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An Inventory of the Geological, Biological and Cultural Resources on Ufe-Oke Hill, Idanre, Southwestern Nigeria

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ABSTRACT

Idanre, which represents a unique topographical landscape within southwestern Nigeria, is being proposed to the United Nations Educational Scientific and Cultural Organization (UNESCO) for designation as a world heritage site. In line with this, we conducted a survey to document the rich geological, biological and cultural resources contained within the Ufe-Oke section of Idanre Hills. Our geological inventory revealed two major rock types, older porphyritic granite and fine grained granite, in addition to other minerals. We identified insects belonging to 174 *species while fishes from* 4 *species were collected. Mammals belonging to* 13 *species were identified through trapping, sightings and signs, although an even greater variety was inferred from interviews with hunters and visits to local fetish markets. Patterns concerning how these biological taxa are distributed altitudinally along Ufe-Oke Hill are discussed. In addition, in the quarters within Ufe-Oke representing the ancient city of Idanre, we characterized about* 200 *pieces of anthropological material, which included pottery shards, beads, chinaware, brass bangles and ancient metal coins. We also identified various other major features of archeological interest. Finally we offer recommendations, in the light of our findings, concerning how the variety of resources catalogued in this study can be effectively harnessed while sustaining at the same time the environmental integrity of this site, which offers the greatest opportunities and potential for tourism.*

***Keywords*:** *Ufe-Oke, Idanre, Nigeria, Geological, Biological, Cultural, Resources, Tourism*

1. Introduction

Nigeria is a signatory to the Convention on Biodiversity [1]. Each signatory to this convention is expected to identify and document its biological diversity, with a view to providing the knowledge necessary for its conservation and sustainable use. However, Nigeria is yet to embark on serious efforts in this direction, despite the fact that a major strategic objective of this convention is to achieve a significant reduction of the current rate of biodiversity loss by the year 2010. Hills and mountains represent unique ecosystems among those that the CBD seeks to conserve. However, rock outcrop communities usually receive very little attention from scientists and environmentalists [2].

Idanre, lying approximately between about 286 to 500 m abve sea level, represents one such topographically unique landscape located within the forest zone of southwestern Nigeria. This locality is also one of historical significance. Oral history claims the people of Idanre originally migrated from Ile-Ife to settle in Ufe-Oke; Ufe-Oke being an adaptation of the Yoruba phrase Ife-Oke, which means "Ife in the Hills". According to Akinbola [3] in 1933 the local residents descended to where present-day Idanre (Odo-Ode) is situated. Ufe-Oke, the group of peaks representing ancient Idanre, continues to arouse increasing ecological and cultural interest, with arrangements currently being made at various levels of the Ondo State government in Nigeria and also by non-governmental organizations to develop its tourism potentials. The area is also being proposed to the United Nations Educational, Scientific and Cultural Organization (UNESCO) for designation as a World Heritage Site.

Important but outdated botanical data exist for Idanre [4]. Also, a preliminary archaeological survey was con-

ducted in 1989 [3]. To date, however, there has been no definite and comprehensive information published on the biodiversity and species abundance in Idanre. Also, the few exploratory investigations carried out on the area have not been done in a holistic fashion, but as separate, unconnected studies. Wilson [5] defined biodiversity as the variety of organisms considered at all levels, from genetic variants belonging to the same species through arrays of species to arrays of genera, families, and still higher taxonomic levels; including the variety of ecosystems, which comprise both the communities of organisms within particular habitats and the physical conditions under which they live.

This demonstrates the importance of conducting biodiversity surveys that are multifaceted, combining various aspects of the environment and investigating important patterns of interaction between these components. An example of such a survey has been carried out by members of this team of authors in Okeiho, southwestern Nigeria [6], establishing relationships between rock composition and floral and faunal diversity. Such a survey is also desirable and long overdue in Idanre. Toward this end it was the purpose of our team, made up of scientists from various fields of natural history, to conduct an inventory to describe the geological, biological and cultural diversity present on Ufe-Oke Hill in Idanre; to provide a database against which future changes in this diversity can be measured; and to investigate how important components of this diversity vary along elevational gradients.

2. Materials and Methods

Idanre is bound by longitudes 5˚00' E to 5˚15' E and latitudes 7˚00' N to 7˚15' N, covering an area of 750 km² (**Figures 1** and **2**). The general terrain of Idanre stands at a height of between 286 - 500 m above sea level (abs). It is elevated in relation to the surrounding rainforest zone of southwestern Nigeria, which lies at ≈ 200 m abs and for which average temperatures have been recorded between 24 - 34˚C and rainfall up to 2000 mm.

The general cover vegetation in Idanre, especially at the base of Ufe-Oke Hills, is composed of herbaceous species, lianes, climbers and tree seedlings. Among these, dominant genera include *Chromolaena*, *Aspilia*, and *Combretum*. Uphill on Ufe-Oke, shallow valleys and cracks accommodate small trees and shrubs while the gentler slopes form substrates for various families of grass. The deeper valleys and cracks accommodate larger, taller trees such as those from the families Sterculiaceae, Apocynaceae, etc, which appear to take the advantage of the deep soil formed from weathering of the rocks. Large areas of the rock surface also support diverse types of lichen, blue-green algae and patches of moss—important indicators of rock degradation and plant succession.

Figure 1. Aerial view of modern Idanre town (Odo-Ode), photographed from Ufe Oke Hill.

From 2007 up to 2009, sampling was carried out in the study area during four visits: twice in the rainy season (≈ April to October) and also twice in the dry season (≈ November to March). These sampling sessions were carried out in the Ufe-Oke section of Idanre Hills across three pre-selected transects, which were designated based on elevation and spatial considerations. These transects are named as follows:

- Base (below 400 m abs): from the foot of Ufe-Oke section of the hills up to the site of the ancient town, where the topography evens out into more level, horizontal ground. Amid these lower slopes lies the stairway carved out for tourists to ascend into the hills (**Figure 3(a)**).
- Mid Height (≈ 400 - 500 m abs): The elevation containing the site of ancient Idanre town, which is located on comparatively horizontal ground and lies amidst the highest jutting peaks within the Ufe-Oke area. This transect contains some anthropological features such as deserted huts from the ancient town and little scattered farm plots under active cultivation. The ancient town is divided into four major quarters which are Isalu, Irowo, Idale and Ajin, demarcated by jutting peaks, gulleys and streams (**Figure 3(b)**).
- Summit (above 500 m abs): The highest peaks in Ufe-Oke, which protrude above Mid Height, the site of the ancient town. Among these highest peaks is Orosun, from where the headwater of Arunjeje River takes its course (**Figure 3(c)**).

During the field visits, rocks and mineral samples were collected and analyzed in thin sections. Collection of insect samples was carried out by hand-picking, sweep-netting, suction trapping and pyrethrum knock-down from the floor litter, tree trunks and canopies. All insect specimens were sacrificed with ethyl acetate, dried prop-

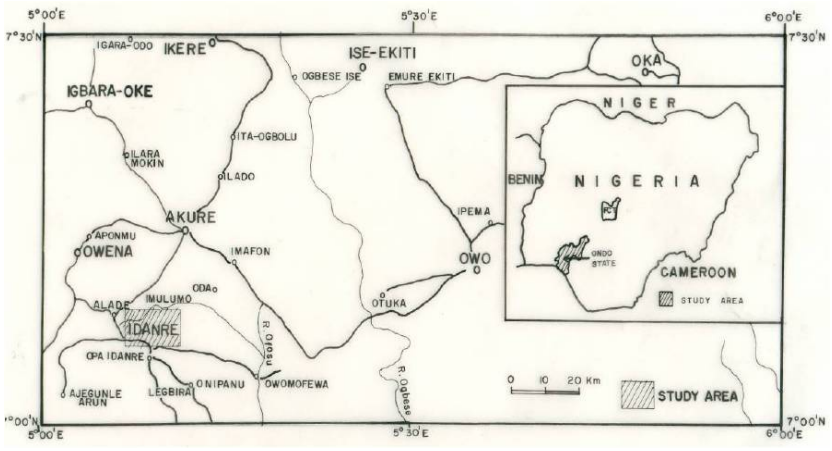

Figure 2. Map showing Location of Study Area.

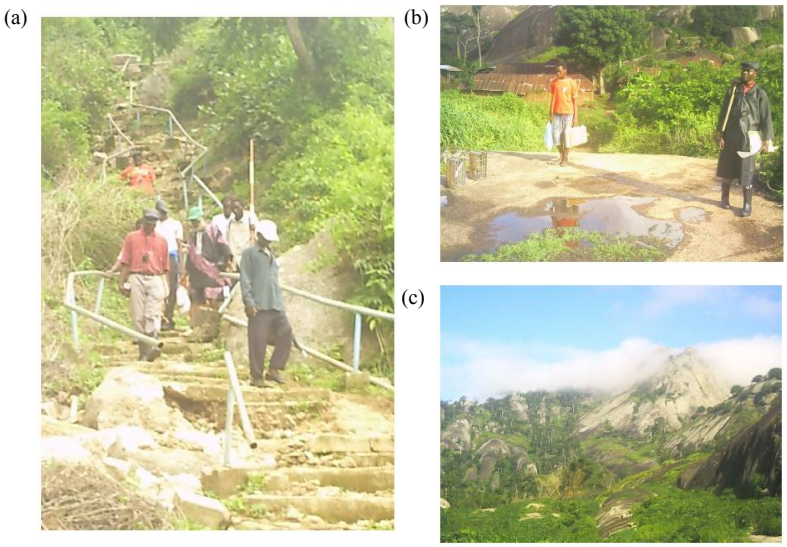

Figure 3. Sites sampled from the Base (a), Mid Height (b), and Summit (c) transects of Ufe-Oke Hill.

erly, and identified before being stored in insect boxes and storage cabinets.

Fish samples were preserved in 80% alcohol. Specimens were collected from five identified rivers at the base of the hill around various sections of Idanre town as well as from Arunjeje River on the Mid Height elevational transect of Ufe-Oke Hill. Fishes were collected with assorted gears depending on the nature of the water body from which samples were collected. The gears used were gill nets of 15 mm and 25 mm mesh sizes, hand nets, hook and line as well as with baskets. Fish species were identified by a combination of keys by Lewis [7] and Fishbase [8]. The total length (TL) and standard length (SL) of fish samples were recorded in millimeters (mm).

In order to assess the diversity of non-volant mammals in Idanre, a two-pronged approach was followed. First, hunters and fetish market traders were interviewed via a questionnaire featuring photographs of mammals known to be present within southwestern Nigeria from the publication of Happold [9], in order to ascertain whether the respondents frequently saw or encountered these animals within Idanre and its environs. Secondly, the Ufe-Oke Hill, the site of ancient Idanre town where tourism activities are concentrated, was sampled for the presence of large mammals using a pair of binoculars. Within Ufe-Oke, sampling for the presence of the smallest-sized mammals such as rodents was through the use of locally manufactured live-capture traps. Also, signs as foot tracks, feacal droppings and partly decomposed carcasses served to confirm the presence of certain mammal groups during the sampling.

The altitudinal position for each scientific sample tak-

en in this study was recorded employing a Global Positioning System (GPS).

3. Results and Discussion

3.1. Diversity of Rocks and Minerals

The geology of Idanre was first published in the Geology Survey of Nigeria (GSN) 1:250,000 on Akure Sheet 61[10]. Jeje [11] showed that the development of different landforms in Idanre hills was controlled by structures such as joint direction, density and lithology. Oyawoye [12] cited the Idanre granite-charnockite association as an example in which charnockite rocks occur at the core of the granite intrusion. According to him, the Idanre granite-charnockite association marks the southern limit of a belt of granite and charnockites that runs for about 200km from Idanre to Osi in Kwara state. Tubosun et al. [13] published U-Pb data on zircons extracted from granite-charnockite associations in Idanre-Ado-Ekiti area.

Durotoye [14] described these hills as residual hills. The hills rise above a dissected pediment that lies at an average altitude of between 150 to 250m above sea level. The headwater of Arunjeje River takes its course from the highest level of these hills. The drainage pattern in the study area is typically dendritic in which rivers and streams are developed along major joint directions and their courses are generally straight [11].

An inventory study of different rock types of Idanre Hills shows that two rock types occur in Idanre area. These are the older porphyritic granite and the fine-grained granite aplite. Outcrop exposures within the study area are generally good because most of the hills are devoid of thick vegetation. This rock type outcrops in so many locations in the study area (**Figure 4(a)**).

The Older porphyritic granite occurs as inselberg and is the major rock type in this area. The term "Older Granite" was introduced by Falconer [15] to distinguish the group of (essentially cal alkaline) plutonic rocks of granitic to granodioritic composition from the high level "Younger Granites" of the Jos Plateau area, North central Nigeria. This rock type is a member of the Older Granite Suites that constitute a major petrographical unit of the Nigerian Basement Complex. The Nigerian Basement Complex is polycyclic and has been involved in at least two or three orogenic episodes (the Liberian, Eburian and Pan-African orogenies). Ocan [16] showed that the coarse porphyritic granites can be distinguished with some measure of confidence as members of the Older Granite suite in the study area.

An inselberg, according to Durotoye (1976), is developed on coarse charnockite rocks and granites, rising abruptly above gently sloping Pediment plains and rejuvenating valleys that are formed over migmatite basement complex rocks. Similar inselberg was reported by Durotoye [14] in Isan-Ekiti where it's down slope initiate rock- boulder landslide. Another inselberg terrain similar to that of Idanre (study area) was reported in Imesi-Ile by Burke and Durotoye [17] and in Olusoye near Ile-Ife by Jeje [18].

The fine-grained granite aplite on the other hand occurred as a minor intrusive in the older granite. They occurred as veins in the former rock type in fewer locations in the study area (**Figure 4(b)**). Ocan [16] showed that the fine-grained granite aplite can also be distinguished with some measure of confidence as members of the Older Granite suite in the study area.

Mineralogically, the coarse porphyritic granites compose, as seen in both hand specimens and thin sections (**Figures 4(c)-(h)**), of quartz of about ~ 25%, orthoclase ~ 40%, Plagioclase ~ 5%, Biotite ~ 2%, Amphibole ~ 1%, Muscovite ~ 0.09% and Opaque ~ 0.5% (see also **Table 1**). The common texture observed, on outcrops, hand specimens and in thin sections under microscope is porphyritic texture (**Figure 4(i)**). In this, the larger grains or crystals of mineral called phenocrysts are embedded or suspended in the fine-grained aggregate called groundmass. In addition, myrmekitic texture was observed on the intergrowths of quartz and plagioclase grains (**Figure 4(i)**).

The color of the finely-grained aplite in the outcrop and hand specimen is pinkish (**Figures 4(b)** and **(j)**). Mineralogical compositions of this rock are mainly interlocking of quartz, K-feldspars (**Figures 4(k)** and **(l)**) and minor occurrence of biotite and opaque mineral (**Figure 4(m)**). In hand specimen the rock has fine-grained, almost sugary texture. Under the microscope the quartz and feldspar are anhedral and meet along straight or sutured contact (**Figure 4(l)**). The pattern commonly suggests a series of interlocking tiles and which best described as mosaic texture.

The field and laboratory evidences have shown that the porphyritic granite is the older rock type in the study area which occurred as intrusion of acidic molten magma into the overburden and cooled down during the last Pan-African Orogeny. The consolidated rock resulting from this process was exposed to the surface due to the erosion of the overburden. Consequently, the exposure of this rock led to its fracturing into joints and crevices which later in-filled by another set of molten magma which cooled down to form the second and younger rock type in the study area, fine-grained granite aplite.

There was evidence of both physical and chemical weathering on the rocky outcrops in the study area. Feldspars are more susceptible to weathering than Quartz. This is evidenced by the alteration of the K-feldspar as seen in the fine-grained granite aplite under microscope (**Figure 4(l)**).

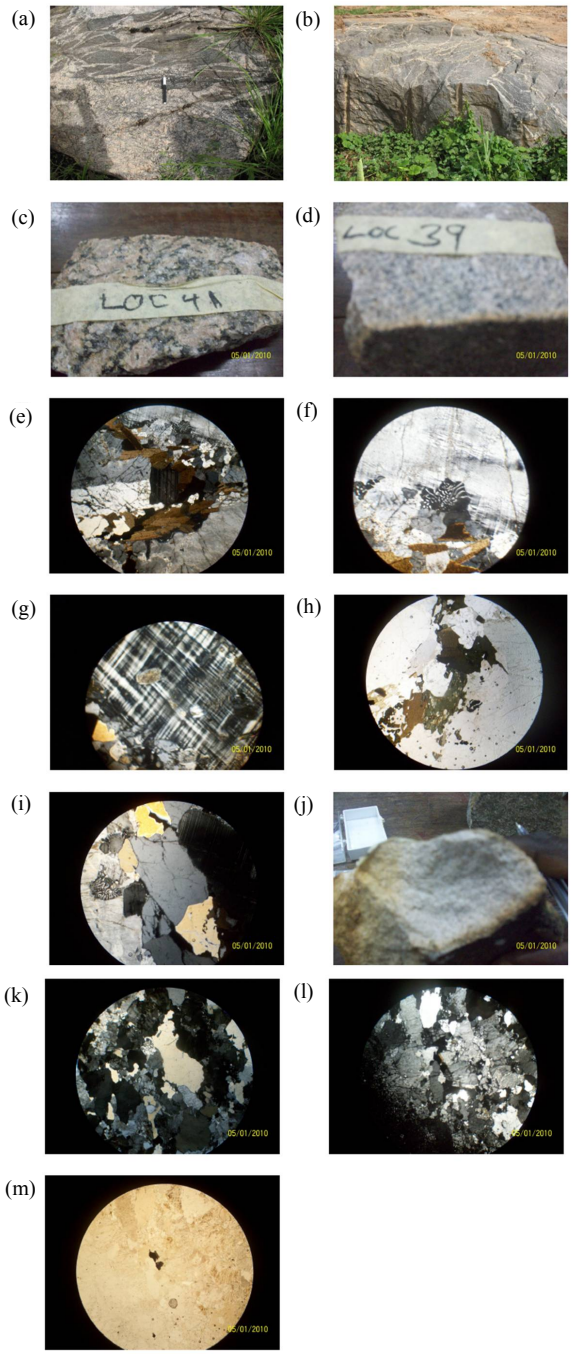

Figure 4. Rocks and minerals discovered on Ufe-Oke hill (a) Outcrop of older porphyritic granite; (b) Outcrop of fine-grained granite aplite; (c)Hand specimen of porphyritic granite showing phenocryst minerals embedded in the groundmass; (d) Small-scaled hand specimen of porphyritic granite showing phenocryst minerals embedded in the groundmass; (e), (f), (g) & (h) Thin sections showing mineral composition of porphyritic older granite; (i) Thin section showing porphyritic and myrmekitic textures; (j) Hand specimen of fine-grained granite aplite with sugary texture; (k), (l) & (m) Thin sections showing mineral composition of (j).

Table 1. General rock diversity in Idanre.

Rock/mineral	Abundance
Older porphyritic granite	Very abundant
Fine grained granite aplite	Less abundant
Quartz	Abundant
Feldspars	Abundant
Biotite	Few
Amphibolites	Occurred as accessory mineral
Opaque minerals	Occurred as accessory mineral

3.2. Diversity of Invertebrates: Insects

A major gap in the understanding of the ecology of Ufe-Oke and Idanre Hills in general is the absence of any information on the insect fauna. It has however been reported that insects, a group that is presumed to constitute about three-fourths of all living animals on earth, are of great importance in the understanding of many ecosystems. In fact, it has been argued that any biodiversity assessments that do not consider insects have omitted the greatest of biodiversity components. Yet, as Miller and Rogo [19] have observed, few centers of expertise on insect diversity and systematics exist in tropical Africa, while most large insect collections are housed in South Africa, Europe and the United States.

In this study, insects belonging to twelve orders, forty eight families and one hundred and seventy four morpho-species were collected from the Base, Mid-height and Summit of Ufe-Oke Hill (**Table 2**).

Chi-square analysis indicates significant difference between collections at the Base and Summit transects ($P < 0.05$). The composition of insect species at the Base is not significantly different from that of Mid-height, nevertheless the probability that these two insect communities are the same is also low ($P = 0.08$). The communities at Mid Height and Summit, on the other hand, are not significantly different ($P = 0.18$).

Variation in the composition of insect species at each collection site may be attributed to differences in topography of each site, type of vegetation in each site as well as human influences [20]. For instance, the Base of Ufe-Oke Hill is characterized by annual plants and other ephemerals. The Base and the surrounding lowland are thickly populated by man; and this may be responsible for the high population of Blattodea and Muscidae at this elevation.

The bulk of the flora at Mid Height consists of semi-deciduous forest or woodland varying greatly in tallness as well as herbaceous vegetation and annuals in farmed areas. Biotic influences of many kinds operate on the vegetation and it is only on hill slopes which are too steep or too stony to cultivate that there are plant communities in a relatively natural state. The Summit is characterized with sparse vegetation which developed from the depressions and gulleys between rock domes.

Table 2. Composition of insect fauna at various elevations on Ufe-Oke Hill. The lower section of the table displays a Chi-square comparison of insect community compositions across different elevational sampling transects on Ufe-Oke Hill. Upper triangle represents Chi-square values while lower triangle represents probability that the insect community structure between each transect being compared is statistically insignificant.

	Number of species		
Insect order	**Base**	**Mid height**	**Summit**
Ephemeroptera	0	0	6
Odonata	0	2	13
Blattodea	3	0	0
Isoptera	2	2	2
Mantodea	3	3	3
Orthoptera	15	15	23
Homoptera	20	21	21
Heteroptera	30	34	34
Coleoptera	30	16	26
Diptera	29	10	14
Lepidoptera	12	12	12
Hymenoptera	17	19	20
Total	**161**	**134**	**174**
χ2 comparisons	**Base**	**Mid Height**	**Summit**
Base	--	16.5	29.26
Mid Height	0.08	--	13.86
Summit	0.002*	0.18	--

* indicates probabilities that are significantly different ($P \leq 0.05$).

There are streams which run through the Mid Height and Summit transects, serving as boundaries to quarters of the ancient Idanre town in Ufe-Oke. For instance, Odolemo stream separates the Idale and Isalu quarters while Arunjeje stream is between Isalu quarters and Ajin quarters. The presence of these streams could explain the high preserve of Odonata and Ephemeroptera on the Summit as shown in **Tables 2**.

3.3. Diversity of Vertebrates: Fishes and Mammals

Four fish species belonging to three families were recorded during the period of study. A breakdown of fish samples collected during this study is presented in **Table 3**. The results obtained from the analysis of fish samples collected showed that the rivers in the Idanre Hill area have fishes of scientific importance. Though the *Barbus* spp are popular in the aquarium trade at the global level [8], this study revealed that they are of food value in the Idanre area. It has been established that fishes of all sizes are consumed in developing nations like Nigeria.

Clarias anguilaris has been reported to be common in many freshwater bodies in Nigeria [21]. In addition to their food value, the *Clarias* species also give some cash value to the school children in this community as some of them sell their catches when they are lucky to find sizeable fish. The angling skill displayed by the children in this area is noteworthy. It is hopeful that with adequate enlightenment on the values on conservation, these children can be encouraged to practice the "catch and return" policy promoted by anglers in developed world.

Though the Carnivora and Artiodactyla recorded a relatively large number of constituent taxa among the mammals within Idanre, many of these taxa were considered by respondents to our questionnaires to be rare. For instance, the Genet was the only carnivoran considered to be common among other carnivorans mentioned, while the Duiker was the only artiodactylan common. Conversely, though the Primates only had three constituent taxa mentioned to be present within Idanre and the Insectivores and Pholidotans only one taxon each, the taxa mentioned within these mammalian orders were regarded as commonly seen or encountered.

Actual sampling on Ufe-Oke hill in this study (data displayed on the lower section of **Table 4**) encountered much fewer taxa [13] when compared to those reported to be present in the questionnaires administered to hunters and fetish market traders [22]. However, this sampling enabled us to assess first-hand the relative diversity of mammals across various elevations within a section of the Idanre area that can be described as its hub of tourism activity.

During transect sampling at various elevations (Base, Mid Height and Summit) four mammal taxa were encountered at the base of Ufe-Oke Hill, all of which were rodents. Other studies have also reported a concentration of rodent populations at low elevations. Major and Jones [22] in the Christine Lake area of Alaska observed that rats occurred mainly at low elevations and that rat signs were rarely detected above 150 m. Witmer and Burke [23], conducting a similar survey on Kiska Island in Alaska, reported that few rats occurred above about 165 m and that most rats occurred at, or below, 20 - 30 m.

Mammals at Mid Height were a bit more diverse, both

Table 3. Fish Samples collected from Idanre. (B) Base, (M) Mid Height.

				Size (mm)	
Family	Species	Location	No.	Tail Length (Range ± Mean)	Standard Length (Range ± Mean)
Clariidae	Clarias anguilaris	River Oto (B)	14	106.11 - 148.34	95.21 - 129.12
		River Osara (B)	5	139.43 - 168.22	123.02 - 147.31
Characidae	Channa sp.	River Arunjeje (M)	17		
	Barbus occidentalis	River Owena (B)	9	46.10 - 66.81	35.44 - 54.12
		River Osara (B)	41		
		River Arunjeje (M)	69		
	Barbus nigeriensis	River Owena (B)	11		
		River Arunjeje (M)	45		

Table 4. Mammal diversity on Ufe-Oke Hill and other environs within Idanre.

General mammal diversity in Idanre inferred from affirmations by hunters and visits to fetish markets {(c) common, (r) rare, (-) absent}

Order	Constituent taxa	Relative abundance
Rodentia	Cane rat *Thryonomys swinderianus*	c
	Ground squirrel *Xerus erythropus*	c
	Rope squirrel *Funisciurus* sp	c
	Sun squirrel *Heliosciurus gambianus*	c
	Giant pouched rat *Cricetomys gambianus*	c
	Multimammate rat *Mastomys natalensis*	c
	Unstriped grass rat *Arvicanthis rufinus*	c
	Brush-tailed porcupine *Atherurus africanus*	r
Carnivora	Genet *Genetta maculata*	c
	African Civet *Civettictis civetta*	r
	Egyptian Mongoose *Herpestes ichneumon*	r
	Cusimanse Mongoose *Crossarchus platycephalus*	r
Artiodactyla	Duiker *Cephalophus* sp	c
	Bushbuck *Tragelaphus scriptus*	r
	Bush pig *Hylochoerus meinertzhageni*	r
Primates	Baboon *Papio anubis*	c
	Mona monkey *Cercopithecus mona*	c
	Monkey *Cercopithecus* sp	c
Insectivora	Black giant shrew *Crocidura odorata*	c
Pholidota	Pangolin *Manis triscuspis*	c
Hyracoidea	Tree Hyrax *Dendrohyrax dorsalis*	r
Lagomorpha	Crawshay's Hare *Lepus crawshayi*	r
Tubulidentata	-	-
Proboscidea	-	-
Perissodactyla	-	-

Mammal diversity on Ufe-Oke Hill inferred from trappings (tr), sightings (st) and signs (sn)

	Taxon	Mode of identification
Base	Giant pouched rat *Cricetomys gambianus*	tr
	Rufous bellied rat *Lophuromys sikapusi*	tr
	Multimammate rat *Mastomys natalensis*	tr
	Unstriped grass rat *Arvicanthis rufinus*	tr
Mid Height	Pangolin *Manis triscuspis*	st
	Ground squirrel *Xerus erythropus*	st
	Giant pouched rat *Cricetomys gambianus*	sn
	Baboon *Papio anubis*	st, sn
	Mona monkey *Cercopithecus mona*	st, sn
	Monkey *Cercopithecus* sp	st, sn
Summit	Baboon *Papio anubis*	st
	Mona monkey *Cercopithecus mona*	st
	Monkey *Cercopithecus* sp	st

in terms of number of taxa (6) and variety, consisting of rodents (the Ground squirrel), pholidotans (the Pangolin) and primates (the Baboon and the Mona along with other species of monkey). Mammal diversity recorded at the Summit of Ufe-Oke Hill was the lowest, with only primates (monkeys and baboons) recorded. Therefore mammal diversity on Ufe-Oke Hill appeared to increase in diversity from the Base to Mid Height, but decreased sharply at the Summit. From viewing **Table 4**, there also appeared to exist a gradient of body size across various elevational transects Ufe-Oke hill, with smaller bodied taxa (rodents) located towards the Base and larger-bodied mammals (baboons and monkeys) existing at the Summit.

Compared to Happold's checklist for mammals in southwestern Nigeria [9], a poor diversity was recorded for mammals in this study with much fewer constituent taxa within each order and a high portion of these taxa considered rare even when present. Some orders, such as Perissodactyla, Tubulidentata and Proboscidea are totally absent.

The most obvious explanation for this would be that Idanre represents a predominantly rocky habitat, specialized and sharply contrasting to the surrounding rainforest.

According to Happold [9] rocky habitats provide an environment which differs greatly to that of the forest. Grasses and trees are absent except in rock crevices where soil has accumulated in gullies. The daytime temperatures in rock fissures are lower than in the forests; hence, small mammals can shelter from the high temperatures outside and are in less danger of overheating, especially in the dry season. He stated that most species which live on rock habitats have to forage in the surrounding forest because the rocks themselves do not have bountiful food supplies. However, some small species, such as rodents, which do not move far from their domiciles, are dependent on the grasses and seeds on the rocks; their population numbers, therefore, are related to the structure of the rocks and the amount and variety of vegetation.

Also, in accordance with the relatively low amount of mammal taxa encountered during the study, many mammals that were once known to be present in southwestern Nigeria are now being increasingly reported as endangered or even locally extinct[e.g., 24,25]. But anthropological activities within Idanre might also have a hand in bringing about scarcity of these mammals. During the study it was observed that various animals play an important role in the socio-cultural life and indigenous religions of the Idanre people. For instance, in a related anthropological study carried out within Idanre, the remains of an elephant skull were found to be buried with along with cultural relics such as cowries and potsherds within an archaeological site [26]. Other examples were the array of cattle skulls adorning the wall around the King's throne in the ancient palace on Ufe-Oke hill, indicative of some royal ritual, and the chain of monkey skulls on the creeping plants that line the walls outside various huts in the ancient town.

The role of animals in Idanre ethnic and ritualistic life is already being taken advantage of and carries a lot potential yet to be exploited for touristic value. However, the indiscriminate trapping and killing of mammals, such as a Giant pouched rat carcass the authors found in a locally constructed trap, long decayed, should be deterred and the local indigenes educated about the importance and usefulness of conserving their biological resources.

Diversity across various elevational transects on Ufe-Oke Hill appears to follow the pattern described by Lomolino and Perault [27], who stated that biological diversity on mountains usually increases from the base and peaks at mid elevation, but declines abruptly approaching the summit. Mammal diversity in this study was found to be greatest at the Base. The Base transect in this study was made up exclusively of rodent taxa. That rodents were found to be the most diverse mammals within Idanre, both from the questionnaire- and actual sampling, is thus not surprising. Carleton and Musser [28] stated that the muroid rodents comprise about 1135 recent species in 261 genera, representing approximately 25% of extant mammalian diversity. According to Jacobs [29] there are about 107 species of murid rodents living in Africa. Happold [30] stated that in Nigeria rodents make up 21.9% of the total number of mammalian species.

Conservation of these rodents, which include various murids and squirrels, along with other small mammals such as the pangolin, will contribute toward maintaining the delicate ecological balance on this rocky ecosystem. Also, the larger-sized mammals toward Ufe-Oke hill top, which are mainly primates such as baboons and various species of monkey, are important in order to maintain the tourism appeal of Idanre.

3.4. Diversity of Cultural Artefacts

Ceramics are the kind of materials that survive most in ancient communities, and they formed the bulk of material retrieved during our survey on Ufe-Oke. Almost 200 potsherds, beads, chinaware, brass bangles (mostly for children) and metal coins from the last century were collected from all quarters of the ancient town. Some half-exposed pots were also photographed in-situ (**Figure 5(a)**), and cultural mounds identified and earmarked in each quarter for excavation.

Photographs of historic buildings and features were taken. A mud wall in one of such collapsed buildings, containing pottery shards, shows evidence of earlier oc-

cupation before the building was reconstructed (**Figure 5(b)**). Several natural formations that could be of immense value as tourist attractions were identified. One interesting feature is the "foot print" of Abogun (**Figure 5(c)**), embedded on the rock floor, and also the "writing" on the wall of another rock (**Figure 5(d)**).

The geological formation of this abandoned settlement has caused a continuing erosion-wash which has exposed and in some cases moved archaeological materials across Ufe-Oke (**Figure 5(g)**). These exposed materials are undergoing gradual destruction, with millions of such material evidences probably already reburied or moved out of their primary context.

A most disturbing situation now is the present renovation of historic buildings on Ufe-Oke which poses a great threat to the recovery of archaeological evidences in some mounds that had been selected earlier for excavation. A good example is the ancient palace which was recently renovated with soil excavated from a mound at the back of the palace where the ancient kitchen of the palace was located. If the current renovation of ancient buildings on this hill continues without carrying out serious archaeological work, it will lead to the loss of vital archeological materials that contain useful information about the past activities of the people of Idanre.

Interestingly, elements of the cultural structure maintained in Ufe-Oke are also reflected downhill in present-day Idanre (Odo-Ode). All the quarters that demarcate Ufe-Oke (Isalu, Irowo, Idale and Ajin) are also present in Odo-Ode (in addition to new quarters that have emerged as the town continues to grow and develop). Similar patterns can also be observed from both past (uphill in Ufe-Oke) and present (downhill in Odo-Ode) methods of constructing of mausoleums (**Figures 5(e)** and **(f)**).

More work needs to be done on Ufe-Oke Hill, as some sites of cultural significance could not be visited due to logistic constraints. For example, we could not reach the cave on Orosun hill where the popular Idanre historic figure, Orosun, is believed to have lived and died. In all, Ufe-Oke represents another interesting settlement for the study of urban development during ancient times in Yorubaland, and also a great asset for tourism development in Ondo State.

4. Conclusions

Ufe-Oke Hill has an interesting geological, biological and cultural diversity. Our geological inventory revealed two major rock types: older porphyritic granite and fine grained granite, in addition to other minerals. We identified insects belonging 174 species, fishes from 4 species and mammals belonging to 22 species. The biological samples we collected are currently being further analyzed

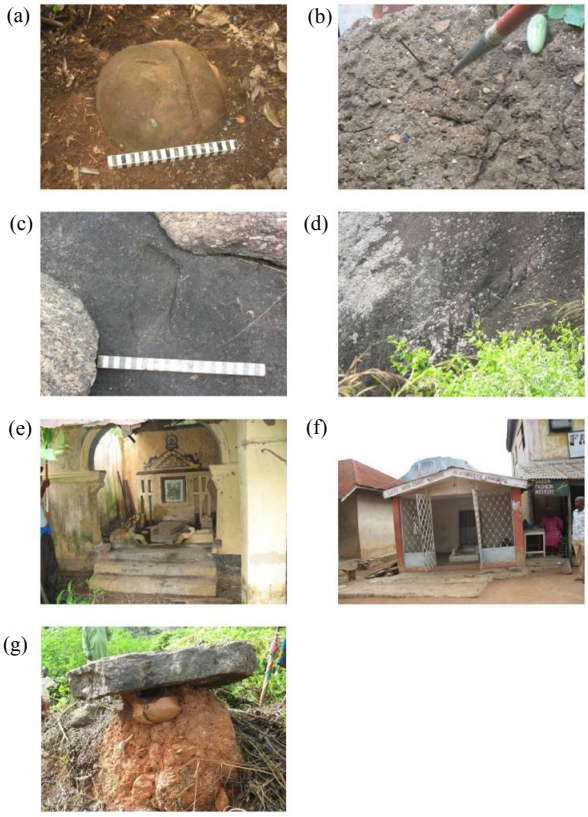

Figure 5. (a) *In-situ* pot; (b) Mud wall of an abandoned building with pottery shards; (c) Footprint of Abogun; (d) Writing on the wall of a rock; (e) Burial mausoleum at Ufe-Oke; (f) Burial mausoleum at Odo-Ode; (g) Erosion-wash exposing archaeological/cultural materials.

employing molecular techniques to also determine the genetic uniqueness of the taxa we encountered on Ufe-Oke. In our anthropological survey we characterized about 200 relics, and identified various other major features of archeological interest. Radio-carbon 14 analyses will be carried out on reference materials from the archeological sites to date the period of occupation and abandonment of these sites.

We found that various biological groups were affected differentially in their patterns of distribution on Ufe-Oke Hill by factors such as elevation, the presence of rivers and also human influences. This is in agreement with Becker *et al* [31] who stated that the elevation at which the richness peaks varies with the taxonomic group. For instance, in this study, insects were generally more diverse at the Summit followed by the Base altitudinal transect; while, specifically, the insect orders Odonata and Ephemeroptera appeared to be more abundant in areas around water (Arunjeje River) and the orders Muscidae and Blattodea in areas around human habitation. Mammals were more diverse at the Base (where there

were more rodents) than at the Mid Height and Summit, which however, featured larger-bodied, more visible taxa such as monkeys, which should be of higher value as tourist attractions.

The natural and cultural resources within Idanre, particular on Ufe-Oke Hill, offer a lot of promise and potential which, nonetheless, should be harnessed sustainably. The rocks and minerals detected in this study should interest the Federal Ministry of Solid Minerals, in its bid to develop this budding sector of Nigeria's economy. The insect taxa identified in our survey will have a positive impact in maintaining the ecological health in Ufe-Oke. Insects, in addition to providing various ecological services, are known to play significant roles in pollination, decomposition of wastes, nutrient recycling, and the biological control of other arthropod pests. They have an array of immune systems, toxins, and venoms that could constitute an important resource base for chemicals of medicinal value. Besides, the indigenous peoples utilize them in traditional medicine [32].

The small mammals documented in this study such as rodents also play a critical role in the ecological balance of Ufe-Oke, participating in natural processes such as the carbon cycle and the food web. The larger-bodied taxa such as monkeys and baboons, because of their greater visibility, are great candidates for tourism. Hunters and trappers within Idanre, however, must be cautioned in their use of these mammals for bushmeat. The knowledge of the existence of many water bodies at the base of the Ufe-Oke Hill reveals there will be lots of aquatic life to be scientifically recorded from this area. It is therefore important to have a documented network of the rivers in Idanre. The link between the Arunjeje River uphill with other rivers at the base of Uke-Oke is yet to be established. Though the fishes in these rivers represent a good protein source for the human population, fishing activities must be regulated in order to prevent the depletion of this important aquatic resource.

In addition to the ecological integrity and natural beauty of Ufe-Oke Hill, its cultural relics represent a major attraction for tourists, and the utmost care must be taken to preserve them. This advice takes into consideration the construction currently being carried out to rehabilitate the ancient huts and palace. While these renovation activities indeed seek to enhance the appeal of the ancient town, they must be carried out in a way that does not destroy or cause deterioration the artifacts themselves. On the other hand, particular disruptive human influences taking place upon Ufe-Oke, such as hunting, trapping and farming, must be discontinued altogether.

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