

Estimate of Biodiversity Indices of Macro Flora and Fauna Resources of Gele-gele Forest Reserve, Edo State, Nigeria.

Aremu, O.T., Osayimwen, F.E. and Emelue, G.U.

Department of Forestry and Wildlife, Faculty of Agriculture, University of Benin, Benin City, Nigeria.

Abstract: Estimate of biodiversity indices of macro flora, fauna and avifauna resources of Gele-gele forest reserve were estimated including frequency, richness, evenness and diversity. Four (5km) straight line transects were laid and were traversed severally to enumerate both plant and wild animal species biodiversity parameters. Thirty three (33) woody plant families were recorded including *Annonaceae*, *Combretaceae*, *Mimisoideae*, *Olaceae*, *Rubaceae*, *Ulmaceae* and *Verbenaceae* amongst others. Along with these families, 74 woody plant species were also recorded including *Enantia chlorontia*, *Alstonia boonei*, *Terminalia superb*, *Strombosia grandifolia* and *Allanblackia floribunda* amongst others. Dominant woody plant species included *Lophia alata*, *Uapaca standtii*, *Macaranga bacteri*, *Milletia griffoniana* and *Raphia hookeri* with 27, 26, 25, 25 and 20 frequency of occurrence respectively. Woody plant diversity, evenness and richness were estimated to be -3.8508, -0.8345 and 73.8354 respectively. Among the wildlife sighted in the reserve included 7 ungulate, 4 primate, 9 rodents and 11 reptile species. Which included *Syncerus caffer*, *Pan troglodytes*, *Heiosciurus rufobrachium* and *Crocodylus niloticus* respectively. Index of wildlife diversity, evenness and richness were -3.420, -0.1025 and 32.7139 respectively. A total of 15 avifauna families representing 46 bird species, avifauna diversity, evenness and richness were estimated to be -3.684, -0.0857 and 45.7388 respectively.

Key words: biodiversity, evenness, richness, wildlife, avifauna, flora.

INTRODUCTION

Biological diversity is the variety of living things and its processes in a given area, which constantly changes. These changes have occurred since live began and they will continue, with or without the presence of humans^[6,4]. Major factors that cause the decline of forest biodiversity in Nigeria include fragmentation of habitats and populations, human over exploitation of renewable natural resources, introduction of toxic and pollutants, introduction of exotic species, conversion of wild areas to agriculture and other intensive human use and alterations in the structure and function of ecosystems^[8].

Rapid destruction of natural forests and the profound modification of our landscapes have increased both the decimation of many plants and wild animal populations, are in the risk of species extinction^[2]. Nigeria has a total of about 1,600 constituted forest reserves in different ecological zones of the country with only about 210 of them located in the high forest areas of the southern Nigeria^[1]. Unfortunately, some of the forest reserves have now been degraded as a result of population pressure. The prolonged deforestation in

Nigeria has seriously depleted, threatened or endangered the biodiversity resources of the country's forest ecosystems. Nigerian has an estimated 274 mammal species belonging to 13 orders, 42 families and 133 genera, over 20,000 insects, 839 birds, 109 snake species and over 20 species of primates^[3]. Also, Nigeria has 935 tree species representing 86 families and 417 genera^[5].

To achieve the goal of maintaining all naturally occurring species in viable populations, both general and specific activities must be included in the basic strategy for maintaining biodiversity. As the biodiversity concept also covers genetic and ecosystem diversity, as well as ecological processes, the most efficient strategy must be to preserve as much as possible of original forests, and to imitate the dynamics, structure and function of the natural ecosystems in a given region in managed forests.

The objectives of the study are to identify the macro flora, fauna and avifauna species in the reserve and also to estimate biodiversity indices of the macro flora and fauna populations including occurrence, diversity, evenness and richness.

MATERIALS AND METHODS

Study Site: Gele-gele forest reserve lies within latitude 5° 55' and 6° 09' N and longitude 5° 16' and 5° 27' E and is located in Ovia North East local Government Area of Edo state, Nigeria. The reserve covers an area of 365 Km² that ranged from water swamp forest to tropical rain forest. The reserve is drained by rivers Osse and Benin.

MATERIALS AND METHODS

Forest Inventory Woody plant species were identified and enumerated along the four (5) Km straight line transects laid in the middle of the reserve. Plants were identified using standard keys as recommended by [5,11] and were classified into economic, ethnobotanical and food plant species. Botanical inventory was used to estimate woody plant frequency, diversity, evenness and richness using Shannon-Weiner functions (H¹) [12].

Wild Animals and Birds Inventory: Wild animals and birds were identified and enumerated along the four (5) Km straight line transects, with an average fall-off distance of 100m and effective study area of 4.0 Km². Only direct census technique was used to enumerate wild animal species as recommended by Seber, [14] while wild animals were identified as described by Jean and Pierre, [9]. Birds were enumerated and identified as recommended and described by Mack and Grant, [12]. Biodiversity parameters of wild animals and birds were calculated according to Magurran, [13] as follows:

$$F_k = \sum Y_i/n \times 100 \quad (1)$$

$$H^1 = \sum P_i \log P_i \quad (2)$$

$$E = H^1/H_{\max} \quad (3)$$

$$D = S - 1/\log N \quad (4)$$

Where: F_k – frequency, Y_i – incidence of species k in site i, n – number of species sampled, H¹ – diversity index, P_i – proportion of individuals for *ith* species out of the total number of individuals, log is natural log, E – evenness, H_{max} – maximum expected diversity (total number of species), D – species richness, S – number of species N – number of species recorded.

RESULTS AND DISCUSSION

Woody Plant Species Biodiversity: A total of 33 woody plant families including *Annonaceae*,

Apocynaceae, *Combretaceae*, *Ebanaceae*, *Olaceae* and *Verbenaceae* amongst others were recorded in the reserve. These represent 74 plant species including *Lophira alata*, *Uapaca standtii*, *Macaranga bacteri*, *Millettia griffoniana* and *Raphia hookeria* amongst others, with the following frequency of occurrence 27, 26, 25, 25, and 20 respectively. *Apocynaceae* family was the most represented in the reserve with 5 plant species. *Minisoidaceae* and *Meliaceae* families were represented by 4 and 3 plant species respectively. The following plant families *Anacardiaceae*, *Bombacaceae*, *Loganiaceae* and *Verbenaceae* were represented by a plant species each. Woody plant species diversity, evenness and richness were estimated to be -3.8508, -0.8345 and 73.8354 respectively (Table, 1). The fairly high woody plant biodiversity indices recorded in the reserve may be attributed to reduced anthropogenic activities observed in the reserve.

Useful Woody Plant Species: Useful woody plant species in the reserve were classified based on their uses into timber, medicinal and food. A total of 21 plant families representing 28 plant species were classified as useful including *Cleistopholis patens*, *Enantia chloroantha*, *Xylopiya quintasii* and *Spathandra blakeoides* as medicinal plants. While, *Parinari excels*, *Irvingia wombulu*, *Elaeis guineensis* and *Eribroma oblonga* were classified as food plant species. Also, *Alstonia boonei*, *Cebia pentandra*, *Allanblackia florinbunda* and *Nauclea diderrichii* were classified as timber plant species (Table, 2).

Wildlife Resources: A total of 34 wildlife species was recorded in the reserve including *Syncerus caffer*, *Phacochoerus porcus*, *Pan troglodytes*, *tragelaphus scriptus* and *Crocodilus niloticus* amongst others. Wild animal species diversity index, evenness and richness were estimated to be -3.420, -0.0125 and 33.7139 respectively (Table, 3).

Avifauna Resources: Fifteen bird families were recorded in the reserve among which were Ardeidae, Bucerotidae, Charadriidae, Strigidae, *Acciptridae*, *Acciptridae* and *Ciconiidae* amongst others, representing forty six (46) bird species. Bird species sighted included *Ispidina picta*, *Apus apus*, *Tockus fasciatus*, and *Strix woodfordii* amongst others. Avifauna diversity index, evenness and richness in the reserve were estimated to be -3.684, -0.0857 and 45.7388 respectively (Table, 4). High birds diversity recorded in the reserve may not be unconnected to the presence of abundance of tree canopies in the reserve which serve as breeding space for bird populations^[7].

Table 1: Check list of woody species in Gele-gele forest reserve

Family	Woody species	Frequency	Number / family
<i>Annonaceae</i>	<i>Cleisopholis patens</i>	2	3
	<i>Enantia chlorantha</i>	5	
	<i>Xylopia quintasii</i>	2	
<i>Anacardiaceae</i>	<i>Lannea welwitschii</i>	1	1
<i>Apocynaceae</i>	<i>Alstonia boonei</i>	3	5
	<i>Alstonia congensis</i>	1	
	<i>Funtumia elastic</i>	3	
	<i>Tabernaemontan pachysiphon</i>	1	
	<i>Voacanga Africana</i>	2	
<i>Bombacaceae</i>	<i>Cebia pentandra</i>	1	1
<i>Burseraceae</i>	<i>Canarium schweinfurthii</i>	3	1
<i>Cesalpiniodeae</i>	<i>Cynometra vogellii</i>	12	8
	<i>Berlinia confuse</i>	1	
	<i>Anthonatha macrophylla</i>	3	
	<i>Daniellia ogea</i>	2	
	<i>Hymenostegia afzelia</i>	8	
	<i>Hylodendron gabunense</i>	15	
	<i>Berlinia coriacea</i>	20	
	<i>Erythrophleum ivorense</i>	8	
<i>Chrysobalemceae</i>	<i>Parinari excels</i>	2	1
<i>Combretaceae</i>	<i>Terminalia superb</i>	3	2
	<i>Terminalia ivorensis</i>	10	
	<i>Terminalia ivorensis</i>	10	
<i>Ebanaceae</i>	<i>Diopyros suaveolens</i>	8	3
	<i>Diospyros dendo</i>	1	
	<i>Diospyros crassiflora</i>	1	
<i>Euphorbiaceae</i>	<i>Drypetes grassweileri</i>	1	
<i>Gultiferae</i>	<i>Allanblackia floribunda</i>	10	7
	<i>Macaranga bacteri</i>	25	
	<i>Uapaca standtii</i>	26	
	<i>Ricinodendron heudelotii</i>	10	
	<i>Pentadesma butyraea</i>	2	
	<i>Garania kola</i>	2	
<i>Irvingianaceae</i>	<i>Irvingia wombulu</i>	3	1
<i>Lecythidaceae</i>	<i>Petersianthus macrocarpum</i>	3	1
<i>Longuniaceae</i>	<i>Anthocleista vogelii</i>	1	1
<i>Melastomataceae</i>	<i>Spathandra blakeoides</i>	10	1
<i>Meliaceae</i>	<i>Entradrophragma angolense</i>	1	5
	<i>Lovoa trichilioides</i>	1	
	<i>Guarea cedrata</i>	6	
	<i>Careapa procera</i>	20	
	<i>Guarea thompsonii</i>	5	
<i>Mimisoideae</i>	<i>Albizia lebbeck</i>	13	4
	<i>Albizia adianthifolia</i>	1	
	<i>Piptadeniastrum africanum</i>	4	
	<i>Pentaclethra macrophylla</i>	11	
<i>Moraceae</i>	<i>Musanga cecropioides</i>	7	2
	<i>Myrianthus arboreus</i>	1	

Table 1: Continue

<i>Myristicaceae</i>	<i>Pycnanthus angolense</i>	8	
	<i>Standtia stipitata</i>	2	2
<i>Ochnaceae</i>	<i>Lophira alata</i>	27	1
<i>Olacaceae</i>	<i>Olax subscorpioidea</i>	3	
	<i>Strombosia grandifolia</i>	16	
	<i>Strombosia pustulata</i>	2	3
<i>Palmae</i>	<i>Elaeis guineensis</i>	2	
	<i>Calamus spp</i>	4	
	<i>Raphia hookeri</i>	20	3
<i>Papilionideae</i>	<i>Baphia nitida</i>	8	
	<i>Millettia griffoniana</i>	24	2
<i>Passifloraceae</i>	<i>Barteria fistulosa</i>	2	1
<i>Rubiaceae</i>	<i>Hollea ciliate</i>	1	
	<i>Psydrex arnoldiana</i>	8	
	<i>Nauclea diderrichii</i>	4	
	<i>Morinda lucida</i>	1	
	<i>Pausinystalia macroceras</i>	2	5
<i>Rutaceae</i>	<i>Zanthoxylum gillettii</i>	1	1
<i>Rhanaceae</i>	<i>Maesopsis eminii</i>	1	1
<i>Sapotaceae</i>	<i>Tieglamella heckelii</i>	1	1
<i>Samydaceae</i>	<i>Homolium longistylum</i>	4	1
<i>Simacoubaceae</i>	<i>Hannoa klaineana</i>	8	1
<i>Sterculiaceae</i>	<i>Eribroma oblonga</i>	2	1
<i>Ulmaceae</i>	<i>Celtis zankeri</i>	2	
	<i>Trema orientates</i>	1	2
<i>Verbenaceae</i>	<i>Vitex grandifolia</i>	1	1
Total	74	436	

Plant diversity index -3.8508, plant species evenness – 0.8345, plant species richness 73.8354

Table 2: Useful woody plant species in Gele-gele forest reserve

Plant family	Plant species	Uses
<i>Annaceae</i>	<i>Cleistopholis patens</i>	M
	<i>Enantia chlorantha</i>	M
	<i>Xylopia quintasii</i>	M
<i>Apocynaceae</i>	<i>Alstonia boonei</i>	T, M
<i>Bombacaceae</i>	<i>Cebia pentandra</i>	T, M
<i>Cesalpinioidae</i>	<i>Anthonatha macrophylla</i>	T, M
	<i>Erythrophleum suaveoleus</i>	T, M
<i>Chrysobalemcueae</i>	<i>Parinari excels</i>	T, F
<i>Combretaceae</i>	<i>Terminalia superb</i>	T, M
<i>Euphorbiaceae</i>	<i>Rianodendron heuoletii</i>	M, F
<i>Guttiferae</i>	<i>Allanblackia florinbunda</i>	T, M
	<i>Garcinia kola</i>	M, F

Table 2: Continue

<i>Irvingiaceae</i>	<i>Irvingia wombulu</i>	F
<i>Lecythidaceae</i>	<i>Petersianthus macrocarpus</i>	T, M
<i>Melastomataceae</i>	<i>Spathandra blakeoides</i>	M
<i>Mimisoideae</i>	<i>Pentaclethra macrophylla</i>	T, M, F
<i>Moraceae</i>	<i>Myrianthus arboreus</i>	F, M
<i>Myristicaceae</i>	<i>Pycnanthus angolense</i> <i>Standtia stipitata</i>	T, M T, M
<i>Olaceae</i>	<i>Olox subscorpioidea</i>	M
<i>Palmae</i>	<i>Elaeis guineensis</i>	F
<i>Passifloraceae</i>	<i>Bartaria fistulosa</i>	M
<i>Rubiaceae</i>	<i>Nauclea diderrichii</i> <i>Pausinystalia macroceras</i> <i>Psydrex amoldiana</i>	T, M T, M T
<i>Rutaceae</i>	<i>Zanthoxylum gelletii</i>	M
<i>Sterculiaceae</i>	<i>Eribroma oblonga</i>	T, F
<i>Sapotaceae</i>	<i>Tieghemella heckelii</i>	T,M

T – timber, M – medicinal, F - food

Table 3: Wildlife species of Gele-gele forest reserve

Wildlife species	Frequency	Percentage
<i>Syncerus caffer</i>	2	2.41
<i>Sylvicapra gramma</i>	4	4.82
<i>Tragelaphus spekeii</i>	2	2.41
<i>Tragelaphus scriptus</i>	2	2.41
<i>Cephalophus maxwelli</i>	5	6.02
<i>Hyemoschus aquaticus</i>	1	1.20
<i>Phacochoerus porcus</i>	5	6.02
<i>Pan troglodytes</i>	1	1.20
<i>Cercopithecus nictitans</i>	1	1.20
<i>Perodicticus potto</i>	1	1.20
<i>Cercopithecus mona</i>	2	2.41
<i>Smutsia gigantean</i>	3	3.61
<i>Heiosciurus rufobrachium</i>	3	3.61
<i>Protxerus stangeri</i>	3	3.61
<i>Anamolurus beecrofti</i>	2	2.41
<i>Euixerus erythropus</i>	4	4.82
<i>Thrynomys swinderianus</i>	4	4.82

Table 3: Continue

<i>Critocomys gambianus</i>	4	4.82
<i>Atherurus africanus</i>	3	3.61
<i>Hystrix cristata</i>	3	3.61
<i>Dendrohydrax dorsalis</i>	4	4.82
<i>Tadarida nigeriae</i>	abundant	abundant
<i>Chamaeleo wiederiheimi</i>	5	6.02
<i>Panaspis togoensis</i>	4	4.82
<i>Crocodilus niloticus</i>	4	4.82
<i>Osteolaemus tetraspis</i>	1	1.20
<i>Chelonia spp</i>	4	4.82
<i>Pelusios spp</i>	2	2.41
<i>Bitis gabonica</i>	1	1.20
<i>Bitis arietans</i>	1	1.20
<i>Naja nigricolis</i>	1	1.20
<i>Dendroapis jamesonii</i>	1	1.20
<i>Grayia smythii</i>	1	1.20

Index of wild animal diversity – 3.420, evenness – 0.1025, richness 32.7139

Table 4: Common avifauna species of Gele – gele forest reserve

Family	Common name	Scientific name	Frequency	(%)
<i>Ardeidae</i>	Great egret	<i>Ardea alba</i>	2	1.82
	Little egret	<i>Egretta garzetta</i>	3	2.73
<i>Acciptridae</i>	Bat hawk	<i>Macheiramphus alcinus</i>	2	1.82
	Black shoulder kite	<i>Elanus caeruleus</i>	6	5.54
	Black kite	<i>Milvus migrans</i>	6	5.54
	African harrier hawk	<i>Polyboroides typus</i>	4	3.63
	Long tailed hawk	<i>Urotriorchis macrourus</i>	1	0.91
	Long crested eagle	<i>Lophaelus occipitalis</i>	2	1.82
<i>Apodidae</i>	African palm swift	<i>Cypsiurus parvus</i>	1	0.91
	Common swift	<i>Apus apus</i>	6	5.45
	Little swift	<i>Apus affinis</i>	4	3.63
<i>Alcedinidae</i>	White bellied kingfisher	<i>Alcedo cristata</i>	1	0.91
	African pygmy kingfisher	<i>Ispidina picta</i>	1	0.91
	Wodland kingfisher	<i>Halcyon senegalensis</i>	2	1.82
	Giant kingfisher	<i>Megaceryle maximus</i>	1	0.91
	Blue breasted kingfisher	<i>Halcyon malimbica</i>	1	0.91
<i>Bucerotidae</i>	White crested hornbill	<i>Tockus albocristatus</i>	3	2.73
	African pied hornbill	<i>Tockus fasciatus</i>	2	1.82
	Piping hornbill	<i>Ceratogymna fistulator</i>	6	5.45
	Black casqued hornbill	<i>Ceratogymna atrata</i>	4	3.63
	Naked faced barbet	<i>Gymnobucco peli</i>	2	1.82
	Yellow-throated-tinker	<i>Pogoniulus subsulphureus</i>	2	1.82
	Yellow rumped tinker bird	<i>Pogoniulus bilineanus</i>	4	3.63
	Hairy breasted barbet	<i>Tricholaema hirsuta</i>	1	0.91
<i>Ciconidae</i>	Woolly necked stork	<i>Ciconia episcopus</i>	1	0.91

Table 4: Continue

<i>Charadriidae</i>	Wood sandpiper	<i>Tringa glareola</i>	2	1.82
	Common sandpiper	<i>Actitis hypoleucos</i>	3	2.73
<i>Columbidae</i>	Red eyed dove	<i>Streptopelia semitorquata</i>	2	1.82
	Blue spotted wood dove	<i>Turtur afer</i>	1	0.91
	Tambourine dove	<i>Turtur tympanistria</i>	2	1.82
	African green pigeon	<i>Treeron calvus</i>	3	2.73
<i>Cuculidae</i>	Black cuckoo	<i>Cuculus clamosus</i>	2	1.82
	Common cuckoo	<i>Cuculus canorus</i>	1	0.91
	African cuckoo	<i>Cuculus gularis</i>	1	0.91
	Brown owl	<i>Tyto alba</i>	2	1.82
	Senegal coucal	<i>Centropus senegalensis</i>	4	3.63
<i>Falconidae</i>	African hobby	<i>Falco cuvierii</i>	2	1.82
<i>Glareolidae</i>	Egyptian plover	<i>Actophipornis africanus</i>	3	2.73
<i>Picidae</i>	Buff spotted woodpecker	<i>Campethera nivosa</i>	1	0.91
	Brown eared woodpecker	<i>Campethera caroli</i>	2	1.82
<i>Poloceidae</i>	Village weaver	<i>Ploceus cucullatus</i>	abundant	abundant
<i>Acciptridae</i>	Blue headed bee eater	<i>Merops muelleri</i>	4	3.63
	Little bee eater	<i>Merops pusillus</i>	3	2.73
<i>Strigidae</i>	African wood owl	<i>Strix woodfordii</i>	2	1.82
	Akun eagle owl	<i>Buba leucosticus</i>	1	0.91
	Fraser's eagle owl	<i>Bubo poensis</i>	1	0.91

Avian diversity – 3.684, evenness – 0.0857, richness 45.7388

Conclusion: Gele-gele forest reserve remains one of the forests with high plants and wildlife biodiversity indices in southern Nigeria. However, these resources may be dwelling in the near future due to consistent illegal logging, encroachment and poaching which may change its status from natural rainforest ecosystem to secondary forest with decreasing biodiversity indices of both plants and wildlife., as loss of habitat is the single largest threat facing wildlife in Africa.

ACKNOWLEDGMENTS

We are grateful to the SDPC and NCF-BAP for providing financial support for this study. We are also thankful to the Edo State Department of Forestry for providing technical assistance for this study and the people living in the adjoining communities of the reserve for their hospitality most especially during data collection for this study.

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