Assessment of Floristic Composition of Forest Undergrowth of International Institute of Tropical Agriculture (IITA) Forest Reserve Ibadan, Nigeria

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Abstract
Assessment of understorey species of a tropical rainforest ecosystem in South-western Nigeria, exemplified by International Institute of Tropical Agriculture (IITA) forest reserve, Ibadan. A total of twenty-four permanent sample plots of 0.0625ha were used for the assessment of understorey composition, density and frequency. Relative frequency, Relative Density and Importance Value Index(IVI), similarity, diversity and Detrended Correspondence Analaysis (DCA) statistics were used to analyse the data. The result showed a total of 3,833 individual from 128species and 44 families (28 shrub, 57 trees, 33herbs, 2 grasses and 8 climbers) were identified. *Papilonaceae* had the height number of species (11) followed by *Moraceae* (10), *Albizia zygia* had the height frequency of occurency (24), density of 169.33/ha. However *Culcasia scandens* had the height density of 299.33/ha. Highest Importance value index of 13.82 was recorded for *Culcasia scandens*, followed by *Chromolaena odorata* (11.80). The least (IVI) 0.18 was recorded for *Blepharis maderaspatensis, Carica papaya, Cissus piñata.* Similarity between paired plots varied from 0.16 to 0.75, Simpson diversity (0.9529) and dominance of 0.0471, number of species present in each of the plot ranged from 0-39. Plot 84 had the highest species (39), high Eigen value (73.7%), length of ordination space (-2 to 6) and the location of all the plots in the first quadrant indicated that the environment was stable indicative of minimal variation in floristic composition between plots and high heterogeneity of the site and species respectively. These findings showed that the IITA forest is diverse in species composition and the diversity of the understory may act as a catalyst for successful natural forest succession. Hence may be creating a more favourable environment for the establishment of native forest flora and habitat for fauna. Ultimately may be leading to conserving biological diversity. The study eventually concludes that a proper protection from human interferences and scientific management of undergrowth of the study area may lead a biodiversity rich site in the country.
Keywords: understory, ordination, Important value index, density, family

Introduction

The loss and fragmentation of tropical forest is the single greatest threat to the world's biological diversity.(Whitemore 1990, Huston 1994). The conservation on biological diversity 1992 highlighted that measures must be implemented for the conservation of natural ecosystems, especially for the tropical forests, which are famous for being the most species rich in ecosystems on earth.

Tropical rainforests are in class by themselves as the earth's most species-rich vegetation areas not only do they have many more tree species than any other vegetation type, but they are also exceedingly rich in non-tree species (Gentry and Dodson, 1987). The non- tree species in tropical rainforests comprises the largest proportion of the forest diversity and tends to be strongly responsive to the environmental gradients. It may be used as an indicator of altered edaphic and environmental conditions, particularly relative to anthropogenic disturbance and natural hazards (Gilliam and Robert, 2003). In the past few decades, most quantitative studies in the tropical rainforests were focused on some selected life-forms such as lianas (Putz, 1984; Chittibabu and Parthesarathy, 2000 ;) or of a defined minimum diameter (Valencia *et al*. 1994; Parthasarathy. 1999;)

The understory plant species are often considered indicators of soil moisture and nutritional status and contribute the degree of biodiversity in forest ecosystem (Tremblay and Larocque, 2001). Compared to other components of forest ecosystems, relatively less attention has been given to the quantitative inventory of understory species in the tropical rainforests, probably because they represent very small proportion of the total biodiversity in the forest ecosystems. However, many understory species may affect the development of dominant tree species at seedling stage by regulating nutrient cycles, modifying microclimatic conditions, or competing for site resources (Gilliam and Robert, 2003; George and Bazzaz, 1999).

A good knowledge of the plant species, composition and structured, diversity and understorey plant species in forest will help us to have an idea of the plants that survive under canopy cover. Therefore, there is need to list, quantify and assess the diversity of the wildlings, shrubs, herbs and grasses of the International Institute of Tropical Agriculture (I.I.T.A) forest, Ibadan. Hence the obejectives of this study includes identifying important understorey species, families and to provide a quantitative description of the structure and floristic composition of understorey species in International Institute of Tropical Agriculture (I.I.T.A) forest, Ibadan.

Materials and Method

Study Area

The study area is located on the one thousand hectares land in the International Institute of Tropical Agriculture (I.I.T.A) campus at Idi-Ose, North of Ibadan. It is located on longitude 7^0 30^1N and latitude 3^0 55^1E and 243m above sea level. The rolling topography is dominated by slopes that are 3-10% (Ano. 1967, Moormann *et al.,* 1975). The area is under-lain by metamorphic rocks of pre-cambrian basement complex, consisting largely of banded gneiss alternating with strata of quartzites and quartz schists. The soils are predominately Ferric Luvisols (Moormann *et al.,* 1975).

The site falls within the humid tropical lowland region with two distinct seasons: the longer wet season and shorter dry season. The rainfall pattern has bimodal peak with an annual total ranges between 1,300-1,500mm most of which falls between May and September. The average daily temperature ranges between 21^0C-23^0C while the maximum is between 28^0C and 34^0C . Mean relative humidity is in the range of 64-84% (Hall and Okali, 1979, Osunsina, 2004).

Data Collection

Data collection for this study was done within the twenty-four (25m x25m) Permanent sample plots established in 1979 by Hall and Okali, The plots were chosen to allow for monitoring and comparison of changes in forest regeneration after 35years. Within each plot ten (2mx2m) quadrants were further laid for easy assessment of the understory. Species present within each of the quadrants were counted and identified. Species that could not be identified on the field were collected and taken to the University herbarium for proper identification.

Statistical analysis

Standard procedure were followed to calculate density,frequency, abundance,relative density(R.D), relative abundance(R.A), and important value index(IVI) of the species. Relative density, relative frequency and important value index were to be calculated according to the formulae of Dumbois Muller and Ellenberg (Soerianegara and Indrawan 1998,Setiadi et al 2001). Diversity indices were computed by using the pooled data for all species; in the 24 sample plot. PAST - PAlaeontological STatistics, ver. 2.08. The diversity of understory. Simpson Diversity and Shannon Diversity index was also used to carried out similarities between the species in the plots. Detrended Correspondence Analysis (DCA) was also carried out on the data to elucidate the relationship that exists between plots and species

Result

Floristic composition and structure of Understorey Species

A total of 3,833 individual representing 128 species and 44 families (57 trees, 33 herbs, 28 shrubs, 8 climbers and 2 grasses) were encountered during the study. *Papilionaceae* had the highest number of species (11) followed by *Moraceae (10), Euphobiaceae (8), Agavaceae, Acanticiae, Anacardiaceae, Bombaceae, Caricaceae*, *Curcubitaceae, Ebenaceae had* one species each (Table 1). *Albizia zygia* had the highest frequency of occurrence (24) with density of 116/ha followed by *Chassalia kolly* (20), density of 169.33/ha. However *Culcasia sc*and*ens* had the highest density of 299.33/ha with frequency of 14, followed by *Chromolaena odorata* (244; 15), *Alchornea cordifolia* (230.67/ha; 18) (table 1). Species like *Drypetes gilgiana, Solanum erianthum, Hildergardia barteri,* had frequency of one. IVI value of the understorey are presented in table (1). *Culcasia Scandens* had the highest IVI of 13.82, followed by Chromolaena odorata (11.80) and the least IVI of 0.18 was recorded for *Blepharis maderaspatensis, Carica papaya, Cissus piñata, Cleistopholuss pattens, Cola nitida* and *Combretum zenkeri.* From the total of 3,833 individuals of understorey encountered, 1018 are trees from 57 species. Accounting for 27.1% of the total population.

Similarity and Diversity indices of Understorey Species

Table (2) present the Simpsons similarity between paired plots which varied from 0.16 to 0.75 for all the plots. Species diversity was generally high, this was reflected in 128 species, Simpsons diversity index was (0.9529), and low dominance value (0.0471). The number of individual (density) species present in all the plots ranged from 90-226 Number of species present in each of the plot ranged from 6-39, the plot with the highest species composition include plot 84 (39), plots 37, 68 and 60 had 35 species each. Plot 6 and 69 had the least no of species (6) each. However dominance was generally high in plot 6 (0.384), plot 69 (0.291), plot 49 (0.21), plot 70 (0.166), plot 84 had the least dominance (0.052). Simpsons diversity was generally high in all the plots except in plot 6 and 69 (0.616) and (0.719) respectively. High diversity value was recorded in plot 84 (0.948) and high species composition

Stand Ordination

The result of stand ordination is presented in figure 1 The stand ordination defining the understorey vegetation of

IITA, with respect to two-axis represent 73.9% of the variance accounted for by the first four-ordination axis. The first axis has 46.1% while the second axis has 26.8%. This presents the picture of the related plots and high heterogenous nature of the plots with the exceptions of plots 14 and 70 that are outliers. This means all the plots in this axis are linked together and the species of plant present in those plots are closely related together and can be said to be able to thrive under the same ecological and environmental conditions such as soil, rainfall, temperature and humidity. The ordination diagram presents three major groups. Group 1 comprises of plots 26, 28, 84, 41, 64. Group 2 comprises of plots 48, 17, 60, 89, 37, 30, 95, 90, 57, 49. Group 3 include plots 68 and 8. This grouping reflects the closeness in relation to the position of the plots to each other and the similarities in their floristic composition.

Species Ordination

Species ordination by DCA of the understorey species of the 24 plots with respect to two-axis represent 72.9% of the variance accounted for by the first four-ordination axis. The first axis has 45.49% and axis 2 has 26.45%. The plant species in the two axis both positive and negative sides are closely related though there is a higher degree of association or relationship as indicated by the variance with the plant resources of the study area. Some of them exhibit stronger relationship with each other hence they are packed together in the same corner of the ordination space. Nearly all the species are located in quadrant 1. The length of the axis ranged from -1 to 5 on both axes. The first horizontal axis shows a gradient separating BLSA, EUTR, CHAL, ANTO, MOME, CEZN, TAPA, MITH, FERN, ENAN, on the negative side of the axis, SPJO, BIGU, MYAR, MAW,CLAN, BANI, FUEL, LECU, RICA, MOTE, BRMI, VEAM, MUPR, GLSA, CHOD, MIEX, ALZY, PAPI, DIMO, CORA, ALLO, ANDI, BANI, CYPR are at the positive end of the axis. This clearly is an indication of the impact of environmental factors on the species distribution.

Discussion and Conclusion

A total of 3,833 individuals from 128 species and 44 families (28 shrub, 33 herbs, 57 trees, 2 grass and 8 climbers) of under storey encountered during the study is an indication of high species richness of the site which is attributed to the presence of few common species which were either young or whose growth was arrested due to shade cast by overhead canopy as well as understorey species. High density and IVI of, CHKO, CUSC and CHOD may be a reflection of invasion as a result of dispersal agent. This reflects the ability of *C. odorata* to out-compete and suppress weeds. This has already been reported in previous studies on weed communities in mixed food crop fields in tropical Africa (Akobundu *et al.,* 1992, de Rouw 1995, Roder *et al.,* 1995, Akobundu *et al.,* 1999, Ikuenobe and Anoliefo, 2003). Few species with high IVI was a reflection of high frequency of individuals and high number (density). The result showed that healthy forest patches are existent, indicated by important climber and Shrub species present.

Apocynaceae, Meliaceae Moraceae, Papilionaceae, Sapinideae and Sterculaceae are the dominant families in the sapling/tree in the forest floor; it is understandable, because a high proportion of the large trees exists as saplings in the understorey. In contrast, the family composition of herbs layer differed considerably with that of the tree layers, the dominant families are Vitaceae, Aristolochiaceae and Euphorbiaceae. This indicates that the seedlings/saplings of these families contributed greatly to the composition of the understorey in the forest.

The high species richness recorded in the study site reflects the heterogeneous distribution pattern in species composition and might be due to climatic factors which influenced the distribution of species, The result is similar to the findings of (Hussain *et al.,* 2000; Abdullahi, 2001; Abdullahi, *et al.,* 2009). The result also showed that IITA forest supports some of the most diverse and productive of all plant communities. This is primarily a result of the rich soils and abundant moisture. Readily available water and productive soils support a greater plant biomass than is usually found in upland areas, resulting in forests with a wide variety of species and complex vertical structures (LaRue *et al.,* 1995).

Species diversity was generally high in the understorey and dominance was low. Simpson's similarity indices between paired plots ranged from 0.16 to 0.75 for the entire plot. High similarity value observed between some paired plots indicates how similar the plots are in floristic composition. Quite an appreciable number of paired plots have percentage similarity far above 50% which means that the level of difference or variation is low.

In summary, this study has demonstrated that the understorey could contribute a lot to the total species richness of IITA forest. The sapling layer and herb/seedling layer may hold as many species as the tree layer (DBH≥10cm). These results suggest that the understorey vegetation should be given full consideration for the assessment of biodiversity patterns in tropical forests.

The ordination diagram of the understorey species with respect to the first two-axis represent 72% of the variance accounted for the first four-ordination axis. This present the picture of the related plots and high heterogeneous nature of the plots with the exception of plots 14 and 70. This may also means that all the plots are clustered together and the species of plants present are closely related together and can be said to be able to thrive under the same ecological and environmental correlations such as soil, rainfall, temperature and humidity (Jayeola, 2004).

The first horizontal axis shows a gradient separation BLSA, CWTR, CHAL, ANTO, MOME, CEZE, TAPA, MITH, FIRN, ENAN, on the negative side of the axis while SPJO, DIGU, MYAR, MAIN, CLAN, BANI, FUEL, LECU, RICA, MOTE, BRMI, VEAM, MUPR, GLSA, CHOD,MIEX, AZZY, PAPI, DIMO, ALCO, ANDI, CYPR are at the positive end of the axis. This clearly is an indication of the impact of environmental factors on species distribution.

Two groups of plots identified from the ordination diagram represent the closeness of the species to each other on the field and the similarities in their floristic composition.

Research conducted has shown IITA forest may act as a catalyst for successful natural forest succession of shrubs, herbs and grasses using the microclimatic conditions. This may be creating a more favorable environment for the establishment of native forest flora and habitat for fauna. Ultimately this may be leading to conserving biological diversity. The study eventually concludes that a continuous protection from human interferences and scientific management of undergrowth of the study area may lead a biodiversity rich site in the country.

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Table 1: Density (D), Frequency (F), Relative Density (RD), Relative Frequency (RF) and Relative Importance Value (RIV) of Understorey species in the Study Area.

Species	CODE	Form	Family	D/1.5	D/Ha	F	RF	RD	IVI
Abrus precatorius	ABPR	*climber*	*papilionaceae*	20	13.33	20.83	0.75	0.52	1.27
Adenia lobata	ADLO	*herb*	*passifloraceae*	6	4	12.5	0.45	0.16	0.61
Afzelia Africana	AFAF	*tree*	*Caesalpiniaceae*	13	8.67	4.167	0.15	0.34	0.49
Agbaarin	AGBA			3	2	4.167	0.15	0.08	0.23
Albizia ferruginea	ALFE	*tree*	*Mimosaceae*	6	4	12.5	0.45	0.16	0.61
Albizia glaberima	ALGL	*tree*	*Mimosaceae*	2	1.33	4.17	0.15	0.05	0.20
Albizia zygia	ALZY	*tree*	*Mimosaceae*	174	116	100	3.60	4.54	8.14
Alchornea cordifolia	ALCO	*shrub*	*Euphorbiaceae*	346	230.67	75	2.70	9.03	11.73
Allophylus africanus	ALAF	*herb*	*sapindaceae*	2	1.33	4.17	0.15	0.05	0.20
Anchomanes difformis	ANDI	*herb*	*araceae*	27	18	20.83	0.75	0.70	1.45
Antiaris africana	ANAF	*tree*	*Moraceae*	2	1.33	8.33	0.30	0.05	0.35
Antiaris toxicaira	ANTO	*tree*	*Moraceae*	21	14	29.17	1.05	0.55	1.60
Aristolochia albida	ARAL	*herb*	*aristolochiaceae*	2	1.33	4.17	0.15	0.05	0.20
Aristolochia elgon	AREL	*herb*	*Aristolochiaceae*	2	1.33	4.17	0.15	0.05	0.20
Aristolochia ringens	ARRI	*herb*	*Aristolochiaceae*	10	6.67	12.5	0.45	0.26	0.71
Asplia africana	ASAF	*herb*	*asteraceae*	9	6	16.67	0.60	0.23	0.83
Baphia nitida	BANI	*tree*	*Papilionaceae*	24	16	41.67	1.50	0.63	2.13
Blepharis maderaspatensis	BLME	*herb*	*Acanthaceae*	1	0.67	4.17	0.15	0.03	0.18
Blighia sapida	BLSA	*tree*	*Sapindaceae*	12	8	25	0.90	0.31	1.21
Blighia unijugata	BLUN	*tree*	*Sapindaceae*	19	12.67	37.5	1.35	0.50	1.85
Bridelia micrantha	BRMI	*tree*	*Euphorbiaceae*	6	4	8.33	0.30	0.16	0.46
Bridelia micrantha	BRMI	*tree*	*Euphorbiaceae*	2	1.33	8.33	0.30	0.05	0.35
Brysocarpus coccineaus	BRCO	*herb*	*Connaraceae*	59	39.33	45.83	1.65	1.54	3.19
Caesalpinia bonduc	CEBO	*shrub*	*Caesalpiniaceae*	8	5.33	4.17	0.15	0.21	0.36
Capiscum fruitscens	CAFR	*herb*	*Solanaceae*	2	1.33	4.17	0.15	0.05	0.20
Carica papaya	CAPA	*tree*	*Caricaceae*	1	0.67	4.17	0.15	0.03	0.18
Carpolobia lutea	CALU	*shrub*	*Polygalaceae*	50	33.33	66.67	2.40	1.30	3.70
Ceiba paetandra	CEPA	*tree*	*Bombacaceae*	2	1.33	8.33	0.30	0.05	0.35
Celtis midberii	CEMI	*tree*	*Ulmaceae*	16	10.67	33.33	1.20	0.42	1.62
Celtis zenkeri	CEZN	*tree*	*Ulmaceae*	72	48	62.5	2.25	1.88	4.13
Centrocema pubscens	CEPU	*climber*	*papilionaceae*	6	4	12.5	0.45	0.16	0.61
Chassalia kolly	CHKO	*herb*	*Rubiaceae*	254	169.33	83.33	3.00	6.63	9.63
Chromolaena odorata	CHOD	*herb*	*asteraceae*	366	244	62.5	2.25	9.55	11.80
Chrysophyllum albidum	CHAL	*tree*	*sapotaceae*	6	4	12.5	0.45	0.16	0.61
Cissampelos oweriensis	CIOW	*herb*	*Menispermaceae*	27	18	37.5	1.35	0.70	2.05
Cissus adenopoda	CIAD	*herb*	*Vitaceae*	66	44	50	1.80	1.72	3.52
Cissus aralioides	CIAR	*herb*	*Vitaceae*	2	1.33	8.33	0.30	0.05	0.35
Cissus pinata	CIPI	*herb*	*Vitaceae*	1	0.67	4.17	0.15	0.03	0.18
Clausenia anisata	CLAN	*herb*	*Rutaceae*	23	15.33	37.5	1.35	0.60	1.95
Cleitophylis pattens	CLPA	*herb*	*Annonaceae*	1	0.67	4.17	0.15	0.03	0.18
Cnestis ferruginea	CNFE	*shrub*	*Connaraceae*	108	72	75	2.70	2.82	5.52
Coffea canephora	COCA	*tree*	*Rubiaceae*	3	2	4.17	0.15	0.08	0.23
Cola millenii	COMI	*tree*	*Sterculiaceae*	32	21.33	50	1.80	0.84	2.64
Cola nitida	CONI	*tree*	*Sterculiaceae*	1	0.67	4.17	0.15	0.03	0.18
Combretum hispidum	COHI	*shrub*	*Combretaceae*	63	42	37.5	1.35	1.64	2.99
Combretum racemosum	CORA	*shrub*	*Combretaceae*	19	12.67	16.67	0.60	0.50	1.10
Combretum spp	COHI	*shrub*	*Combretaceae*	29	19.33	33.33	1.20	0.76	1.96
Combretum zenkeri	COZE	*tree*	*Combretaceae*	1	0.67	4.17	0.15	0.03	0.18
Comelina bengalensis	COBE	*herb*	*commelinaceae*	5	3.33	12.5	0.45	0.13	0.58
Culcasia scandens	CUSC	*herb*	*Araceae*	449	299.33	58.33	2.10	11.71	13.81
Cyathula prostrata	CYPR	*grass*	*amaranthaceae*	28	18.67	12.5	0.45	0.73	1.18
Deinboilia pinnata	DEPI	*tree*	*Sapindaceae*	10	6.67	25	0.90	0.26	1.16
Dialum guinensis	DIGU	*tree*	*Caesalpiniaceae*	7	4.67	16.67	0.60	0.18	0.78
Dioscorea bulbifera	DIBU	*climber*	*dioscoraceae*	3	2	12.5	0.45	0.08	0.53
Dioscorea dumetorum	DIDU	*climber*	*dioscoraceae*	3	2	4.17	0.15	0.08	0.23
Diospyros mobuttensis	DIMO	*tree*	*Ebenaceae*	12	8	29.17	1.05	0.31	1.36
Draceana arborea	DRAR	*shrub*	*Agavaceae*	18	12	25	0.90	0.50	1.37
Drypetes floribunda	DRYP	*shrub*	*Euphorbiaceae*	7	4.67	4.17	0.15	0.18	0.33
Entradophagma angolensis	ENAN	*tree*	*Meliaceae*	4	2.67	8.33	0.30	0.10	0.40
Eudenia trifoliolata	EUTR	*herb*	*Capparidaceae*	7	4.67	12.5	0.45	0.18	0.63
Fagara santolinoides	FASA	*shrub*	*Rutaceae*	3	2	4.17	0.15	0.08	0.23
fern	FERN	*herb*		18	12	16.67	0.60	0.50	1.07
						4.17			
Ficus capensis	FICA	*tree*	*Moraceae*	2	1.33		0.15	0.05	0.20
Ficus exasperata	FIEX	*tree*	*Moraceae*	19	12.67	29.17	1.05	0.50	1.55

Ficus mucuso	FIMU	*tree*	*Moraceae*	3	2	8.33	0.30	0.08	0.38
Ficus sur	FISU	*tree*	*Moraceae*	1	0.67	4.17	0.15	0.03	0.18
Futumia elastica	FUEL	*tree*	*Apocynaceae*	11	7.33	25	0.90	0.29	1.19
Gliricidia sepium	GLSA	*tree*	*Papilionaceae*	28	18.67	12.5	0.45	0.73	1.18
Glypheea brevis	GLBR	*tree*	*Tiliaceae*	12	8	16.67	0.60	0.31	0.91
Grewia campanifolia	GRCA	*tree*	*Tiliaceae*	49	32.67	45.83	1.65	1.28	2.93
Haemanthus nultiflorus	HANU	*herb*	*amaryllidaceae*	5	3.33	4.17	0.15	0.13	0.28
Hildebergia	HILD	*tree*	*Sterculiaceae*	4	2.67	4.17	0.15	0.10	0.25
Holarrhena floribunda	HOFL	*tree*	*Apocynaceae*	4	2.67	8.33	0.30	0.10	0.40
Hoslundia opposita	HOOP	*shrub*	*Lamiaceae*	5	3.33	8.33	0.30	0.13	0.43
Icacina trichanta	ICTR	*herb*	*Icacinaceae*	135	90	66.67	2.40	3.52	5.92
Ipomea spp	IPSP	*herb*	*Convolvulaceae*	1	0.67	4.17	0.15	0.03	0.18
Ipomoea invoculata	IPIN	*herb*	*Convolvulaceae*	3	2	4.17	0.15	0.08	0.23
Isirigun	ISIRI			2	1.33	4.17	0.15	0.05	0.20
Lecaniodiscus cupanioides	LECU	*tree*	*Sapindaceae*	46	30.67	75	2.70	1.20	3.90
Lepsistema oweriensis	LEOW	*shrub*	*Convolvulaceae*	2	1.33	4.17	0.15	0.05	0.20
Leptoderis brachyptera	LEBR	*shrub*	*Papilionaceae*	28	18.67	50	1.80	0.73	2.53
Lonchocarpus cyanescens	LOCY	*shrub*	*Papilionaceae*	16	10.67	37.5	1.35	0.42	1.77
malacantha alnifolia	MAAL	*tree*	*Sterculiaceae*	68	45.33	37.5	1.35	1.77	3.12
Mallotus oppositifolius	MAOP	*shrub*	*Euphorbiaceae*	50	33.33	45.83	1.65	1.30	2.95
Mangifera indica	MAIN	*tree*	*Anacardiaceae*	1	0.67	4.17	0.15	0.03	0.18
Manicaira obovata	MAOB	*tree*	*Sapotaceae*	9	6	8.33	0.30	0.23	0.53
Manihot esculenta	MAES	*shrub*	*Euphorbiaceae*	34	22.67	20.83	0.75	0.89	1.64
Mezoneuron benthamianum	MEBE	*tree*	*Moraceae*	3	2	8.33	0.30	0.08	0.38
Milletia excelsa	MIEX	*shrub*	*Caesalpiniaceae*	2	1.33	4.17	0.15	0.05	0.20
Milletia thonningi	MITH	*tree*	*Papilionaceae*	34	22.67	66.67	2.40	0.89	3.29
Momordica charantia	MOCH	*climber*	*cucurbitaceae*	12	8	20.83	0.75	0.31	1.06
Monodora tenuifolia	MOTE	*tree*	*annonaceae*	29	19.33	54.17	1.95	0.76	2.71
Morus mesozygia	MOME	*tree*	*moraceae*	18	12	25	0.90	0.47	1.37
Mucuna pruriens	MUPR	*climber*	*papilionaceae*	25	16.67	16.67	0.60	0.65	1.25
Mucuna sloanei	MUSL	*climber*	*papilionaceae*	3	2	4.17	0.15	0.08	0.23
Myrianthus arborea	MYAR	*shrub*	*Moraceae*	5	3.33	8.33	0.30	0.13	0.43
Newboldia laevis	NELA	*tree*	*Boraginaceae*	46	30.67	66.67	2.40	1.20	3.60
Olax subsicopiodes	OLSU	*tree*	*olacaceae*	13	8.67	25	0.90	0.34	1.24
ovaria chame	OVCH	*tree*		1	0.67	4.17	0.15	0.03	0.18
Parquetina nigrescens	PANI	*tree*	*asclepiadaceae*	19	12.67	37.5	1.35	0.50	1.85
Paullinia pinnata	PAPI	*shrub*	*Sapindaceae*	13	8.67	25	0.90	0.34	1.24
Penisetum puperium	PEPU	*grass*	*poraceae*	12	8	4.17	0.15	0.31	0.46
Phyllanthus reticulata	PHRE	*herb*	*euphorbiaceae*	1	0.67	4.17	0.15	0.03	0.18
Piper guinensis	PIGU	*climber*	*piperaceae*	4	2.67	12.5	0.45	0.10	0.55
Pupalia lappacea	PULA	*herb*	*Amaranthaceae*	6	4	4.17	0.15	0.16	0.31
Rauvolfia vomitoria	RACA	*tree*	*apocynaceae*	1	0.67	4.17	0.15	0.03	0.18
Richiea caparoides	RICA	*tree*	*capparidaceae*	10	6.67	8.33	0.30	0.26	0.56
Rothmannia longiflora	ROLO	*tree*	*Rubiaceae*	3	2	8.33	0.30	0.08	0.38
Sansaveria liberica	SALI	*shrub*	*Agavaceae*	59	39.33	25	0.90	1.54	2.44
Secamore afzelii	SEAF	*shrub*	*Asclepiadaceae*	17	11.33	29.17	1.05	0.44	1.49
Smilax anceps	SMAN	*herb*	*Smilacaceae*	26	17.33	37.5	1.35	0.68	2.03
Solanum erianthum	SOER	*shrub*	*Solanaceae*	2	1.33	4.17	0.15	0.05	0.20
Sphenocentrum jollyanum	SPJO	*shrub*	*Menispermaceae*	240	160	66.67	2.40	6.26	8.66
Spondia monbin	SPMO	*tree*	*Anacardiaceae*	34	22.67	37.5	1.35	0.89	2.24
Sterculia tragacantha	STTR	*tree*	*sterculiaceae*	32	21.33	54.17	1.95	0.83	2.78
Strophanthus spp	STSP	*herb*	*Apocynaceae*	11	7.33	16.67	0.60	0.29	0.89
Tabernaemontana pachysiphon	TAPA	*tree*	*Apocynaceae*	4	2.67	8.33	0.30	0.10	0.40
Tabernamontana spp	TASP			1	0.67	4.17	0.15	0.03	0.18
Talinum voticosum	TAVO	*tree*	*Portulacaceae*	25	16.67	4.17	0.15	0.65	0.80
Titonia diversifolia	TRDI	*shrub*	*Asteraceae*	9	6	4.17	0.15	0.24	0.39
Tomatococus daniela	TODA	*herb*		16	10.67	4.17	0.15	0.42	0.57
Tragia benthami	TRBE	*Herb*	*euphorbiaceae*	9	6	8.33	0.30	0.24	0.54
Trema orientalis	TROR	*tree*	*ulmaceae*	3	2	4.17	0.15	0.08	0.23
Trichilia monaldepha	TRMO	*tree*	*Meliaceae*	38	25.33	37.5	1.35	0.99	2.34
Triplochiton scleroxylon	TRSC	*tree*	*Sterculiaceae*	2	1.33	4.17	0.15	0.05	0.20
Vernonia amygdalina	VEAM	*shrub*	*Asteraceae*	6	4	12.5	0.45	0.16	0.61
				3833	**2555.33**	**2775**	**100**	**100**	**200**

Table 2: Similarity Indices of Plant Species

	plot14	plot8	plot68	plot90	plot49	plot37	plot57	plot48	plot95	plot76	plot89	plot41	plot64	plot26	plot84	plot97	plot86	plot70	plot28	plot60	plot17	plot30
plot14	1.00																					
plot8	0.60	1.00																				
plot68	0.67	0.60	1.00																			
plot90	0.50	0.40	0.62	1.00																		
plot49	0.75	0.63	0.67	0.50	1.00																	
plot37	0.57	0.68	0.57	0.62	0.75	1.00																
plot57	0.52	0.48	0.68	0.44	0.50	0.60	1.00															
plot48	0.47	0.36	0.41	0.54	0.46	0.50	0.28	1.00														
plot95	0.41	0.40	0.41	0.50	0.38	0.52	0.52	0.41	1.00													
plot76	0.33	0.24	0.33	0.35	0.21	0.37	0.24	0.37	0.41	1.00												
plot 89	0.53	0.44	0.41	0.54	0.42	0.53	0.36	0.47	0.59	0.37	1.00											
plot41	0.53	0.48	0.43	0.50	0.63	0.60	0.48	0.50	0.59	0.33	0.65	1.00										
plot64	0.52	0.39	0.43	0.39	0.48	0.61	0.43	0.48	0.70	0.30	0.70	0.83	1.00									
plot26	0.40	0.24	0.32	0.38	0.42	0.35	0.44	0.31	0.48	0.41	0.47	0.56	0.65	1.00								
plot84	0.50	0.48	0.43	0.54	0.50	0.51	0.56	0.47	0.59	0.33	0.56	0.61	0.74	0.53	1.00							
plot97	0.48	0.48	0.48	0.46	0.46	0.59	0.60	0.45	0.52	0.30	0.52	0.62	0.57	0.48	0.62	1.00						
plot86	0.27	0.16	0.19	0.31	0.25	0.31	0.24	0.38	0.46	0.31	0.50	0.58	0.52	0.65	0.54	0.46	1.00					
plot70	0.36	0.27	0.41	0.36	0.41	0.41	0.32	0.32	0.45	0.41	0.59	0.59	0.41	0.68	0.59	0.45	0.64	1.00				
plot28	0.40	0.44	0.41	0.50	0.46	0.50	0.56	0.38	0.52	0.26	0.53	0.66	0.65	0.59	0.66	0.55	0.54	0.50	1.00			
plot60	0.43	0.36	0.37	0.54	0.50	0.54	0.48	0.41	0.45	0.30	0.50	0.50	0.57	0.44	0.53	0.55	0.42	0.50	0.56	1.00		
plot17	0.56	0.40	0.52	0.44	0.42	0.52	0.40	0.48	0.48	0.36	0.68	0.56	0.52	0.40	0.60	0.48	0.24	0.41	0.48	0.64	1.00	
plot30	0.43	0.36	0.43	0.58	0.42	0.50	0.48	0.47	0.45	0.30	0.50	0.53	0.52	0.43	0.73	0.45	0.38	0.36	0.57	0.50	0.44	1.00

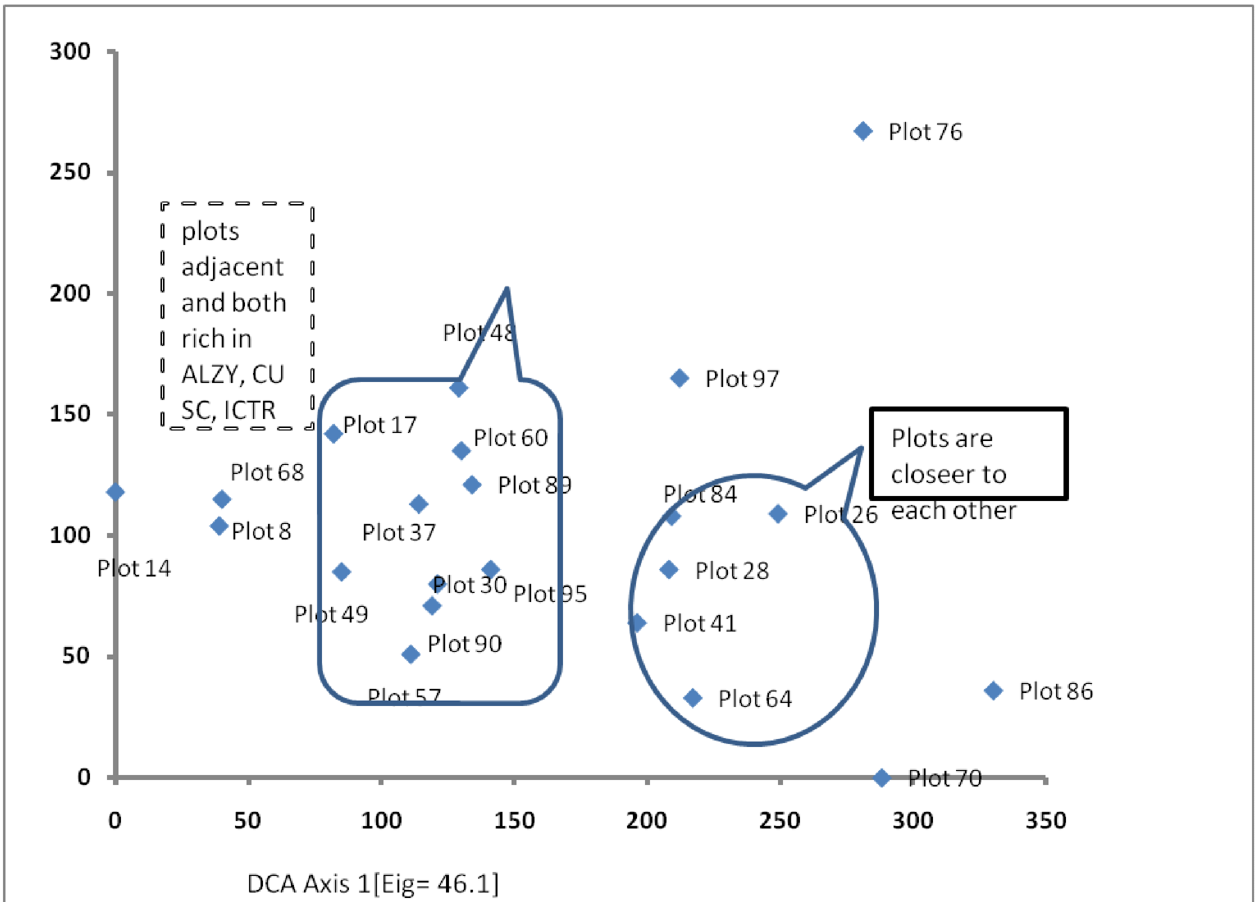

Figure 6: Stand Ordination by Detrended Ordination Analysis (DCA) of stands defining the Understorey vegetation of IITA, Ibadan in 2011

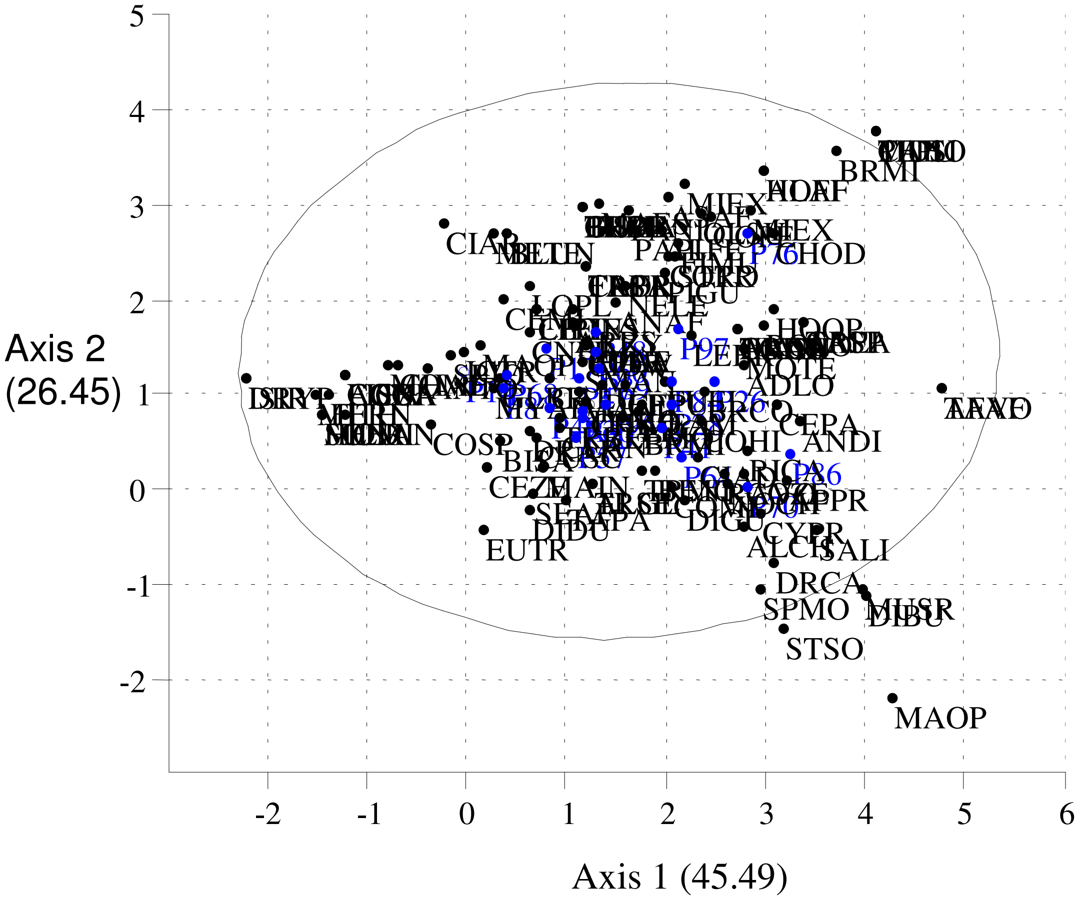

Figure 1. Species Ordination by Detrended correspondence Analysis (DCA) Defining the Understorey Species in the study area. (The circle represents the 95% ellipses)