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Woody plant species composition and diversity in disturbed and undisturbed areas of Omo Forest Reserve, Ogun State, Nigeria

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ABSTRACT

Conservation of tropical forests is of global concern. In Omo Forest Reserve, unregulated timber extraction and illegal farming activities constitute threats to biodiversity conservation. The extent of these threats is not adequately documented. The effects of logging and shifting cultivation on woody plant species composition and diversity were investigated in Omo Forest Reserve, Nigeria. Four 50 × 50m sample plots were randomly located in each of: primary forest, logged-over forest, farm fallow and crop farm. Complete enumeration of woody plant species with Diameter at Breast Height (DBH) ≥ 10cm was carried out within the 50 × 50 m sample plots. Woody species with DBH ≥2cm but ≤10cm were considered as undergrowth and enumerated within 5 × 5 m sample plots located at the four corners of each 50 × 50 m plot. Data collected were analyzed using Correlation, Shannon-wiener Diversity Index, Simpson's evenness Index, frequency and relative frequency. Sixty-seven (67) woody plant species were identified. *Gmelina arborea* was the predominant plant species with 308 trees ha^{-1}. Woody plant species diversity was significantly different among the land use types. Selective logging and farming encroachment reduce woody plants species composition and diversity in the forest reserve. If the rates of logging and agricultural clearing are not controlled, Omo Forest Reserve may lose a high proportion of its biodiversity within a short time. Therefore, agroforestry and multiple-use forestry practices which will protect other components of the ecosystem than timber are recommended as a forest management approach.

Key words: Land use, forest degradation, woody plants, depletion, sustainability

INTRODUCTION

Omo Forest Reserve is an important ecological and economic asset due to its high flora and fauna diversity. However, conservation of the diverse woody plant species in the forest reserve constitutes a challenge to forest managers, environmentalists and conservationists. Many valuable woody plant species have been destroyed and depleted in the forest due to commercial logging and agricultural land clearing. The sustainable use of the forest presupposes that equitable use between demands for forest lands as well as its resources and the protection of forest diversity can be achieved. According to United Nations (2011), over 70% of Nigerians engage in farming as a means of

livelihood. Clearing the forest for logging opens up areas of forest that were initially inaccessible to become accessible. This leads to further degradation by fire and farming (Boehm and Siegert, 2001) which affect the forest species composition, diversity and structure.

During logging, most of the high valued timber tree species are selectively felled creating a gap and eventually impeding the survival of some of the shade-loving species that are slow growing. In most cases, gaps created by the felling and evacuation of selectively logged timber trees create easy access for arable crop farmers who clear the forestland year-in year-out for food crop production; thereby limiting the chances of some native plant species to survive.

Area J4 in Omo Forest Reserve is a timber production forest, but also provides habitat for wildlife; and serves as field facility for educational research. According to the Ogun State Ministry of Forestry (2004), Omo Forest Reserve is of great conservation value with 200 species of tree, 125 species of bird and many mammal species including forest elephant, chimpanzee and white-throated guenon monkeys; all of which are seriously endangered by logging, farming and poaching activities. Many non-timber forest products gathered from this forest provide livelihood support for thousands of enclave dwellers and outsiders. Despite its socio-economic and ecological importance, the forest reserve is being overexploited through unregulated logging and illegal farming activities which have continued to degrade the forest ecosystem.

Logging activities are done with little or no consideration for sustainability of the residual stock and the entire forest ecosystem. The resulting forest depletion has not been adequately quantified. We investigated the impacts of selective logging and shifting agriculture on woody plant species richness and diversity in the forest reserve with a view to highlighting the effects on sustainable management of the forest.

MATERIALS AND METHODS

Study Area

The study area is Omo Forest Reserve in Ogun State, Nigeria. The reserve was named after Omo Tree (*Cordia millenii*) which is an indigenous tree species in the area. It lies within the tropical lowland rainforest and houses about 8,000 species of plants. It has a land area of 1,305.5km^2 and is divided into Areas J1-J4 (519.3km^2), Area J5 (565.8 km^2), Area J6 (220.4 km^2), and enclaves (65 km^2) (Ola-Adams, 1999) (Figure 1). Due to selective logging in the past, the forest is largely a secondary re-growth with pockets of primary forest in areas with restricted access, or where logging is difficult and along river courses (Bolaji, 2014).

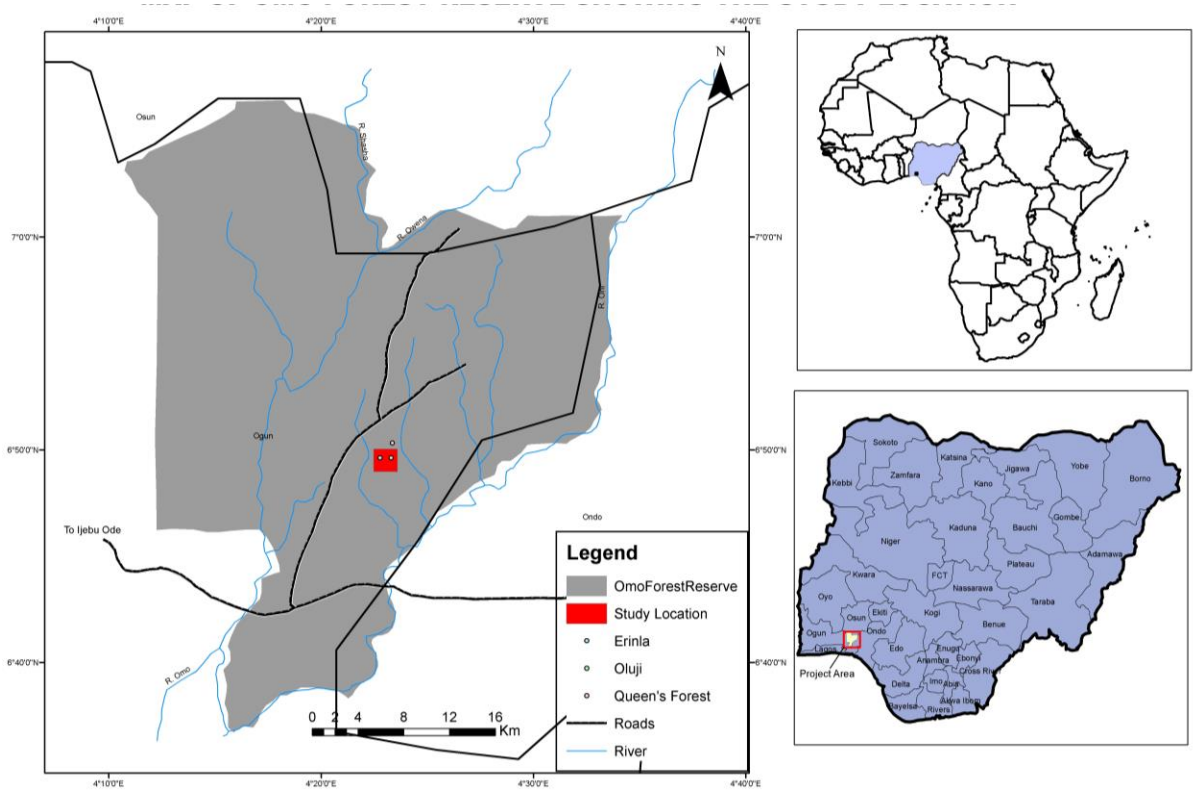

Figure 1: Map of Omo Forest Reserve showing the Study Location

Method of Data Collection

The study area was stratified into four, based on land use as described by Gauch (1982). These include: Primary Forest (PF) which is located in Queen's Forest, Logged-Over Forest (LF) in *Erinla* community; and Farm Fallow (FF) and Crop Farm (CF) located in *Oluji* Area.

Four 50 × 50 m sample plots were randomly located in each of: primary forest, logged-over forest, farm fallow and crop farm, with a minimum distance of 50m between any two plots in order to give room for variations in microsite factors. In each of the plots, five 5 × 5 m subplots were established such that four quadrats were at the corners and one at the centre. At the centre of each 5 × 5 m subplot, one 1 × 1 m subplot was located. Individual woody plant species with DBH $\geq$ 10cm and stumps of felled trees in the various land-use types were counted within the 50 × 50 m sample plots. All woody plants species with DBH $\geq$2.0cm but < 10.0cm were enumerated within the 5 × 5 m subplots while plants with <2.0cm DBH were enumerated within the 1 × 1 m mini-plots.

Data Analysis

Species richness was calculated using Menhinick's biodiversity index as follows:

$$\mathbf{D} = \frac{s}{\sqrt{N}}$$

Where D equals species richness, s equals the number of different species represented in the sample, and N equals the total number

of individual species of woody plants in that sample.

Species diversity was estimated using Shannon-Wiener diversity index as cited by Spellerberg (1991) and Turyahabwe and Tweheyo (2010):

$$H' = -\sum_{i=1}^{s} P_i \, In \, P_i$$

Where H' = Species diversity index, P_i = the proportion of number of individuals or the abundance of i^{th} species expressed as a proportion of the total abundance.

Species Frequency Distribution

The following formulas were used in line with Maingi and Marsh (2006).

$$\text{Frequency} = \frac{Number\ of\ quadrats\ in\ which\ species\ occur}{Total\ number\ of\ quadrats\ sampled}$$

$$\text{Relative frequency} = \frac{Species\ frequency\ of\ individual\ species}{Sum\ of\ frequency\ values\ for\ all\ species} \times 100$$

$$\text{Density} = \frac{Number\ of\ individual\ species}{Area\ sampled}$$

$$\text{Relative density} = \frac{Species\ density\ of\ individual\ species}{Total\ density\ for\ all\ species} \times 100$$

RESULTS

Woody plant species composition and diversity across the land use types

A total of 1,392 timber plant species were recorded. The highest total woody plant species density of 1,392/ha was recorded in the logged-over forest. This was followed by primary forest with 720.00/ha, crop farm with 640.00/ha and farm fallow with 628.00/ha (Figure 2). The most abundant woody plant species in the logged-over forest and crop farm were *Gmelina* arborea and *Rauvolfia vomitoria* with species density of 896.01/ha and 159.99/ha respectively. Most of the plant species found in the farm fallow are herbs with fewer numbers of tall and large-diameter trees. For instance, *Phoenix reclinata* had a density of 96.00/ha; and an abundance of 8.00 in logged-over forest, 16.0/ha and 4.00 in farm fallow, but was not recorded at all in both crop farm and primary forest. *Elaeis guineensis* had density and abundance of 32.01/ha and 48.00, 8.00/ha and 6.00 respectively in the logged-over forest and crop farm but did not occur at all in farm fallow and primary forest. *Milicia excelsa* and *Bombax buonopozense* had densities of 80.01/ha and 48.00/ha; and abundance of 6.67 and 6.00 respectively in the logged over forest. They both did not occur in crop farm and farm fallow; but *Milicia excelsa* had a density of 48.00/ha and an abundance of 4.00 in primary forest.

Woody plants species richness across the land use types

The highest number of woody plant species was recorded in the primary forest (Figure 3). *Milicia excelsa, Cordia millenii, Nauclea diderichii, Myrianthus arborea, Terminalia spp and Khaya spp,* were observed to have low densities in all the land use types. *Terminalia superba* had a density of 24.0/ha and 16.0/ha in the primary forest and farm fallow respectively, but was not found at all in crop farm and logged over forest.

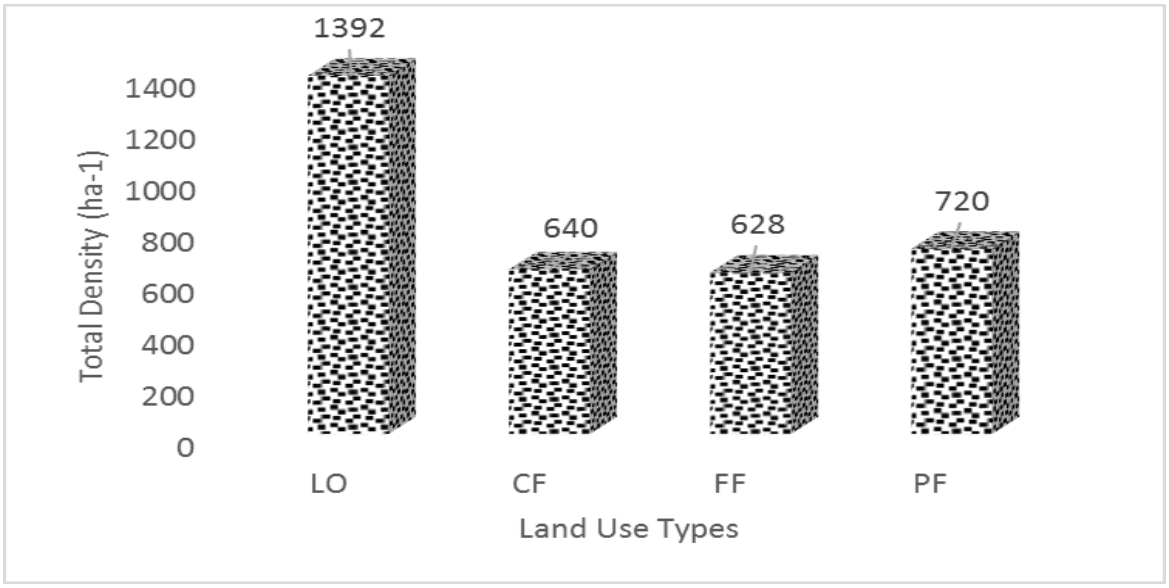

Figure 2: Density of woody plant species across the land-use types

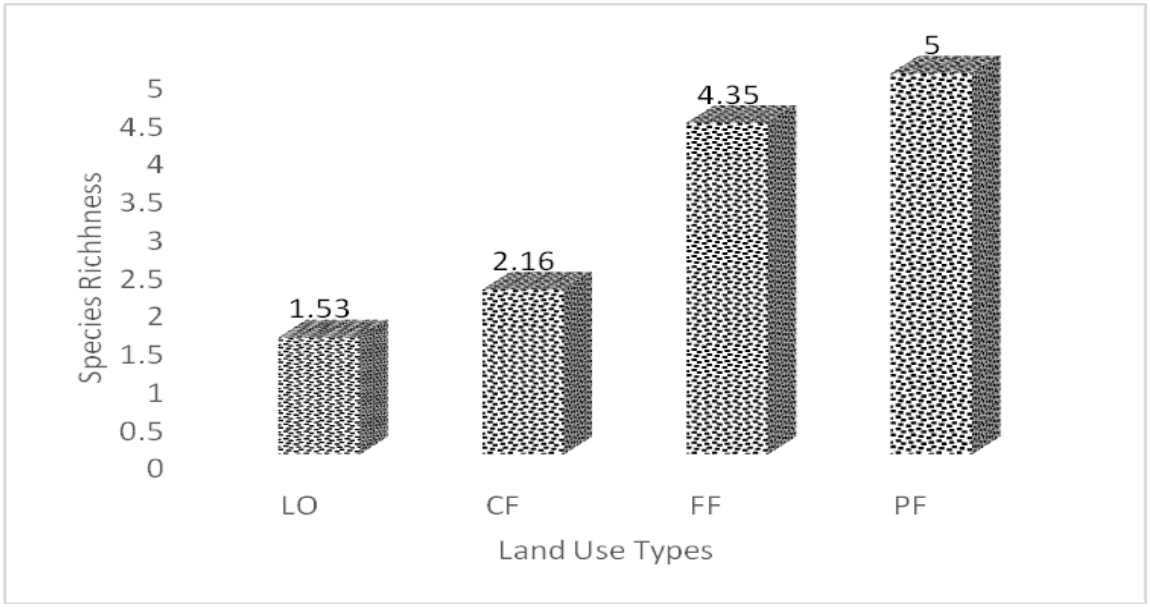

Figure 3: Woody plant species richness across the land-use types

The details of plants species composition, density, relative density, abundance and relative abundance in the various land use types are presented in Table 1.

Table 1: Woody plant species composition in the various land-use types

Plant Species	Density(ha-1)	Frequency	Abundance	re...density	re...frequency	re…abundance
	Logged-over Forest					
Bombax buonopozense	48	66.67	6.00	3.45	10.53 A	4.39
Bridelia grandis	15.99	33.33	4.00	1.15	5.26 C	2.93
Cleistopholis patens	15.99	33.33	4.00	1.15	5.26 C	2.93
Elaeis guineensis	32.01	33.33	8.00	2.3	5.26 C	5.86
Entandrophragma angolense	15.99	33.33	4.00	1.15	5.26 C	2.93
Gmelina arborea	896.01	100	74.67	64.37	15.79 A	54.64
Milicia excelsa	80.01	100	6.67	5.75	15.79 A	4.88
Phoenix reclinata	96	100	8.00	6.9	15.79 A	5.85
Rauvolfia vomitoria	159.99	100	13.33	11.49	15.79 A	9.76
		Crop Farm				
Afzelia africana	16	33.33	4.00	2.5	5.56 C	4.29
Albizia zygia	48	33.33	12.00	7.5	5.56 C	12.86
Anthocleista vogelli	32	33.33	8.00	5	5.56 C	8.57
Bambusa vulgaris	16	33.33	4.00	2.5	5.56 C	4.29
Ceiba pentandia	48	66.67	6.00	7.5	11.11 A	6.43
Citrus grandifolia	16	33.33	4.00	2.5	5.56 C	4.29
Elaeis guineensis	48	66.67	6.00	7.5	11.11 A	6.43
Ficus capensis	48	66.67	6.00	7.5	11.11 A	6.43
Gmelina arborea	256	100	21.33	40	16.67 A	22.86
Nauclea diderrichii	48	33.33	12.00	7.5	5.56 C	12.86

Rauvolfia vomitoria	48	66.67	6.00	7.5	11.11 A	6.43
Solanum americanum	16	33.33	4.00	2.5	5.56 C	4.29
Farm Fallow						
Afzelia africana	48	100	4.00	7.64	7.69 C	4.32
Albizia zygia	32	100	2.67	5.1	7.69 C	2.88
Bambusa vulgaris	16	66.67	2.00	2.55	5.13 C	2.16
Bosqueia angolensis	16	33.33	4.00	2.55	2.56 R	4.32
Cedrela odorata	16	33.33	4.00	2.55	2.56 R	4.32
Cedrus libani	32	100	2.67	5.1	7.69 C	2.88
Cola gigantea	16	33.33	4.00	2.55	2.56 R	4.32
Cordia millenii	32	66.67	4.00	5.1	5.13 C	4.32
Elaeis guineensis	36	66.67	4.50	5.73	5.13 C	4.86
Entada africana	32	66.67	4.00	5.1	5.13 C	4.32
Entandrophragma angolense	16	33.33	4.00	2.55	2.56 R	4.32
Gmelina arborea	80	100	6.67	12.74	7.69 C	7.21
Psidium guajava	16	33.33	4.00	2.55	2.56 R	4.32
Hevea brasiliensis	16	33.33	4.00	2.55	2.56 R	4.32
Leucaena leucocephala	32	66.67	4.00	5.1	5.13 C	4.32
Musa sapientum	48	66.67	6.00	7.64	5.13 C	6.49
Musanga cecropioides	16	33.33	4.00	2.55	2.56 R	4.32
Nuclea diderrichii	32	66.67	4.00	5.1	5.13 C	4.32
Phoenix reclinata	16	33.33	4.00	2.55	2.56 R	4.32
Tectona grandis	32	66.67	4.00	5.1	5.13 C	4.32
Terminalia superba	16	33.33	4.00	2.55	2.56 R	4.32
Zanthoxylum spp	16	33.33	4.00	2.55	2.56 R	4.32

Primary Forest

Antiaris toxicaria	48	66.67	6.00	6.67	4.26 R	5.69
Bambusa vulgaris	12	33.33	3.00	1.67	2.13 R	2.84
Brachystegia leonensis	12	33.33	3.00	1.67	2.13 R	2.84
Carapa procera	12	33.33	3.00	1.67	2.13 R	2.84
Cedrus deodara	36	100	3.00	5	6.38 C	2.84
Ceiba petandra	48	66.67	6.00	6.67	4.26 R	5.69
Combretum micranthum	24	66.67	3.00	3.33	4.26 R	2.84
Cordia millenii	24	33.33	6.00	3.33	2.13 R	5.69
Diospyros barteri	24	33.33	6.00	3.33	2.13 R	5.69
Ficus capensis	12	33.33	3.00	1.67	2.13 R	2.84
Ficus elastica	36	100	3.00	5	6.38 C	2.84
Ficus exasperata	12	33.33	3.00	1.67	2.13 R	2.84
Guibourtia ehie	12	33.33	3.00	1.67	2.13 R	2.84
Khaya anthotheca	60	100	5.00	8.33	6.38 C	4.74
Khaya grandifolia	36	33.33	9.00	5	2.13 R	8.53
Macrosphyra longistyla	12	66.67	1.50	1.67	4.26 R	1.42
Milicia excelsa	48	100	4.00	6.67	6.38 C	3.79
Morus mesozygia	12	33.33	3.00	1.67	2.13 R	2.84
Nauclea diderrichii	24	66.67	3.00	3.33	4.26 R	2.84
Petersia africanum	24	33.33	6.00	3.33	2.13 R	5.69
Pycananthus angolensis	36	100	3.00	5	6.38 C	2.84
Schefflera actinophylla	24	66.67	3.00	3.33	4.26 R	2.84
Terminalia superba	24	66.67	3.00	3.33	4.26 R	2.84
Triplochiton scleroxylon	24	66.67	3.00	3.33	4.26 R	2.84

- E= endangered; T,= threatened; R= rare; C = common.

Information on occurrence, density and distribution of woody species below 2.0cm d.b.h is presented in Table 2.

Table 2: Composition of woody species across the land use types

Tree Species	Density(ha-1)	frequency	Abundance	re...density	re...frequency	re…abundance
		Logged-over Forest				
Funtumia africana	192	240	6	4.92	4.92 R	5.02
Phoenix reclinata	384	480	24	9.84	9.84 C	20.09
Rauvolfia vomitoria	384	480	24	9.84	9.84 C	20.09
Gmelina arborea	1472.04	1840.05	18.4	37.71	37.71 C	15.4
Elaeis guineensis	447.96	559.95	9.33	11.47	11.47 C	7.81
Milicia excelsa	63.96	79.95	1.33	1.64	1.64 T	1.12
Andropogon tectorum	63.96	79.95	4	1.64	1.64 T	3.35
Hoslundia opposita	128.04	160.05	2	3.28	3.28 R	1.67
Coula edulis	128.04	160.05	4	3.28	3.28 R	3.35
Oeceoctides maculata	63.96	79.95	4	1.64	1.64 T	3.35
Adenia lobota	63.96	79.95	4	1.64	1.64 T	3.35
		Crop Farm				
Elaeis guineensis	255.96	319.95	8	6.56	6.56 C	6.7
Gmelina arborea	384	480	8	9.84	9.84 C	6.7
Nauclea diderrichii	63.96	79.95	4	1.64	1.64 T	3.35
Bridelia grandis	192	240	4	4.92	4.92 R	3.35
Adenia lobata	320.04	400.05	10	8.2	8.2 C	8.37
Cryptosepalum tetraphyllum	63.96	79.95	2	1.64	1.64 T	1.67
Cnestis ferruginea	128.04	160.05	4	3.28	3.28 R	3.35
Laportea aestuans	63.96	79.95	4	1.64	1.64 T	3.35
		Farm Fallow				
Aquitic aroid	128.04	160.05	2.67	3.28	3.28 R	2.23
Alchornea sp	63.96	79.95	4	1.64	1.64 T	3.35

Alternanthera spp	320.04	400.05	6.67	8.2	8.2 C	5.58
Aedesia baumannii	63.96	79.95	4	1.64	1.64 T	3.35
Melanthera scadens	128.04	160.05	8	3.28	3.28 R	6.7
Ficus exasperata	128.04	160.05	4	3.28	3.28 R	3.35
Oeceoclades maculata	128.04	160.05	4	3.28	3.28 R	3.35
Cnestis ferruginea	63.96	79.95	2	1.64	1.64 T	1.67
Gmelina arborea	63.96	79.95	2	1.64	1.64 T	1.67
Cryptosepalum tetraphyllum	128.04	160.05	8	3.28	3.28 R	6.7
Manihot species	63.96	79.95	4	1.64	1.64 T	3.35
Etanda gigas	128.04	160.05	8	3.28	3.28 R	6.7
Leptodens sp	128.04	160.05	8	3.28	3.28 R	6.7
Laportea aestuans	63.96	79.95	2	1.64	1.64 T	1.67
Milletia thonningii	63.96	79.95	2	1.64	1.64 T	1.67
		Primary Forest				
Guibourtia ehie	48	60	1	1.23	1.23 T	0.84
Newbouldia laevis	192	240	3	4.92	4.92 R	2.51
Triplochiton scleroxylon	96	120	3	2.46	2.46 R	2.51
Aquatic croidis	144	180	4.5	3.69	3.69 R	3.77
Adenia cissampeloides	96	120	3	2.46	2.46 R	2.51
Bambusa vulgaris	48	60	1.5	1.23	1.23 T	1.26
Alternanthera spp	144	180	3	3.69	3.69 R	2.51
Huslundia opposita	48	60	1	1.23	1.23 T	0.84

E, endangered; T, threatened; R, rare; C, common.

Occurrence of Tree Stumps

Eighteen stumps of timber size trees were found per hectare in logged over forest, 12 in crop farm, four in farm fallow and non in primary forest.

DISCUSSION

Six tree species namely *Bombax buonopozense, Bridelia grandis, Cleistopholis patens, Afzelia africana, Entandrophragma angolense and Milicia excelsa* have low densities in the logged over forest. This may be attributed to their intensive selective logging; since they are locally important for timber production. This is worsened by the usual negative effect of unsustainable logging on the residual stock. In addition to the frequent removal of such choice species during logging, their seedlings and saplings may also be killed in the process of logging and log transportation. Also, the high density of *Milicia excelsa (Iroko)* in the primary forest with zero occurrences in the crop farm and farm fallow may be an evidence of the destructive effects of farming activities on woody species in the study area. This is in agreement with Popoola (2014), who observed that *Iroko* has been subjected to so much pressure that the species now occurs in reasonable numbers only in strictly protected areas in Nigeria. Therefore, this study further confirms the observation of Boehm and Siegert (2001) that selective logging and forestland clearing for crop farming affected the native species composition and paved the way for forest degradation.

The increasing densities of woody species from crop farm to primary forest is an indication that plant species composition of the original native forest could be regained; if left to fallow for a sufficiently long period. This is in line with findings of other studies on tropical forest succession (Brown and Lugo, 1990; Holl *et al*., 2000; Wijdeven and Kuzee, 2000).

The fact that some woody plant species such as *Gmelina arborea* and *Rauvolvia vomitoria* were abundant in the logged over forest and crop farm, but not present in the primary forest is understandable. *Gmelina arborea* is a common plantation species within the Omo Forest Reserve. The seeds of the species might have been dispersed to the logged-over forest following gaps created by selective logging. Similarly, *Rauvolvia vomitoria* is a typical species of secondary vegetation (Keay, 1989) which must have also been one of the pioneer colonizers of the gaps created during selective logging and land clearing for farming purposes. When natural forest is cleared, it creates opportunity for re-colonization of the site by plant species hitherto suppressed or prevented from regenerating due to unfavourable microclimatic conditions under the canopy. Seeds may germinate from soil seed bank; while seeds of other species might be brought in by agents of dispersal such as wind, animals and water. The latter are usually mainly herb and climber species.

The domination of the farm fallow vegetation by herbs may be an indication that many of the larger trees and shrubs have been removed first, during logging, and subsequently by slash and burn farming. This is in conformity with NEST (1991) and Boehm and Siegert (2001) that the farmers are the main deforesting agents through logging, clearing and bush burning for crops cultivations. Ugbogu and Oyebola (2013) also reported that many valuable medicinal woody plants species in Omo Forest Reserve were represented by a single species as a result of unsustainable logging activities and food crop production. The implication of this finding is that the unsustainable logging and farming encroachments have negatively impacted on the diversity of plant species in Omo Forest Reserve. This has placed many of the species under pressure to the extent that they may be

easily driven into extinction if the trend is not reversed.

The reason for the highest composition of woody plant species in primary forest may not be far-fetched. Generally, woody plant species diversity follows the trend: primary forest > farm fallow > crop farm > logged over forest. This further emphasizes the deleterious effect of selective logging and unsustainable farming on plant species diversity in the study area.

This finding is in contrast with Pandey and Shukle (1999), who report that intermediate disturbance, maintains diversity; moderate disturbance promotes non-equilibrium species richness, while high disturbance interferes with vegetation growth and development. Abugov, (1982) puts it that diversity is maximum at the intermediate level of disturbance. But this study shows low diversity with increased level of disturbance. The difference in the observations may be due to differences in the methods of logging and land clearing (Zapfack *et al*., 2002, Bobo *et al*., 2006, Mbue *et al*., 2009). The decrease in species diversity from primary forest to farm fallow to crop farm and to logged over forest are attributable to effect of land use (Bobo *et al*., 2006, Gradstein *et al*., 2007; Sagar *et al*., 2008). Also the occurrence of highest number of stumps of timber-size trees in the logged-over forest followed by farm fallow, with the lowest in the protected primary forest in an indication that logging and farm clearing are responsible for the highest number of tree removals in the study area.

CONCLUSION

Selective logging and agricultural land preparation reduce woody plants diversity in Omo Forest Reserve. The undergrowth species composition was favored by forest conversion to other land uses; particularly agriculture (Crop farm and Farm fallow). Contrarily, large diameter woody plant species were more negatively impacted by logging and agricultural land clearing. The species richness, diversity, density, frequency and abundance of woody plants were influenced by selective logging, and slash and burn farming. Many of the choice timber species were encountered only in the primary forest which enjoys some level of protection. Therefore, logging and agricultural encroachment going on within the reserve should be controlled to guide against further loss of biodiversity.

The preservation of Omo Forest Reserve from human destruction will probably require the protection of adjoining buffer or support areas for farming. Also, responsible land management and logging practices should be adopted to maintain and encourage woody plant species diversity. Such management practices may include an insistence that, loggers are made to comply with proof of plant regeneration before the issuance of another permit. Strict supervision should be provided during logging activities to reduce the level of damage to the residual stock. Enrichment planting may be carried out in the other land use types, than natural forest in order to help re-introduce some disappearing native species like *Milicia excelsa, Cordia millenii, Nauclea diderichii, Myrianthus arborea, Terminalia spp and Khaya spp.* Agroforestry practices should be re-invigorated for forest regeneration, to reduce the pressures on reserved forest for agricultural land uses.

REFERENCES

Abugov, R. (1982). Species Diversity and Phasing of disturbance. *Ecology* 63, pp. 289-293.

Bobo, K.S., Wattert, M., Fermon, H., Njokagbor, J., Muhlenberg, M. 2006. From forest to farmland: Species richness patterns of trees and understorey plants along a gradient of Forest Conservation in South-western Cameroon. *Biodiversity Conservation* 15, pp. 4097 – 4117.

Boehm, H.D.V. and Siegert, F., 2001. Ecological Impact of the One Million Hectare Rice Project in Central Kalimantan, Indonesia, using Remote Sensing and GIS. Paper presented at the 22nd Asian Conference on Remote Sensing *(ACRS)*. Singapore, 5-9 November 2001. Singapore: Centre of Remote Imaging, Sensing and Processing (CRISP); National University of Singapore; Singapore Institute of Surveyors and Valuers (SISV); Asian Association on Remote Sensing (AARS). : 22–24.

Bolaji, B.O. 2014: Performance Study of the Eco-Friendly Hydro-fluoro-olefins and Dimethyl-Ether Refrigerants in Refrigeration Systems. *Sigurnost (Safety)*, 56 (2), pp. 113-121.

Brown S. and Lugo A.E. 1990. Tropical secondary forests. *Journal of Tropical Ecology* 6, pp. 1–32.

Delang, C.O. and Wang, W. 2013. Chinese forest policy reforms after 1998: The case of the Natural Forest Protection Program and Slope Land Conversion Program. *International Forestry Review* 15(3), pp. 290-304

Gauch, H. G., 1982. *Multivariate Analysis in Community Ecology*. Cambridge University.

Gradstein, S. R. ; Kessler, M. and Pitopang, R. 2007. Tree species diversity relative to human land uses in tropical rain forest margins in Central Sulawesi: Stability of Tropical Rainforest Margins. *Environmental Science and Engineering*, 104, pp. 319-332.

Holl K.D., Loik M.E., Lin E.H.V. and Samuels I.A. 2000. Tropical montane forest restoration in Costa Rica: overcoming barriers to dispersal and establishment. *Restoration Ecology* 8, pp. 339–349.

Keay, R.W.J.1989. *Trees of Nigeria.* Oxford University Press, New York. 476pp.

Maingi, J.K. and Marsh, S.E.2006. Composition, Structure, and regeneration patterns in a gallery forest along the Tana Rivers near Bura, Kenya. *Forest Ecology and Management*. 236, (2&3), pp. 211-228.

Mbue, I. N.; Ge, J.; Kanyamanda, K.. ; Njemnsi, Y. N. and Samake**,** M**.** 2009. Floristic inventory and diversity assessment of a low land African Montane Rainforest at Korup, Cameroon and implications for conservation. *African Journal of Ecology*, Volume 48(3), 759–768

Ogun State Ministry of Forestry 2004: Ogun State. htt://www.ogunstate.gov.ng/ministry-of-forestry.html

NEST (Nigeria Environmental Study Team) 1991. *Nigeria's Threatened Environment: A National Profile,* Ibadan, Nigeria. 288pp.

Ola-Adams, B. A. (1996): *Conservation and Management of Biodiversity,* pp. 118 - 133 In B. A. Ola-Adams and L. O. Ojo (Eds). Proceedings of BRAAF seminar, 9 - 11 Jan. 1996, Omo Biosphere Reserve.

forest conserv

Press, Cambridge.

Ola- Adams (1999). Biodiversity inventory of Omo Biosphere reserve, Nigeria. *Country report on Biosphere reserve for biodiversity conservation and sustainable development in Africa (BRAAF) project*, 351pp.

Pandey, S.K. R.P. Shukle 1999. Plant diversity and community patterns along the disturbance gradient in a plantation forest of sal (*Shorea robusta* Gaertn.). *Current Science* 77, pp. 814-818.

Popoola L.(2014). Imagine a Planet Without Forest. *An Inaugural Lecture delivered at the University of Ibadan,* 24 July, 2014 90pp.

Sagar, R.; Singh, A. and Singh, J.S. 2008. Differential effect of woody plant canopies on species composition and diversity of ground vegetation. *Tropical Ecology* 49, pp. 189-197.

Spellerberg, I. F. 1991. *Monitoring Ecological Change*, Cambridge University Press, Cambridge.

Turyahabwe, N. and Tweheyo, M. 2010. Does Forest tenure influence forest vegetation characteristics? A comparative analysis of private, local and central government forest reserves in Central Uganda: *The International Forestry Review* 12 (4), pp. 320-338.

Ugbogu, O.A and Oyebola, T.O. 2013. Checklist of medicinal plants in Omo Forest Reserve in the rain forest zone. *Journal of Forest Research and Management.* 10, pp. 107-119.

United Nations 2011. http://www.defense .gov/pubs/2011-National-Military-Strategy.pdf strength and will to protect our national interests do so at their peril. II Strategic Environment.

Wijdeven S.M.J. and Kuzee M.E. 2000. Seed availability as a limiting factor in forest recovery processes in Costa Rica. *Restoration Ecology* 8, pp. 414 -424.

Zapfack, L., Engwald, S., Sonke, B., Achoundong, G. and Madong, B. A. 2002. The impact of land conversion on plant biodiversity in the forest zone of Cameroon. *Biodiversity and Conservation* 11, pp. 2047-2061.