to examine plant species diversity indicators.

RESULTS

Twenty-three (23) animals were counted in the research study area, according to the data. The White-throated Monkey has the highest frequency of observation (19%), which is closely followed by the Mona Monkey (13%). The African Tree Pangolin has the lowest observation rate of all of the pangolin species (Table 1). There have been opportunistic sightings of Chimpanzees, Forest Elephants, Forest Buffalos, and Bushbabies inside the research study area (Table 2). The dry season (0.9101) had more sightings than the wet season (0.9101), according to the Simpson diversity (0.9066).

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Table 1

Name of Animals	Scientific Names	Family	Frequency of Observation in percentage %
White Throated Monkey	<i>Cercopithecus erythrogaster</i>	Cercopithecidae	19
Red Capped Margabey	<i>Cercocebus torquatus</i>	Cercopithecidae	11
Putty Nosed Monkey	<i>Cercopithecus nictitans</i>	Cercopithecidae	10
Mona Monkey	<i>Cercopithecus mona</i>	Cercopithecidae	13
Maxwell Duikers	<i>Cephalophus maxwelli</i>	Cephalophinae	9
Red Flanked Duiker	<i>Cephalophus sylvicultor</i>	Cephalophinae	7
Yellow Backed Duiker	<i>Cephalophus rufilatus</i>	Cephalophinae	5
West Africa Sitatunga	<i>Tragelaphus spekii</i>	Bovidae	6
Bush Buck	<i>Tragelaphus scriptus</i>	Bovidae	6
Western Tree Hyrax	<i>Dendrohyrax arboreus</i>	Procaviidae	4
Kucusimance mongoose	<i>Crossarchus obscurus</i>	Viverridae	3
Rock Hyrax	<i>Procavia capensis</i>	Procaviidae	3
Tree Hyrax	<i>Dendrohyrax arboreus</i>	Procaviidae	3
African Tree Pangolin	<i>Phataginus tricuspis</i>	Manidae	1

Table 2: Other Animals Observed with Opportunistic Sighting

Me of animals	Scientific names	Family	Opportunistic sighting
Forest Elephant	<i>Loxodonta cyclotis</i>	Elephantidae	<i>Footprints, dung, debarking Ucaapa trees, feeding on tetrapleura tetraptera ,debarking and felling of trees Musanga sp, Albizia sp</i>
Forest Buffalo	<i>Syncerus caffer nanus</i>	Bovidae	<i>Foot prints, dung, grazing Cyprus ex exculenta round the lakes, wallowing in the mud area</i>
Bush Pig	<i>Potamochoerus</i>	Suidae	<i>Feeding on sedges crabs and snails, footprints</i>

	porcus		
Civet cat	Viverra civeta	Viverridae	Footprints and fecal droppings
Chimpanzee	Pan troglodytes	Hominidae	Nest on top of rocky hills
Bushbaby	<i>Sciurocheirus cameronensis</i>	Galagidae	Night calls

Table 3: Diversity index of animals sighted between the two seasons

Diversity Index	Dry season	Lower	Upper	Wet season	Lower	Upper
Taxa_S	17	13	17	14	10	14
Individuals	63	63	63	34	34	34
Dominance_D	0.08995	0.08088	0.1328	0.09343	0.08997	0.1609
Simpson_1-D	0.9101	0.8672	0.9191	0.9066	0.8391	0.91
Evenness_e^H/S	0.784	0.6566	0.8491	0.8669	0.7062	0.9151
Brillouin	2.238	1.991	2.289	2.026	1.715	2.038
Menhinick	2.142	1.638	2.142	2.401	1.715	2.401
Margalef	3.862	2.896	3.862	3.687	2.552	3.687
Equitability_J	0.9141	0.8471	0.9406	0.9459	0.8619	0.9637

Table 4: Checklist of mammals in the study area

Common Name	Scientific Name	Family
Chimpanzee	Pan troglodytes	Hominidae
White Throated Monkey	Cercopithecus erythrogaster	Cercopithecidae
Red Capped Margabey	Cercocebus torquatus	Cercopithecidae
Putty Nosed Monkey	Cercopithecus nictitans	Cercopithecidae
Mona Monkey	Cercopithecus mona	Cercopithecidae
Maxwell Duikers	Cephalophus maxwelli	Cephalophinae
Red Flanked Duiker	Cephalophus sylvicultor	Cephalophinae
Yellow Backed Duiker	Cephalophus rufilatus	Cephalophinae
Bush Buck	Tragelaphus scriptus	Bovidae
West Africa Sitatunga	Tragelaphus spekii	Bovidae
Forest Buffalo	(Syncerus caffer nanus	Bovidae
Forest Elephants	Loxodonta cyclotis	Elephantidae
Bush Pig	Potamochoerus porcus	Suidae
Rock Hyrax	Procavia capensis	Procaviidae
Tree Hyrax	Dendrohyrax arboreus	Procaviidae
Kucusimance mongoose	Crossarchus obscurus	Viverridae
Civet cat	Viverra civeta	Viverridae
African Tree Pangolin	Phataginus tricuspis	Manidae

DISCUSSION

The undisturbed segment of Nigeria's Idanre forest reserve contains one of the reserve's greatest populations of big animal species. 19 of the 23 big animals met in the research area were directly observed in this compartment; four were documented by their activities, and one was recorded by opportunistic observations and its activities. These findings are in line with those of [44] Akinsorotan and Ogunjemite (2011), Awoku and Ogunjemite (2019) [45] reported the same species of large animals in Okomu National Park and Idanre Forest Reserve, a forest environment in southern Nigeria that is highly rich in primates species, White Throated Monkey, an endemic monkey species, and Red Capped Margabaygroup sizes were high. This is consistent with the findings of [46] Oates *et al.*, (2008) and Orimaye (2017) [47], who found similar large group sizes for primate species in Okomu National Park and Idanre Forest Reserve.

The majority of the large animals were found in the undisturbed compartment, with the exception of Forest Elephants and Forest Buffaloes, which were found in the secondary compartment. This might be attributed to human activity in the research region. Because of the lessened influence of agricultural, logging, and hunting activities in this region, the distribution of big animals is concentrated in this section of the reserve. The chosen research region appears to have more of these huge creatures due to the limited influence of human activities in this area, as described in prior studies by Akinsorotan and Ogunjemite (2011) [47]. The chimps were not seen during the investigation time, but their behaviors were documented on dormant heavily eroded rocks. Their behavior may have changed as a result of poaching, deforestation, and farming in the research region. The

research region is rich in big animals, which will aid in the planning of sustainable tourism.

CONCLUSION AND RECOMMENDATIONS

The Idanre Forest Reserve provides an exceptional opportunity to boost the study area's tourist potential by ensuring direct observations of around 18 big animal species. Tourist amenities (tracks, trails, and lodging) should be constructed inside the forest reserve to provide a diverse variety of complementary destinations for ecotourism growth. Because nature conservation is a highly significant land use form, it is critical to create their foundations for profit-oriented management so that they can survive the economic and political forces that threaten their survival. Local community leaders should have a voice in how the forest reserve is managed in order to conserve these enormous beasts. There is a need for compartmentalization of the entire forest for easier administration of the forest reserve; this is one of the strategies to ensure their long-term functioning. There is a necessity to provide strict protection to these animals in the compartments in order to avoid the repetition of the situation that occurred in other compartments. The government should work with local community leaders to halt the surge of illegal colonies in the study area.

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