Ground Flora Composition and Diversity of the Riparian Vegetation of Omo Biosphere Reserve, Ogun State, Nigeria

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Abstract

This study assessed the ground_flora diversity of the riparian forest of Omo Biosphere Reserve. It is stratified into three zones namely: Core Buffer and Transition. The Riparian forests along Major River and Streams were surveyed in the stratified zones and compared to the Upland vegetation. Stratified sampling was adopted and ninety plots (25 m × 25 m) were randomly assessed in the three strata of the study area. Sites were chosen based on accessibility within the zones and it was ensured that a variety of physiognomy was well represented. For each of the plots, the ground_flora was taken by measuring 5 m by 5 m sub plots from the corners of each plot and at the center. A total of 450 (5 m by 5 m) sub plots was used. The botanical name of ground_flora were identified, counted and recorded. Ground_flora species list was obtained, species abundance was determined and biodiversity of ground_flora was assessed through Species richness, Shannon-index (H) and Equitability index of Pielou (E). A total of 115 ground_flora species from 44 families were identified. The overall Riparian forest diversity of Ground_flora is 4.231. Ground_flora along streams had highest diversity index (4.01) and ground_flora in the upland vegetation had the highest abundance of 670 stand. *Diospyros dendo* is the most occurring species in all zones. Findings have important implications for improving ecosystem management.

Keywords: Biodiversity, Ground flora, Riparian Vegetation, Fragmentation

Introduction

The conservation of biological diversity is a key component of sustainable forest management (eycott *et al*. 2006) with ground_flora communities comprising one of the most important elements of biodiversity (french *et al*. 2008). Ground_flora vegetation is an integral part of any forested community and various herbaceous species have been shown to be useful indicators of site disturbance, health and potential productivity (Foti and Devall 1993). Ground_flora intervene in forest ecosystems by contributing to the biogeochemical cycle (sveinbjörnsson and oechel 1992), providing food and shelter for animals (carey and harrington 2001) and possibly also by increasing the filtration of water, thus encouraging the regeneration of shrub and canopy layers and reducing soil erosion (truscott *et al*. 2004). Many studies have demonstrated that forest overstory reduction by means of thinning or partial cutting stimulates ground_flora development because the removal of trees allows more light to reach the understory and also results in a higher availability of water and mineral nutrients (kleintjes *et al*. 2004;deal 2007;french *et al*. 2008) Due to this interaction with environmental variables and stressors, ground_flora species can be indicators of disturbance or stress (lapaix et al. 2009), and abundance or distribution of certain species can indicate environmental stressors (pykälä 2004; lapaix et al. 2009).

The natural vegetation associated with waterways and mostly represented by riparian forests (RFs) is credited to be among the most species-rich ecosystems all over the world, and particularly in tropical savanna (Nilsson *et al.*, 1997). Riparian forests are essential areas for global biodiversity (Sala *et al*., 2000); they are important because they guard key resources for mankind, such as stream environment, the quality and the source of water (Trimble, 1999), and harbour a diverse range of flora and physical structure (Kokou *et al.*, 2002). In proportion to their occupied area within a watershed, they carry out more ecological and productive roles than adjacent uplands perform (NRC, 2002). Unfortunately, they are extremely endangered worldwide (Sparovek *et al*., 2002), and current management strategies, particularly in the tropics, seem to have limited effects.

The rapid changes in land use have led to the advanced destruction and fragmentation of riparian forests which provide fertile soil for cultivation, give prospects for irrigation, provides pasture for grazing and serve as accommodation to a wide range of valued and rare plants and animals. This has been altered greatly as a result of over exploitation and land degradation most especially with the depletion of the riparian forests which are methodically aimed at for illegal selective tree cutting, indiscriminate harvest of herbs and shrubs, hunting and conversion to agriculture which has led to their degradation. Riparian forests have repeatedly been disregarded or excluded from general vegetation studies in favour to upland forests as a result of accessibility to the terrain. Besides, the status of ground_flora vegetation and it's significance especially as an important factor in the biodiversity of forest ecosystem and its influence on the future composition cannot be under emphasized.

Hence, the need for information on the comprehensive evaluation of the riparian forest ground-flora of Omo Biosphere Reserve, this study provides an unparalleled opportunity to thoroughly describe the current ground flora condition and will provide prospects to predict the future of the forest and measure long term effect for standard forest management practices of ground_flora composition and structure in Omo biosphere reserve, Ogun state, Nigeria

Material and Methods

Study Area

Omo Biosphere Reserve is an internationally recognized and unique habitat whose landscape has been partitioned as a result of biological population protection to meet up with the requirement of a typical biosphere reserve. It stretches North from latitudes 6° 35' to 7° 05' N and East longitude 4° 19' to 4°40'E in Ijebu area of Ogun State, Southwestern Nigeria (Fig. 1). This study was carried out within the zonation of the reserve: The core (Strict Nature Reserve), the buffer zone and the transition zone within Omo Biosphere Reserve in Ogun State, Southwestern Nigeria.

Geologically the reserve lies on crystalline rocks of the undifferentiated basement complex which in the southern parts is overlain by Eocene deposits of the sand, clay and gravel. The soils are predominantly ferruginous tropical. The reserve is made up of several soil types but they all belong to the tertiary sediments. The sedimentary soils are mostly of the Iwo and Alagba series most of the soils are heavily leached being Oxic Tropudoles and Rhodic Paleudults. The vegetation of Omo Forest Reserve is mixed moist semi-deciduous rainforest. This can be distinguished into a dry evergreen mixed deciduous forest in the northern part and a wet evergreen forest in the southern part. The mean annual rainfall ranges from about 1600 to 2000 mm with two annual peaks in June and September, with November and February being the driest months (Lowe, 1993).

The core zone covers about 460 hectares. The buffer zone surrounds the core area with an area of 8,165 hectares while the transition zone trans-borders the buffer zone and covers an area of 666,498.75 hectares. Each of these zones are separated by forest road, foot path, river streams or enclaves. Riparian areas within the biosphere consist of vegetation along major rivers, streams and wetlands. Representative sites were chosen along the major river, streams and Upland in each of the core, buffer, and transition zone. Figure1 is the map of Ogun state with the map of Nigeria showing Ogun State in inset. Figure 2 is the map of Omo Biosphere Reserve.

Method of Data Collection

Ground_Flora Assessment

The Reserve is stratified into Core, Buffer and Transition zones. Sites were chosen based on accessibility within the zones and ensured that variety of physiognomy were well represented. The sampling units were located inside each of the stratum within the zones where vegetation is relatively undisturbed and edge effect adequately overcome. Stratified sampling was adopted and ninety plots (25 m × 25 m) were randomly selected and assessed in the three strata for identification and accurate floristic diversity assessment.

Thirty plots each were sampled along the riparian vegetation (in the core, buffer and transition) out of which 15 were sampled along the riparian forest and 15 plots for the adjacent upland vegetation in each zone.

For each of the plots, the ground_flora was taken by measuring 5 m by 5 m sub plots from the corners of each plot and at the center. A total of 450 (5 m by 5 m) sub plots was used.

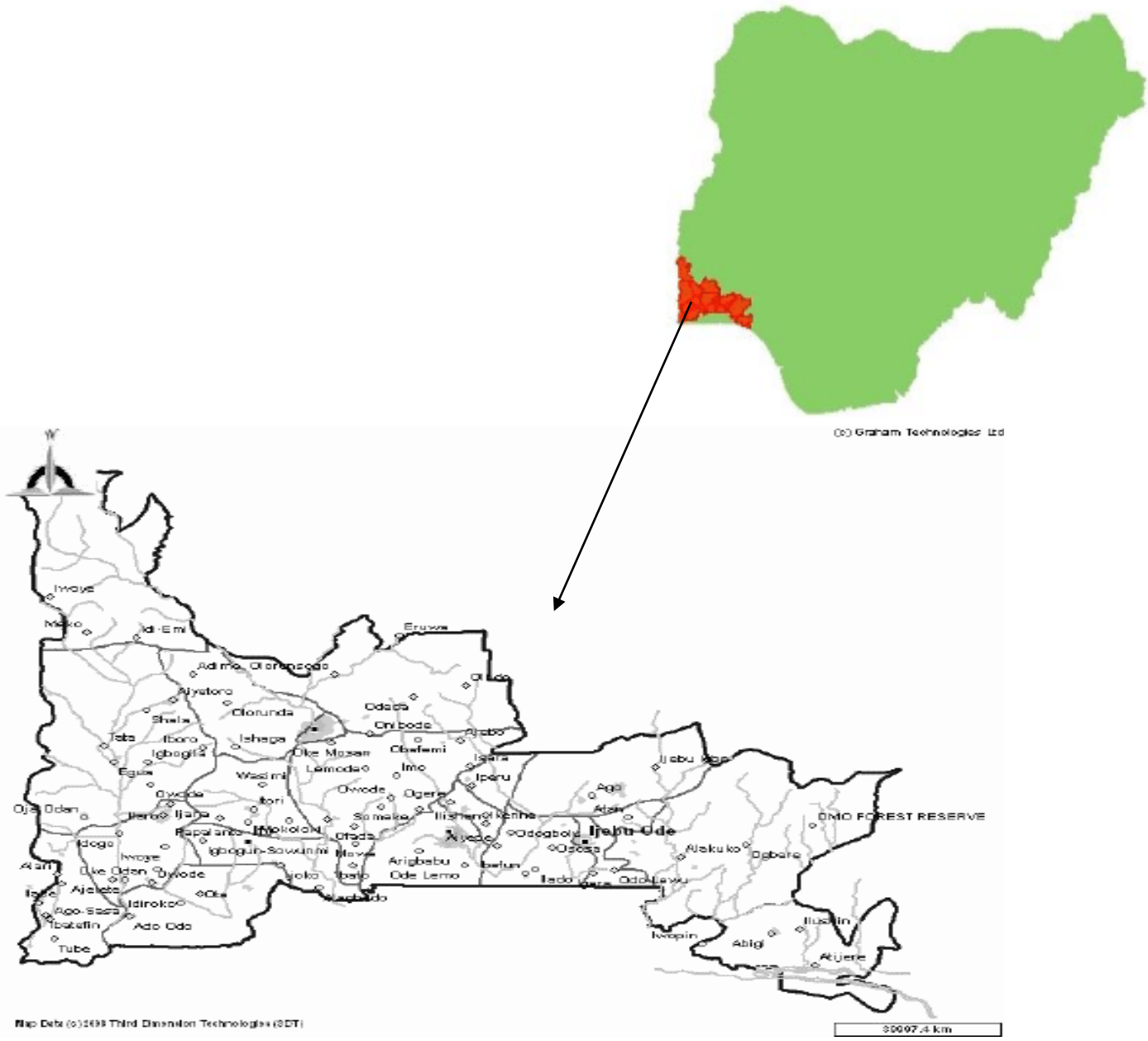

Figure 1: Map of Ogun State showing Omo Forest Reserve with map of Nigeria showing Ogun State in inset

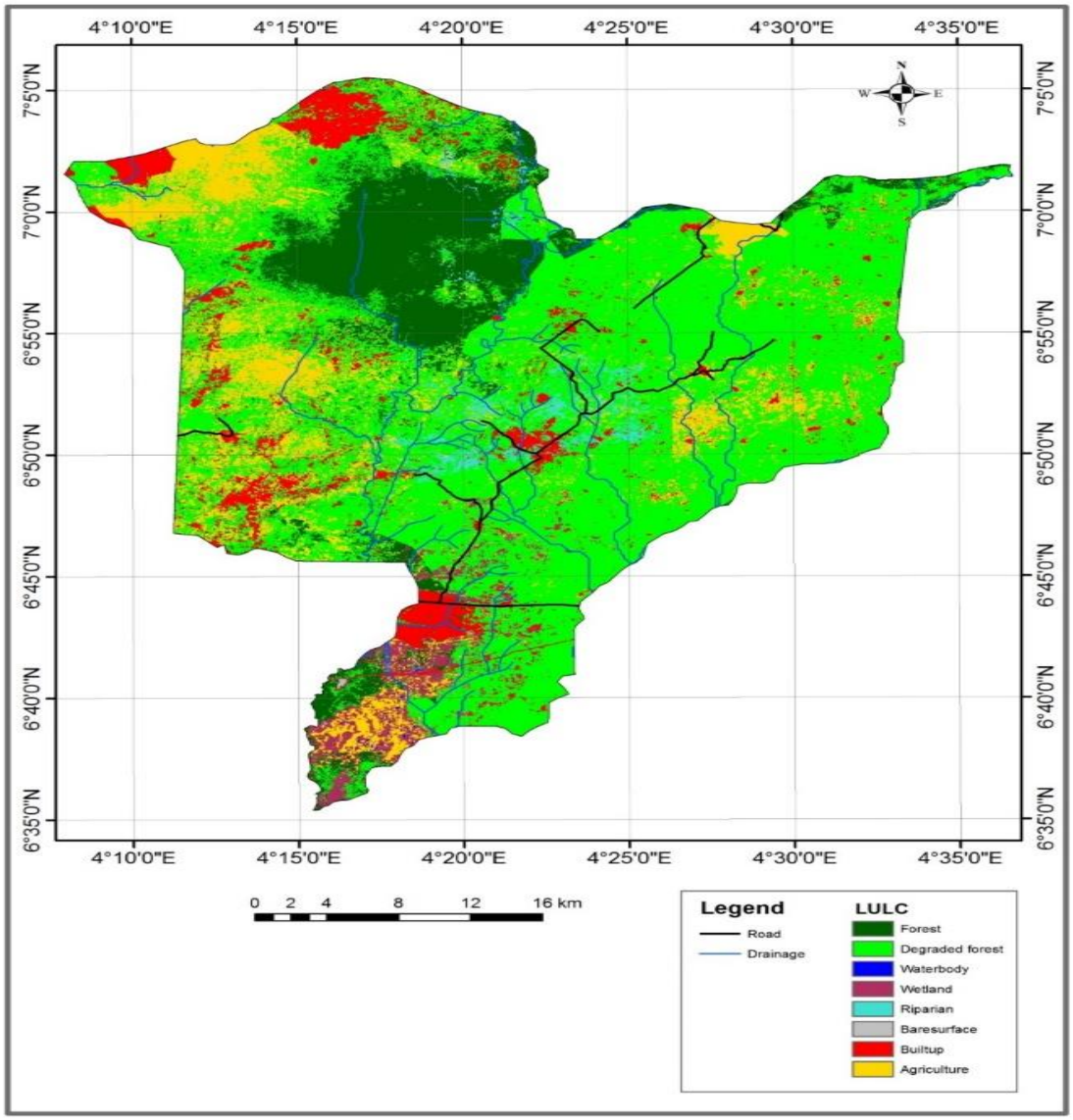

Figure 2. Map of Omo Biosphere Reserve

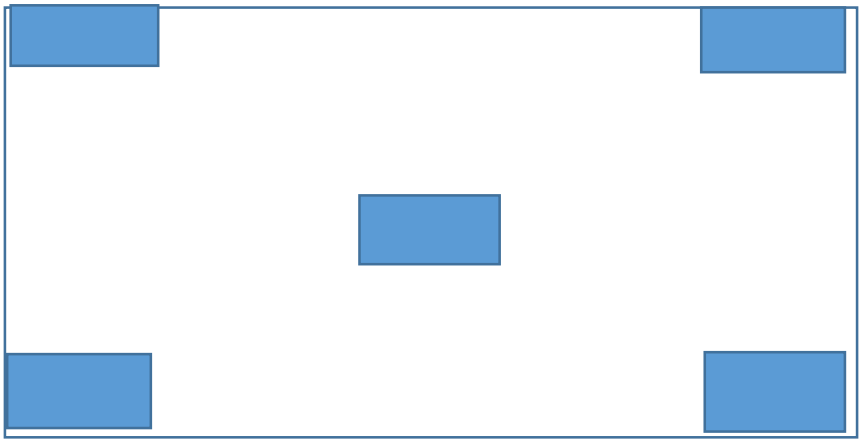

Figure 3: Ground_flora Sampling Method

The botanical name of ground_flora that was encountered in each sample plot were identified, counted and recorded. Ground_flora that could not be identified on field was tagged 'unknown'. They were collected and preserved for identification in the Forestry Herbarium Ibadan (FHI). All ground_flora were assigned to families and number of species in each family was obtained for species classification. Frequency of occurrence was obtained. Ground-flora were identified on site with the help of taxonomists. Species Abundance was determined. Biodiversity of ground-flora was assessed through Species richness, Shannon-index (H) and Equitability index of Pielou (E).

Biodiversity Indices

Family Importance Value (FIV)

$$= \frac{\text{Relative Frequency} + \text{Relative density}}{2}$$

Species Relative Density (RD): These was obtained using the formula.

$$\text{Density} = \frac{No\ of\ a\ Species\ per\ unit\ area}{\text{Total number af all species}}$$

$$\text{Relative Density} = \frac{No\ of\ a\ Species\ per\ unit\ area}{\text{Total number af all species}} \times 100$$

Species Relative Frequency (RF): These was obtained using the formula.

$$\text{Frequency} = \frac{No\ of\ plot\ in\ which\ a\ species\ is\ enumerated}{\text{Total number af plots}}$$

$$\text{Relative Density} = \frac{Frequency\ of a\ specie}{\text{Total freuency af all species}} \times 100$$

Species Relative Abundance was obtained using the formula

$$\text{Abundance} = \frac{Total\ number\ of\ a\ specie}{\text{Total area sampled}}$$

$$\text{Relative Abundance} = \frac{Abundance\ of\ a\ specie}{\text{Total Abundance all species}} \times 100$$

Species Diversity Index: This was calculated using the Shannon-Wiener diversity index (Kent and Coker, 1992):

$$H' = -\sum_{i=1}^{S} \text{pi ln(pi)}$$

Where:

H' = Shannon-Weiner diversity index

S = Total number of species in the community

Pi= Proportion of S made up of the i^{th} species

Ln=natural logarithm

Simpsons Diversity Index (Simpson, 1949): This was calculated using the formula:

$$D = 1 - \frac{\sum n\,(n-i)}{N(N-1)}$$

Where:

n = Number of individuals of each species

N = Total number of individuals of all species

Species Evenness in each community will be determined using Shannon's equitability (E_H):

$$E_H = \frac{H'}{lnS} = \frac{\sum_{i=1}^{S} p1 \ln(p1)}{\ln S}$$

E_H is the Shannon diversity index,

S is the total number of species in the community,

pi is the proportion of a species to the total number of plants in the community

Ln is the natural logarithm.

Results

Diversity of Ground_flora in the Riparian Systems of Omo Biosphere Reserve. A total of One hundred and fifteen (115) ground_flora species of forty four (44) families were found along the Riparian systems of the Biosphere Reserve. The three most important ground_flora species included *Diospyros dendo* (6.71), *Drypetes sp* (5.41), and *Dracaena manni* (4.04). The species with less important values includes *Albizia zygia*, *Harungana madagascariensis*, *Hippocratea indica*, *Marcaranga barteri*, *Magnifera indica*, *Mitragyna ciliata*, *Morus mesozygia*, *Ricinodendron heudelotii and Strychnos spinosa* all with a value of 0.157 (Table 1).

Table 1: Ground_flora Diversity in the Riparian System of Omo Bioshpere Reserve

SPECIES	FAMILY	Total	density	Freq (/ha)	RF	RD	FIV
Afromamum melegueta	Rubiaceae	9	0.0144	.0003	0.613	0.981	0.797
Albizia auxilliary	Fabaceae	1	0.0016	.0003	0.613	0.109	0.361
Albizia ferruginea	Fabaceae	8	0.0128	.0005	1.022	0.872	0.947
Albizia zygia	Fabaceae	1	0.0016	.0001	0.204	0.109	0.157
Alchornea cordifolia	Euphorbiaceae	11	0.0176	.0004	0.818	1.2	1.009
Alchornea laxiflora	Euphorbiaceae	7	0.0112	.0001	0.204	0.763	0.484
Alstonia boonei	Apoyanacee	5	0.008	.0002	0.409	0.545	0.477
Alternanthera nodiflora	Amaranthaceae	2	0.0032	.0001	0.204	0.218	0.211
Annonidium manni	Annonaceae	2	0.0032	.0003	0.613	0.218	0.416
Anthocleista microphylla	Gentianaceae	4	0.0064	.0002	0.409	0.436	0.423
Anthocliesta vogeli	Longaniaceae	5	0.008	.0002	0.409	0.545	0.477
Antholotha microphylla	Caesalpinioideae	4	0.0064	.0001	0.204	0.436	0.32
Aspilla africana	Compositae	10	0.016	.0001	0.204	1.091	0.648
Bambusa vulgaris	Poaceae	6	0.0096	.0004	0.818	0.654	0.736
Baphia nitida	Fabaceae	14	0.0224	.0005	1.022	1.527	1.275
Blighia sapida	Sapindaceae	2	0.0032	.0002	0.409	0.218	0.314
Bombax buonopozense	Bombacaceae	6	0.0096	.0004	0.818	0.654	0.736
Boronia scabra	Rutaceae	4	0.0064	.0001	0.204	0.436	0.32
Bridelia ferruginea	Euphorbiaceae	6	0.0096	.0001	0.204	0.654	0.429
Bulchhozia coriacea	Capparaceae	10	0.016	.0003	0.613	1.091	0.852
Calpolobia lutea	Polygalaceae	13	0.0208	.0009	1.84	1.418	1.629
Ceiba pentandra	Malvaceae	2	0.0032	.0002	0.409	0.218	0.314
Celtis zenkeri	Ulmaceae	3	0.0048	.0004	0.818	0.327	0.573
Centrosema africana	Fabaceae	3	0.0048	.0001	0.204	0.327	0.266
Centrosema pubescens	Fabaceae	5	0.008	.0001	0.204	0.545	0.375
Chassalia kolly	Rubiiaceae	25	0.04	.0017	3.476	2.726	3.101
Chromolaena odorata	Asteraceae	22	0.0352	.0005	1.022	2.399	1.711
Chrysophyllum albidium	Sapotaceae	4	0.0064	.0002	0.409	0.436	0.423
Clausena anisata	Rutaceae	2	0.0032	.0002	0.409	0.218	0.314
Cliestopholis patens	Annonaceae	25	0.04	.0018	3.681	2.726	3.204
Cola gigante	Sterculiaceae	12	0.0192	.0006	1.227	1.309	1.268
Cola nitida	Sterculiacae	6	0.0096	.0004	0.818	0.654	0.736
Costus age	Costaceae	3	0.0048	.0002	0.409	0.327	0.368
Diospyros barteri	Ebenaceae	16	0.0256	.0005	1.022	1.745	1.384
Diospyros Dendo	Ebenaceae	80	0.128	.0023	4.703	8.724	6.714
Diospyros mobutens	Ebenaceae	2	0.0032	.0002	0.409	0.218	0.314
Discorea bulbifera	Dioscoreaceae	2	0.0032	.0002	0.409	0.218	0.314
Dissotis canescens	Melastomataceae	2	0.0032	.0002	0.409	0.218	0.314
Dissotis rotundifolia	Melastomataceae	5	0.008	.0003	0.613	0.545	0.579
Dracena maani	Agavaceae	31	0.0496	.0023	4.703	3.381	4.042
Drypetes sp.	Euphorbiaceae	45	0.072	.0029	5.93	4.907	5.419
Elaeis guineensis	Palmae	35	0.056	.0018	3.681	3.817	3.749
Ficus exasperata	Moraceae	4	0.0064	.0002	0.409	0.436	0.423
Ficus microphylla	moraceae	13	0.0208	.0004	0.818	1.418	1.118
Funtumia elastica	Apocyanaceae	2	0.0032	.0002	0.409	0.218	0.314

Garcinia kola	Guttiferae	13	0.0208	.0005	1.022	1.418	1.22
Gmelina arborea	Verbenaceae	10	0.016	.0004	0.818	1.091	0.954
Grewia pubescens	Tiliaceae	7	0.0112	.0004	0.818	0.763	0.791
Harunga madagascariensis	Guttiferae	1	0.0016	.0001	0.204	0.109	0.157
Heisteria parvifolia	Olacaceae	6	0.0096	.0002	0.409	0.654	0.532
Heliotropium indicum	Boraginaceae	6	0.0096	.0003	0.613	0.654	0.634
Hipprocratea indica	Celastraceae	1	0.0016	.0001	0.204	0.109	0.157
Holarrhena floribunda	Apocyanaceae	7	0.0112	.0004	0.818	0.763	0.791
Homalium species	Flacourtiaceae	7	0.0112	.0003	0.613	0.763	0.688
Icacina tricangatha	Fabaceae	12	0.0192	.0008	1.636	1.309	1.472
Ipomea aquatic	Convolvulaceae	5	0.008	.0003	0.613	0.545	0.579
Khaya grandifolia	Meliaceae	2	0.0032	.0002	0.409	0.218	0.314
Khaya species	Meliaceeae	3	0.0048	.0003	0.613	0.327	0.47
Landolphia owarensis	Apocyanaceae	16	0.0256	.0008	1.636	1.745	1.69
Lecaniodiscus cupanioidies	Sapindaceae	4	0.0064	.0002	0.409	0.436	0.423
Lonchocarpus cyanescens	Fabaceae	11	0.0176	.0005	1.022	1.2	1.111
Lonchocarpus zanthoxyloides	Rutaceae	2	0.0032	.0001	0.204	0.218	0.211
Macaranga barteri	Euphorbiaceae	13	0.0208	.0006	1.227	1.418	1.322
Magnifera indica	Anacardiaceae	4	0.0048	.0002	0.409	0.436	0.432
Mallotus oppositifolius	Euphorbiaceae	5	0.008	.0003	0.613	0.545	0.579
Marantochloa mannii	Marantaceae	2	0.0032	.0002	0.409	0.218	0.314
Marcaranga barteri	Euphorbiaceae	1	0.0016	.0001	0.204	0.109	0.157
Margaritaria discoidea	Euphorbiaceae	5	0.008	.0003	0.613	0.545	0.579
Marianthus arborea	Cecropiaceae	3	0.0048	.0002	0.409	0.327	0.368
Massularia acuminata	Mimosoideae	3	0.0048	.0001	0.204	0.327	0.266
Measobotrya barteri	euphorbiaceae	4	0.0064	.0002	0.409	0.436	0.423
Microdesmis puberula	Pandaceae	10	0.016	.0006	1.227	1.091	1.159
Mimosa pudica	Mimosaceae	3	0.0048	.0002	0.409	0.327	0.368
Mitragyna ciliata	Rubiiaceae	1	0.0016	.0001	0.204	0.109	0.157
Morus mesozygia	Moraceae	1	0.0016	.0001	0.204	0.109	0.157
Mucuna pruriens	Fabaceae	2	0.0032	.0002	0.409	0.218	0.314
Musa paradisiaca	Musaceae	6	0.0096	.0003	0.613	0.654	0.634
Musa sapiens	Musaceae	7	0.0112	.0004	0.818	0.763	0.791
Musanga cecropoides	Cecropiaceae	2	0.0032	.0002	0.409	0.218	0.314
Myaryantus arboreus	Moraceae	3	0.0048	.0002	0.409	0.327	0.368
Nauclea didericchi	Rubiaceae	3	0.0048	.0003	0.613	0.327	0.47
Nephrolepsis undulata	Polypodiaceae	3	0.0048	.0002	0.409	0.327	0.368
Nesogodornia papaverifera	Sterculiaceae	6	0.0096	.0004	0.818	0.654	0.736
Newbouldia laevis	Bignoniaceae	4	0.0064	.0002	0.409	0.436	0.423
Nuclea latifolia	Rubiceae	4	0.0064	.0004	0.818	0.436	0.627
olax subscorpioidea	Olacaceae	8	0.0128	.0006	1.227	0.872	1.05
Palisota hirsuta	Commelinaceae	3	0.0048	.0003	0.613	0.327	0.47
Panicum maximum	Poaceae	2	0.0032	.0001	0.204	0.218	0.211
Paullina pinnate	Sapindaceae	25	0.04	.0012	2.454	2.726	2.59
Pavetta ccombosa	Rubiaceae	3	0.0048	.0002	0.409	0.327	0.368
Pentaclethra macrophylla	Mimosoideae	6	0.0096	.0004	0.818	0.654	0.736
Phalopsis falocephala	Acanthaceae	3	0.0048	.0002	0.409	0.327	0.368

Phyllanthus amarus	Euphorbiaceae	4	0.0064	.0002	0.409	0.436	0.423
Phyllanthus species	phyllanthaceae	2	0.0032	.0002	0.409	0.218	0.314
Picralima nitida	Apocyanaceae	18	0.0288	.0012	2.454	1.963	2.208
Pycanthus angolensis	Myristiaceae	4	0.0064	.0002	0.409	0.436	0.423
Rauvolfia vomitori	Apocyanaceae	5	0.008	.0002	0.409	0.545	0.477
Ricinodendron heudelotii	euphorbiaceae	1	0.0016	.0001	0.204	0.109	0.157
Rinorea dentata	Violaceae	41	0.0656	.0022	4.499	4.471	4.485
Rothmannia hispida	Rubiaceae	2	0.0032	.0002	0.409	0.218	0.314
Scottelia coriacea	Flacourtiaceae	16	0.0256	.0010	2.045	1.745	1.895
Sida acuta	Malvaceae	3	0.0048	.0002	0.409	0.327	0.368
Solanum terminale	Solanaceae	2	0.0032	.0002	0.409	0.218	0.314
Sphenocentum jollyallum	Menispermaceae	9	0.0144	.0004	0.818	0.981	0.9
Spondias mombin	Anacardiaceae	2	0.0032	.0001	0.204	0.218	0.211
Sterculia rhinopetala	Sterculiaceae	14	0.0224	.0008	1.636	1.527	1.581
Strombosia postulata	Olacaceae	18	0.0288	.0006	1.227	1.963	1.595
Strychnos spinosa	Longaniaceae	1	0.0016	.0001	0.204	0.109	0.157
Terminalia superba	Combretaceae	6	0.0096	.0002	0.409	0.654	0.532
Thammatococuss daniella	Marantaceae	3	0.0048	.0003	0.613	0.327	0.47
Theobroma Cacao	Malvaceae	13	0.0208	.0008	1.636	1.418	1.527
Trema orientalis	Ulmaceae	2	0.0032	.0002	0.409	0.218	0.314
Trichilia monadelpha	Meliaceae	9	0.0144	.0005	1.022	0.981	1.002
Urena lobata	Malvaceae	3	0.0048	.0002	0.409	0.327	0.368
Vitex doniana	Verbanaceae	2	0.0032	.0001	0.204	0.218	0.211
116		**917**	**1.4672**	**.489**	**100**	**100**	**100**

Table 2 shows the distribution of ground flora species within the major rivers, streams and upland. A total of 134 species were found in all the zones of the 450 sub plots. Eighty eight (88) species were found along the Major rivers, 75 species were found along the stream and 84 species were found on the upland. Nineteen (19) species were encountered along the major rivers, 20 species occurred only along streams while 16 were found only on the upland. Seven (7) species were found occurring only in both major rivers and streams and 38 species occurred all through the zones.

Table 3 shows that the Shannon index varied from 2.93 to 4.01 through the major rivers and streams in the core, buffer and transition zones. The overall Riparian forest diversity in Omo riparian forests was 4.231 which is a high value.

Riparian forests ground_flora along streams had highest diversity index (4.01), followed by the major rivers (3.99) and uplands (3.77). The Equitability index of Pielou was 0.59. Table 4 shows the percentages of the ten most important ground_flora species which was 36% while the remaining 105 species had 63% of the total ground_flora flora. Table 5 shows the percentages of the ten most important families having 58.4% with family Euphorbiaceae taking the highest abundance while the remaining 44 families had 41.5% of the total ground_flora composition.

Table 2. Species Diversity of Ground flora across the Zones

Number of Ground flora Species In The Zones				
Species	**Major Rivers**	**Streams**	**Upland**	**Total**
Aframomum melegueta	6	3	3	12
Albizia auxilliary	1		2	3
Albizia ferruginea	7	1	3	11
Albizia zygia	2			2
Alchornea cordifolia	8	3	1	12
Alchornea laxiflora		7		7
Alstonei boonei	5			5
Alternanthera nodiflora		2		2
Annonidium manni	2		8	10
Anthocleista microphylla		4		4
Anthocliesta vogeli		5		5
Antholotha microphylla	4			4
Antiaris africana			2	2
Aspilla africana		10		10
Balphia nitida			1	1
Bambusa vulgaris	1	5	1	7
Baphia nitida	6	8	24	38
Blighia sapida	2		2	4
Bombax buonopozene	4	2	6	12
Boronia scabra	4			4
Bridelia ferruginea		6		6
Buchholzia coriacea	10		43	53
Calpolobia lutea	9	4	12	25
Carica papaya			2	2
Ceiba pentandra		2	2	4
Celtis ferruginea			2	2
Celtis zenkeri	2	1	24	27
Centrosema africana		3		3
Centrosema pubescens		5		5
Chassally kolly	17	8	7	32
Chromolaena odorata	12	10	14	36
Chrysophyllum albidium	4		1	5
Clausena anisata	1	1	1	3
Cleistoformis Patens	10	15	7	32
Clerodendrum volubile			1	1
Cola gigantica	11	3	8	22
Cola nitida	4			4
Combretrum indicum			3	3
Costus age	3			3
Dialium guineense			1	1
Diospyros barteri	14	2	14	30
Diospyros Dendo	54	26	82	162
Diospyros mespiliformis			6	6
Diospyros mobutens	2			2
Discorea bulbifera		2		2
Dissotis canescens	3	2		5
Dissotis rotundifolia		2		2
Dracena maani	19	12	28	59
Drypetes species	27	18	27	72
Elaeis guineensis	13	22	10	45
Erythrococca anomaia			2	2
Ficus exasperata	4	13	16	33
Ficus mucosa		13	6	19
Funtumia elastica	1	1	6	8
Garcinia kola	5	8	11	24
Gmelina arborea		10		10
Grewia brevis			1	1
Grewia pubescens	2	5	2	9
Harunga madagascariensis		1		1
Heistera parvifolia	6		10	16
Heliotropium indicum	3	3		6
Hipprocratea indica	1			1
Holarrhena floribunda	3	4	1	8
Homalium species	2	5		7
Icacina tricangatha	8	4	10	22
Ipomea aquatica		5		5
Khaya grandifolia	3			3
Khaya species	3			3
Landolphia owarensis	9	7		16
Lecaniodiscus cupanioidies	4		2	6

Lonchocarpus cayanensis	5		10	15
Lonchocarpus zanthoxyloides	2			2
Macaranga barteri	3	13	4	20
Macaranga occidentalis			1	1
Magnifera indica	1			1
Mallotus oppositifolius		5	2	7
Marantochloa mannii	2			2
Marcaranga barteri		1		1
Margaritaria discoidea	3	2	7	12
Margnifera indica	1			1
Marianthus arborea	3		2	5
Massularia acuminata		3		3
Mesobotrya barteri	3	1	2	6
Microdesmis puberula	4	2	2	8
Milicia excelsa			4	4
Mimosa pudica		3		3
Mitragyna ciliata	1			1
Morus mesozygia	1		5	6
Mucuna pruriens		2		2
Musa paradisiaca		6		6
Musa sapiens	3	4		7
Musanga cecropoides	2			2
Myaryantus arboreus		3		3
Naulea didericchi		3		3
Nephrolepsis undulata	4	9	2	15
Nesogordonia papaverifera	3	3	4	10
Newbouldia laevis	4		4	8
Nuclea latifolia		4		4
Olax subscorpioidea	8		6	14
Palisota hirsuta	3		3	6
Panicum maximum		2		2
Paullina pinnata	23	2	9	34
Pavetta combosa	3			3
pentaclethra macrophylla		6		6
Phalopsis falocephala	3			3
Phaulopsis imbricata			1	1
Phyllanthus amarus		4	5	9
Phyllanthus muellerianus	2			2
Picralima nitida	8	10	1	
Pycanthus angolensis	4		2	6
Rauvolfia vomitoria	1	4	10	15
Ricinodendron heudelotii	1		5	6
Rinorea dentata	26	16	46	88
Rothmannia hispida	2		4	6
Scottelia coriaea	11	5	21	37
Sida acuta	2	1		3
Solanum pubescens	2		1	3
Solanum terminale			5	5
Spenocentrum jollyallum	9		25	34
Spondia mumbin	2		1	3
Sterculia rhinopetala	18	3	14	35
Strombosia ferruginea			1	1
Strombosia pustulata	14	4	24	42
Strychnos spinosa		1	1	2
Terminalia Superba	4	2	2	8
Tetrapleura tetraptera	2		2	4
Thaumatococcus daniella	3		2	5
Theobroma Cacao	11	2	5	18
Trema orientalis	2		6	8
Trichilia Monadelpha	6	3		9
Urena lobata		3		3
Vitex doniana	2		1	3
Xylopia aethiopica			1	1
Zanthoxylum zanthozyloies			2	2
Total	**538**	**405**	**670**	**1614**

Table 3: Floristic and Stand Characteristics of Riparian Forest Ground_Flora in Omo Biosphere Reserve

Region	Site	No of G.Flora	Abundance/ha	Rel. Abundance	Simpson	Shannon	Evenness
	Major river	45	.0214	0.8491	0.935	3.234	0.563
CORE	Stream	32	.0138	0.866	0.076	3.003	0.629
	Upland	31	.0269	0.0738	0.926	2.935	0.607
	Major river	36	.0154	0.0413	0.958	3.385	0.777
BUFFER	Stream	38	.0154	0.0413	0.958	3.385	0.777
	Upland	34	.0219	0.0659	0.934	3.001	0.591
	Major river	44	.0167	0.0385	0.962	3.506	0.756
TRANSITION	Stream	38	.0131	0.036	0.964	3.484	0.857
	Upland	54	.0185	0.0342	0.966	3.66	0.719
All region	UPLANDS	88	.0674	0.0385	0.962	3.776	0.496
All region	MAJOR RIVERS	87	.0525	0.0288	0.971	3.999	0.627
	STREAMS	77	.0402	0.02413	0.976	4.01	0.716
Riparian Forest GF of Omo	**All major rivers and streams**	**116**	**.0917**	**0.0235**	**0.976**	**4.231**	**0.593**

Table 4: Ten most Important Species of Omo Biosphere Reserve Ground Flora

Species	Absolute Abundance	% Abundance
Diospyros Dendo	80	8.7241
Drypetes species	45	4.9073
Dracena maani	31	3.3806
Rinorea dentate	41	4.4711
Elaeis guineensis	35	3.8168
Chassalia kolly	25	2.7263
Chromolaena odorata	22	2.3991
Picralima nitida	18	1.9629
Strombosia pustulata	18	1.9629
Diospyros barteri	16	1.7448
***Total**	331	36.096
****Total**	586	63.904
Overall total	**917**	**100**

Total abundance of the 10 most prominent species, ** Total abundance of the rest 106 species

Table 5: Riparian Forest Ground flora Family Dominance: 10 most important family

Species	**Absolute abundance**	**% Abundance**
Euphorbiaceae	102	11.123
Ebenaceae	98	10.687
Fabaceae	60	6.5431
Apocyanaceae	53	5.7797
Rubiaceae	47	5.1254
Voilaceae	41	4.4711
Sterculiaceae	38	4.1439
Palmae	35	3.8168
Agavaceae	31	3.3806
Sapindaceae	31	3.3806
***Total**	536	58.451
****Total**	381	41.549
Overall total	**917**	**100**

Total of the 10 most important ground flora family, **Total of the remaining 44 ground flora family

Discussion

The three most important ground_flora species of Omo Biosphere Reserve were *Diospyrous dendo*, *Drypetes species* and *Dracaena manni*. This conforms to the findings of Olatidoye 2018, on the most abundance tree species of Omo Biosphere Reserve which includes *Diospyrous dendo*, *Drypetes species* and *Cliestopholis patens*. The similarity in the first two species of the ground_flora and tree species shows a resemblance of the species growth pattern within the reserve and it is dependent on forest type and structure, as well as site fertility and history.

In comparing the ground_flora species of the riparian vegetation and that of upland vegetation, ground-flora abundance was found to be higher in the upland vegetation. This could be as a result of the open canopy formation influencing the rate of light penetration on the ground_flora while the closed canopy in the riparian vegetation could have reduced the rate of light penetration thereby causing a decrease in the rate of seedling germination. This accords with related literature where the detrimental effect of canopy closure on vascular species is documented (Ferris *et al*., 2000). Ground_flora diversity along stream was higher than that of Major river and upland, this may be as a result of the low intensity in the rate of flow of water which enables inundation and support of seed settlement for germination.

The diversity index which is the measure of species diversity in a community provides information about rarity and commonness of species in a community. The overall ground_flora diversity was very high (4.23), it was higher than the value obtained for the tree species diversity (3.74) of the same site (Olatidoye 2018) and a value of 3.54 by Akinyemi (2017) in Omo Biosphere Reserve. Out of the 44 families observed, Family Euporbiaceae, Ebenaceae, Fabaceae, Apocyanaceae, Rubiaceae, Violaceae, Sterculiaceae, Palmae, Agavaceae, and Sapindaceae were found to be most common and contributed about 58.5% of the family ground_flora abundance in the riparian vegetation of Omo Biosphere Reserve. This is similar to the findings of Ojo (2004) who observed 32 families with the Family Ebenaceae, Apocyanaceae, Euporbiaceae, Sterculiaceae, Olacaceae and Rubiaceae as the most common families in the Abeku sector of Omo Biosphere Reserve. In general, species show habitat preferences based on the suitable conditions for their survival. But some sites at certain periods are unsuitable for certain species due to the incompetence of species in the local abiotic habitat, or local predators (Janzen, 1970; Connell, 1978).

Ground_floras generally have key impact on the vegetation communities and the future of the forest, Therefore, at this stage, the conservation and management in this environment are influential factors that will sustain the future of this forest and properly maintain the species.

Conclusion

This study revealed the variations in the ground_flora species composition of the riparian forest vegetation of Omo Biosphere Reserve, Nigeria. One hundred and fifteen species from forty families were observed in the riparian vegetation of Omo Biosphere Reserve. The three most occurring ground flora species were *Diospyrus dendo*, *Drypetes species* and *Dracaena manni*. The upland vegetation had higher abundance of the species in comparison to the ground flora species of the riparian vegetation while higher diversity of ground flora was recorded in the forest along the streams. The ground_flora in general was relatively high and predicts a sustainable future for the forest.

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