REGENERATION OF INDIGENOUS WOODY SPECIES WITHIN THE TREE PLANTATIONS IN UKPOM BENDE FOREST RESERVE, ABIA STATE SOUTHEASTERN NIGERIA.

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ABSTRACT
The status of indigenous tree species regenerated under the canopies of three tree plantations (*Gmelinaarborea, Tectonagrandis* and *Teminaliaivorensis*) in Ukpom Bende Forest Reserve was studied. The study assessed the diversity and density of naturally regenerated indigenous woody species with the view to ascertaining how the plantations have performed in terms of conservation of native biodiversity. Vegetation assessment within the stands was conducted using line transects survey and quadrat methods. Four line transects which were 100m apart were established in each of the tree plantations. Two quadrats, 10m x 10m each representing the sample plots, were located at 100m intervals along each of the four transects given a total of eight replicates sample plotsin each plantation. Vegetation was assessed through analysis of floristic composition, species richness and evenness. A total of38 plant species native species belonging to 30 families were recorded in *G.arborea* plantation. In *T.grandis*plantation, 28 plant species belonging to 22 families were enumerated,while 32 plant species belonging to 22 families were enumerated in *T.ivorenensis* plantation.*G. arborea*plantation also had the highest density of plant (3454 plants ha^{-1}), followed by *T.ivorensis*plantation (2078 plants ha^{-1}), while *T.grandis*plantation had the least density of plant (2428 plants ha^{-1}). *G. arborea* plantation exhibitedthe highest ShannonWiener- diversity and evenness (3.5 and 0.96), while *T. ivorensis*plantation had the least value (2.7 and 0.77). Highest similarity index was observed between the plantation stands of *G.arborea* and *T. grandis*(0.75) while*T. grandis*and *T.ivorenensis* plantation stands recorded the least similarity (0.67). The study showed that tree plantations can foster the regeneration of indigenous woody species thereby enhancing conservation of native woody species.
Keywords: Regeneration, Species Density, Diversity,Indigenous Species, Forest Reserve.

INTRODUCTION

According to the FAO(Food and Agricultural Organization) (2006), plantation forests are established through planting or seeding of one or more indigenous or introduce tree species in the process of afforestation or reforestation. Their main objective is often the production of timber or fuelwood (plantation provided about 35% of the global wood supply in 2007) but some are established to reduce erosion, fix carbon dioxide or provide other environmental, economic, or social benefit (Eckehard*et al.*, 2008). Plantation forests comprising of exotic species such as *Gmelinaarborea, Pinuscarribea, Tectonagrandis* and others occupy $2{,}160km^2$ out of the $96518km^2$ total land area of forest estate of Nigeria (Abayomi *et al*, 1992) In Nigeria, most forest reserves were established as a response to natural disaster and other purposes such as environmental protection, reducing global warming by acting as carbon sinks, conservation of biodiversity, source of industrial raw material and to complement the natural forest in wood supplies (Oluwalana,1997).

The potential advantages of plantation forest include: readily available information on propagation techniques, silvicultural behavior, management practices of the species, relatively fast growing rates and provision of wood that can be used for various purposes in relatively short period of time (Hundera, 2010). Plantation forests facilitate regeneration of native species under their canopy and catalyze the subsequent succession processes (Parrotta et al, 1997). It also improves degraded lands by stabilizing soils, improving soil nutrient status and increasing soil organic matter through enhancing of above ground litter production.

The potential disadvantages include: a) unforeseen risks, such as problem of adaptability and susceptibility of species to diseases, b) negative impacts on the environment, e.g. undesirable changes in the physical, chemical and biological conditions of the soil: and c) undesirable invasion/colonization of arable lands, pastures and native vegetation as well as displacement of the local flora (Teketayand Senbeta, 2001).

Many studies have indicated that forest plantations can foster the regeneration of native woody species under the canopy and facilitate the subsequent succession process (Teketayand Senbeta,2001; Tesfaye and Berhamu, 2006;Hundera,2010).The importance of conserving biological diversity in forest ecosystems has generated policy proposals aimed at minimizing the conversion and fragmentation of the remaining large areas of native forests and establishment of plantation forest all over the world (Sample, 2004). Tropical timber plantations provide a variety of environmental services, including recovery of biodiversity on degraded lands. Plantations can speed forest succession processes by improving microclimate conditions and

attracting seed dispersers, thus promoting woody regeneration (Cusack and Montagnini, 2004).Sometimes exotic plantations can help restore native biota on degraded sites (Lugo, 1997), by stabilizing soil and creating site conditions favorable for native animalsand plants to re-colonize.Similarly, Ashton *et al*. (2001) andCarnevale andMontagnin (2002) noted that plantations can increase biodiversity by promoting woody understory regeneration. In addition to increasing biodiversity, plantation forest can restore soil fertility, reduce erosion and restore biodiversity productivity (Teketay and Senbeta, 2001; Montagini, 2001, Hundera 2010).

It is important to monitoring the composition and densities of indigenous woody species following plantation establishment to determine the ability of the plantation to allow recruitment particularly native species thereby enhancing conservation of native woody species. Therefore, the objective of this study was to assess the density and diversity of indigenous species in Ukpom Bende Forest reserve.

MATERIALS AND METHODS

The Study Area

The study was carried out at Ukpom Bende Forest Reserve about 20Km Southeast of Umuahia, along Umuahia –Bende highway. The Reserve is about 14.750 km^2.and lies on latitude 5^0 34' N and longitude 7^0 32' E. The soil is loamy clay and is derived from the crystalline acid rocks of undifferentiated basement complex (Ogbonnaya 2002). The vegetation is of tropical rain forest ecological zone. The mean annual rainfall of the area is between 1800-2238. The mean annual temperature of the area ranges between 32^0C and 23^0C while the relative humidity is between 65-85% (ADP 2010).The Forest Reserve was acquired in 1929, gazetted in 1953 while plantation establishment began in 1958. The species planted included *Gmelina aborea, Tectona grandis, Naucleadiderrichi, Terminalia ivorensis, Mitragyna,* and *Khaya grandifolia*. Others were *Lovea, Entradrophragma, Cederela odorata, Treculia africana, Irvingia* sp, *Triplochytonscleroxylon, Eucalyptus* species etc. The objectives of management include production of timber, poles, pulpwood, fuelwood and non-timber forest products. It also aimed to conserve biodiversity and provide ecological services such as protection of fragile soils, protection of catchment area of the Inyang river and climate amelioration.

Methods of Data Collection

Three plantations (a) *Gmelina arborea (b)Tectona grandis and* (c)*Terminalia ivorensis* were selected for the study. Vegetation assessment within each plantation was conducted using a line transect survey and quadrat methods. Four transects which were 100m apart were established in each of the plantation. Two replicates sample plots, each 10mx10m were located at 100m intervals along each of the line transect, given a total of eight replicates sample plots of 10mx10m in each plantation. The starting point of all line transects were located randomly in each plantation. The sample plots were laid down in each plantation and the first sample plot (10m x 10m) was located randomly. All the sample plots were located at least 50m from the plantation edge to avoid edge effect. In each of the sample plot all of the naturally regenerated indigenous tree species were identified and counted. Species identification was conducted at herbarium of the Department of Forestry and Environment Management, MichaelOkpara University of Agriculture Umudike.The identification followed Flora of Tropical West Africa (Hutchinson and Dalziel (1954-1972).

Methods of Data Analysis

Frequency, density,and relative abundance of plant species were determined by the following the methods as outline by Muller-Dombois and Ellenberg (1974).

The Shannon-Wiener diversity index (H) and Shannon-Wiener evenness (E) were computed following Magurran (1988).

$H = -\sum pi \ln pi$, where pi is the proportion of individuals found in species i.

For a well-sampled community, we can estimate this proportion as pi = ni/N, where ni is the number of individuals in species i and N is the total number of individuals in the community.

Shanon-Wiener evenness $(E)=H/H_{max.}$Where, H is the diversity index and H_{max} is the maximum diversity possible.

Similarity in species composition among the plantation stands was computed using Sorensen Similarity index(Kent and Coker, 1993).

Sørensen's Similarity index (QS) $= \frac{2C}{A+B}$

Where, A and *B* are the number of species in samples A and B, respectively, and *C* is the number of species shared by the two samples; QS is the quotient of similarity and ranges from 0 – 1. The value will be close to 1.0 for sites that have most of their species in common and for very dissimilar sites the value would be close to 0.

RESULTS

Number of families and of native species enumerated in the three plantations at Ukpom Bende Forest Reserve as well as density re presented inTable 1.There was variation in the species composition of the plant species recruited in the three plantations studied. In *Gmelina arborea* plantation, 38 plant species belonging to 30 families were enumerated; in the *Tectona grandis* plantation 28 plant species belonging to 22 families were recorded while in *Terminalia ivorenensis* plantation, 32 plant species belonging to 22 families

were enumerated. Six families namely Euphorbiaceae, Acanthaceae,Zingiberaceae,Gramineae, Icacinaceae, and Papilionaceae have the highest representation of plant species across the three plantation stands.

The density of understory regenerated indigenous plant species varied among the plantations (Table 1). The highest density of regenerated native plants (number of regenerated individuals per hectare) was recorded in *Gmelina arborea* plantation (3454 plants ha^1) followed by *Terminalia ivorenensis*(2428 plants ha^1) and the lowest (2078 plants ha^1) in the *Tectona grandis* plantation.

The percentage relative abundance of the regenerated native species ranges from 0.17 to 9.09% in *G. arborea* plantation (Table 1), with *Alchornea codifolia*havingthe highest relative abundance of 9.09%, followed by*Mallotus oppositifolia* (7.45%) and *Costus afer* (7.00%), while *Melicia excelsa* had the least relative abundance of (0.17%).The percentage relative abundance in *Tectonagrandis* plantation varies from 0.48 to 10.30%, with Costus*afer* having the highest relative abundance (10.30%), followed by *Macaranga bateri*(7.60%) and *Manniphyton fulvum* (7.60%), while the least was *Canarium schweinfurtii*(0.48%). The percentage relative abundance in *Terminalia* ivorensis ranges from 0.10 to 10.46%, with *Icacina trichantha* having the highest (10.46 %), followed by *Costus afer* (7.83%) and *Acanthus montanus*(7.14%), while *Smilax anceps* had the least (0.10%).

Table 1:Number of species ha^{-1} (D) and percentage relative abundance (%RA)of regenerating species /ha under the plantations in Ukpom Bende Forest Reserve, 2012

Species	Family	*G.arborea*		*T. grandis*		*T.ivorensis*	
		D	*%RA*	*D*	*%*	*D*	*%RA*
Acanthus montanus	Acanthaceae	190	5.50	135	6.50	188	7.14
Diplazium sammatii	Athyriaceae	30	0.87	125	6.02	50	2.06
Aspilia Africana	Asteraceae	178	5.15	-	-	176	7.25
Mussanga cecropioides	Aquifoliaceae	30	0.87	12	0.58	-	-
Ceiba pentandra	Bombacaceae	8	0.23	-	-	-	-
Canarium schweinfurtii	Burseracea	32	0.93	10	0.48	36	1.48
Dialium guineensis	Caesalpinaceae	106	3.07	30	0.87	15	0.62
Combretum hispidum	Combretaceae	22	0.64	-	-	35	1.44
Cnestis ferruginea	Connoraceae	168	4.86	134	6.45	76	3.13
Alchornea cordifolia	Euphorbiaceae	314	9.09	44	2.12	152	6.26
Mallotus oppositifolium	Euphorbiaceae	258	7.45	145	6.98	136	5.60
Manniphyto nfulvum	Euphorbiaceae	156	4.52	158	7.60	156	6.42
Phyllanthus amarus	Euphorbiaceae	-	-	-	-	32	1.32
Centrosema puberscens	Fabaceae	154	4.46	87	4.19	119	4.90
Andropogon tectorum	Gramineae	1 42	4.11	74	3.56	89	3.67
Panicum maximum	Gramineae	44	1.27	-	-	102	4.20
Resisantia indica	Hippocrateaceae	-	-	-	-	16	0.66
Icacina trichantha	Icacinaceae	218	6.13	110	5.29	154	10.46
Napoleana vogali	Lecithidaceae	-	-	24	1.15	12	0.49
Albiziazygia	Leguminosae	-	-	-	-	64	2.64
Senna hirsute	Leguminosae	-	-	-	-	128	5.27
Sida spp	Malvaceae	158	4.57	104	5.00	-	-
Mimosa pudica	Mimosaceae	32	0.98	40	1.92	-	-
Pentaclethra macrophylla	Mimosaceae	33	0.32	12	0.58	18	0.74
Milicia excels	Moraceae	6	0.17	-	-	11	0.45
Treculia africana	Moraceae	24	0.69	16	0.77	20	0.82
Ficus thonningii	Moraceae	-	-	12	0.58	-	-
Ficus experata	Moraceae	67	1.94	-	-	16	0.66
Elaeis guineensis	Palmeae	12	0.35	22	1.06	20	0.82
Raphia hookeri	Palmeae	-	-	-	-	10	0.41
Baphia nitida	Papilionaceae	122	3.53	124	5.97	144	5.93
Pterocarpu sosun	Papilionaceae	18	0.52	16	0.77	14	0.58
Acroceru szinanoides	Poaceae	46	1.33	-	-	-	-
Capolohialutea	Polygalaceae	36	1.06	-		-	-
Smilax anceps	Similaceae	48	1.39	31	1.49	24	0.10
Cola hispida	Streculiaceae	-	-	14	0.67	-	-

Physalism icrantha	Solenaceae	-	-	-	-	18	0.74
Solanu mtorvum	Solenaceae	150	4.34	60	2.89	35	1.44
Vitex grandoifolia	Verbanaceae	14	0.41	-	-	72	2.97
Costus afer	Zingiberaceae	242	7.00	214	10.30	190	7.83
Bombers sp	Bombacaceae	8	0.23	-	-	-	-
Mitragyna sp	Rubiaceae	8	0.23	-	-	-	-
Napolina vogeli	Lecithidaceae	12	0.35	-	-	-	-
Spongia mobin	Anacardiaceae	18	0.52	-	-	-	-
Macranga barteri	Euphorbiaceae	98	2.83	174	8.37	-	-
Diospyro ssp	Ebenaceae	140	4.05	105	5.05	-	-
Stromosia pustulata	Olocaceae	112	3.24	46	2.21	-	-
Total density		**3454**	**100**	**2078**	**100**	**2428**	**100**
Total Number of Species		**38**		**28**		**32**	

Shannon Wiener diversity index and evenness showed considerable variation among the plantation stands(Table 2). *G. arborea* plantation stand exhibited the highest value of Shannon diversity and eveness (3.5 and 0.96) followed by *T. grandis* (2.9 and 0.87), while *T. ivorensis* had the least value (2.7 and 0.77).

Table 2: Shannon Wiener diversity, Evenness and density of naturally regenerated plant species in the different plantation stands in Ukpom Bende Forest Reserve, 2012

Stands	Richness	Density (No. of trees ha^{1})	Diversity (H)	Evenness (H/Ins)
G. arborea	38	3454	3.5	0.96
T. grandis	28	2078	2.9	0.87
T. ivorensis	32	2428	2.7	0.77

Sørensen's similarity differed among the plantation stand (Table 3). *G. arborea* plantation and *T. grandis* exhibited the highest similarity index (0.75), while *T. grandis*and *T. ivorensis* showed the least similarity (0.67)

Table 3: Sørensen's Coefficient of Similarity in species composition of naturally regenerated plant species between different stands investigated inUkpom Bende Forest Reserve, 2012

Plantation stand	*G. arborea*	*T. grandis*	*T. ivorensis*
G. arborea	-	0.75	0,71
T. grandis		-	0.67
T. ivorensis			-

DISCUSSION

The result indicates that tree plantations can foster the regeneration of indigenous woody species and increase biodiversity in the plantation stands.The finding supports Ogbonna and Nzegbule (2007), that plantations differ in their ability to allow seed germination particular indigenous species because of the type of vegetation covers and microclimate condition they create. The plantations permit the process of forest succession over time by attracting seed dispersal agents, providing a nurse effect for the colonizing native species and increasing nutrient status of top soil through litter fall BrockerhoV *et al*., 2003). The result corroborates the finding of Eckehard (2008) that the tree plantations can make an important contribution to the conservation of native biodiversity and disagree with a common perception of plantation forests as ecological deserts that do not provide habitat for valued organisms. The result further agreed with numerous studies in many countries that plantation forests can provide habitat for a wide range of native forest plants, animals, and fungi (BrockerhoV*et al*., 2003,Barbaro *et al*., 2005, Carnus *et al.*, 2006). Plantations can contain substantial components of biological diversity across many taxa, including rare species in some cases (Norton, 1998; Wilson and Watts, 1999). The number of families, species and density of regenerated plant species recorded in this study were fewer than those enumerated in natural forest by some researchers, such as Okojie *al.*,(1988) and Dike (2002).Other studies such as Eckehard,(2008), Hundera (2010) and Teketay and Senbeta, (2001), have also shown that plantation stands usually support fewer native species than a natural forest. Plantation forests often have lower plant diversity than natural woodland, because they are generally planted and managed to ensure a high yield of a single, or few species (Coote*et al.*, (2012). The relative abundance of important indigenous economic timber species such as *Milicia excels*, *Diospyros*

species and *Bombers* speciesin the entire plantations was low. This could be attributed to scarcity of seed source or mother tree due to over exploitation of these species, in addition to their poor ability to coppice. Besides the absence of regenerating important timber species may be due to the absence of ecological requirement for seed germination and seedling growth of the species (Hundera, 2010). The Shannon- Wiener diversity index, a measure of both abundance and evenness of the species was high across the three plantations studied. This underscores the importance of plantation stands for the purpose of ecosystem restoration and enhancement of native biodiversity.

CONCLUSION

The three plantations allow recruitment of indigenous woody species thereby concentrating native biodiversity. However, the plantations differ in their ability to allow seed germination because of the type of vegetation cover and the microsite condition they create. The plantations enhance the process of forest succession over time by attracting seed dispersal agents and producing a nurse effect for regenerated indigenous woody species. Tree plantations should therefore be promoted in order to enhance conservation of native woody specie for their environmental, social and economic values.

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