

IMPACTS OF URBAN GREENING INDUCED-SPECIES HOMOGENIZATION ON ECOSYSTEM FUNCTIONS AND SERVICES IN SOME SELECTED CAPITAL CITIES IN THE SOUTH SOUTH REGION OF NIGERIA

***Ita-Nya E.P.¹; Obafemi A. A.^{1,2} and Ndukwu, B. C.^{1,3}**

¹Institute of Natural Resources Environment and Sustainable Development, Faculty of Science, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

²Department of Geography and Environmental Management, Faculty of Social Sciences, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

³Department of Plant Science and Biotechnology, Faculty of Science, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

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ABSTRACT

The study examined the impacts of urban greening induced species homogenisation on ecosystem functions and services in some selected capital cities in the South south region of Nigeria. The study established quadrats of 30mx200m along road (transects) in GRAs of Uyo City, Akwa Ibom State and Yenagoa City, Bayelsa State labelled as sampled sites and a quadrat of 100mx100m were established as control sites (secondary forest) at a minimum of 300m from the sampled sites. Jaccard Similarity Index was used for the degree of homogenisation of plants while Levene Statistics was used to determine the significant differences in the degree of plant homogenisation between sample and control sites at $p < 0.05$ significance levels. Findings showed that *Vossia cuspidata* was highest (51.4%) in one of the sampled sites in Uyo City while *Cynodon dactylon* highest (80.6%) in abundance in Yenagoa in one of the sampled roads. Similarity index for homogenization was 1.6% and 10% in Uyo City and Yenagoa City respectively. Furthermore, 96.8% of identified plants were missing in Uyo (GRA) sampled sites (roads) while 84.6% of native plant species identified in the control sites are missing from the urban sampled sites in Yenagoa City. The Levene statistics have shown that there is a significant difference in the level of homogenization between sampled sites and control sites in the study area ($F=34.857$; $p < 0.05$). The plants in the control sites provided all ecological functions and services more than the sampled site except ornamental functions (11.0%). The study concluded that the introduction of non-native plants as a result of urban greening activities have altered ecosystem functions and services and have promoted species homogenization in the urban centres. Based on findings, the study recommended that urban greening projects and activities should be managed effectively by the city authorities, to reduce its impacts on the plants species diversity and to improve the vegetation status which can promote ecosystem functions and services.

Keywords: Urban, Greening, Homogenization, Ecosystem functions, South-south region, Nigeria.

1. INTRODUCTION

Plant biodiversity is an important component of urban ecosystems, and contributes to the value of public life by enhancing air quality and improving aesthetic value of the environment in parks and recreation. However, due to urbanization, there is a tremendous and severe erosion of local plant species diversity. Urbanization generates enormous environmental changes (Zhao, *et al.*, 2006; Pearce *et al.*, 2018) and promotes loss of indigenous species, natural habitats and consistently reduces the accessible areas for many wild species. All these factors combined produced loss in biodiversity in an urban setting. Urban areas influences regional flora by changing the availability or spatial arrangement of habitats, their species and evolutionary selection of plants populations (Williams *et al.*, 2010). Urban landscaping including planting of species normally supports the introduction of alien species by humans; and poses serious threat to biodiversity (Bigirimama *et al.*, 2011). Alarmingly, growing urban landscaping is expected to promote the introduction of exotic species and this mostly leads to the extirpation of some native plants (Duncan *et al.*, 2011), and decline of native biodiversity. Thus, accelerating urbanization and its associated processes usually lead to the introduction of alien plant species and tremendous environmental modifications favouring biotic homogenization (Abadie *et al.*, 2011). In an urban setting, biotic homogenization was observed as an expansion of alien plant species and a reduction of native plant species (Arevalo *et al.*, 2010).

Similarly in Nigeria, rapid urbanization and land use change in most cities has led to the alteration of structure and composition of forests (Wear, 2013). Novel ecosystem assemblages have developed in both urban and peri-urban forests in response to land use change, as well as species introductions, ecological disturbance, and socio-political and economic shifts (Conway and Bourne, 2013; Raupp *et al.*, 2006). In addition, many urban floras include both human-cultivated and spontaneously occurring species, each of which is subject to distinct ecological and human influences (Knapp *et al.* 2012). Although there is evidence of high biodiversity within cities (McKinney 2006, Grimm *et al.*, 2008; Knapp *et al.* 2008, Newbold *et al.*, 2015), few studies have disentangled these ecological and human influences that drive urban biodiversity.

Although, urbanization results in native habitat destruction and is regarded as a major threat to biodiversity; some cities are richer than others in terms of plant species, both from intentional and unintentional introductions but also due to natural factors. For instance, in some cases, cities are built up in areas of natural heterogeneity which supports natural biodiversity and thus, makes it richer in terms of plant species diversity (Luc and Emmanuel, 2014).

Urban plant communities and species homogenization arise from the ecological assembly processes that operate in natural ecosystems e.g., habitat filtering (Mayfield *et al.*, 2005; Kraft *et al.*, 2015); and species interactions (Hillerislanders *et al.*, 2012), as well as human desires and influences (Aronson *et al.*, 2016; Jenerette *et al.*, 2016). Human preferences for the species in urban greening have greatly facilitated the spread of non-native species, resulting in the homogenization of urban plant communities across spatial scales (Qians *et al.*, 2016). Cities homogenize the physical environment because they are built to meet the relatively narrow needs of just one species, our own. Also, cities are maintained for centuries in a disequilibrium state from the local natural environment by the importation of vast resources of energy and materials. Consequently, as cities expand across the planet, biological homogenization increases because the same “urban-adaptable” species become increasingly widespread and locally abundant in cities across the planet (McKinney, 2006). As urbanization often produces a local gradient of

disturbance, one can also observe a gradient of homogenization. Synanthropic (human mediated symbiosis) species adapted to intensely modified built habitats at the urban core are “global homogenizers”, found in cities worldwide.

Thus, there are several contrasting processes that can be observed, which are introduction of often ubiquitous alien plant species (biological invasion), decline and extirpation of native species, and a remaining high species richness of native species, based on those that are common (McKinney, 2006; Ecological Society of America (ESA), 2016). This knowledge gap makes it difficult to interpret comparisons of diversity, both among different urban assemblages and when comparing urban and natural assemblages. As natural landscapes are altered by urbanization, there is a gap in our understanding of the implications these changes might have on regional urban and peri-urban plants diversity. Thus, advancing toward urban sustainability in the 21st century will require understanding the extent to which urbanization may be producing socially and environmentally homogeneous or differentiated landscapes at neighbourhood, metropolitan, national, and continental scales which also have several implications on loss in plants species richness and diversity. It is thus sequel to this background that the present study is focussing on the impacts of urban greening induced species homogenization on ecosystem functions and services in some selected capital cities of South south region of Nigeria.

2.MATERIALS AND METHODS

Study Area Description

The study was carried out in Uyo, Akwa Ibom and Yenagoa, Bayelsa States in the South south region of Nigeria (Figure 1). The South south region is found within the Niger Delta of Nigeria. South south region of Nigeria is located between latitudes 5° 00'N and 6° 30'N and longitudes 5° 20'E and 9° 00'E. The South-south region with the Niger River is sitting directly on the Gulf of Guinea on the Atlantic Ocean in Nigeria. The study area features a tropical monsoon climate, designated by the Koppen climate classification as "Am", and it is mostly found in the southern part of the country. This climate is influenced by the monsoons originating from the South Atlantic Ocean, which is brought into the country by the maritime tropical air mass, a warm moist sea to land seasonal wind (Britanica, 2014). Its warmth and high humidity gives it a strong tendency to ascend and produce copious rainfall, which is a result of the condensation of water vapour in the rapidly rising air (Park, 2004). The temperature ranges are almost constant throughout the year. The South-south region of Nigeria experiences heavy and abundant rainfall. These storms are usually conventional in nature due to the regions proximity, to the equatorial belt. The annual rainfall received in this region is very high, usually above the 2,000 mm (78.7 in) rainfall totals giving for tropical rainforest climates worldwide. Over 4,000 mm of rainfall is received in the coastal region of Nigeria around the Niger Delta area. Bonny town found in the coastal region of the Niger delta area in southern Nigeria receives well over 4,000 mm of rainfall annually (Geographical Alliance of Iowa, 2010). The geology includes a new threefold lithostratigraphic subdivision comprising an upper sandy Benin formation, an intervening unit of alternating sandstone and shale named the Agbada formation, and a lower shaly Akata formation. These three units extend across the whole delta and each ranges in age from early Tertiary to Recent (Short and Staeuble, 1967). The south-south region is well drained with both fresh and salt water. The salt water is caused by the intrusion of seawater inland, thereby making the water slightly salty. Drainage of the study area is poor because of the

presence of many surface water and heavy rainfall between 2000mm and 2400mm (Mmom and Fred-Nwagwu, 2013). The vegetation includes the rainforest, swampy forest and mangrove (Geographical alliance of Iowa, 2010). The primary economic activities in most rural communities in the south-south region include peasant farming, petty trading and fishing, shifting cultivation (Slash and burn), which involves cultivating a piece of land for a number of years and then abandoning it for a more fertile land is traditionally practised in the area. Some of the cash crops grown in the study area include oil palm (*Elaeis guineensis*), cacao (*Theobroma cacao*), cassava (*Manihot esculenta*) and rubber (*Hevea brasiliensis*) (Enaruvbe and Atafo, 2015).

Plant Species Identification and Enumeration

The vegetation makes up of sampled roads in each major urban centre's government residential areas (GRAs) and control sites (Table 1). The study made use of (3) major street roads in the GRAs in each major cities, whereby plants were identified and enumerated in order to understand their vegetation status. These roads were selected based on their high vegetation composition and status, while the control sites were selected based on the diverse diverse species of plants can be enumerated and used as basis of comparison for the research. The control sites are the primary or secondary forest, nature parks or any other relatively undisturbed forests in each study area. The control sites were located at a minimum of 300m away from the sampled roads (sites). The study applied transect methods whereby quadrats of 30 m by 200m used for the data collection were selected within each transect (street road). In other words several quadrats were established regularly in relation to the road length for each sampled street roads. Therefore, plant types were identified and enumerated on the spot with the help of a Taxonomist from the start to the end of the street road (transect). Quadrats of 30m x 200m were laid on both sides of the road and a gap of 100m was created till the next quadrat and so on until the end of the street road (Figure 2). On the other hand, the control sites plant species were identified within selected secondary forest using also quadrat methods. Five (5) 30m x 30m randomly selected quadrats were delimited within quadrats of 100m x 100m laid within each control sites for the collection of data on the vegetal composition and the plant species types. The data collection exercise was carried out between March and June, 2019 (for a period of four (4) months). The data collected on plant types and composition were used for the computation of analytical vegetation features such as species composition, species density, species diversity, species richness, species evenness and similarity index which followed standard phyto-sociological methods. The identification of plant was also carried out with the help of a Taxonomist from the University of Port Harcourt. The plants that were not identified in situ were taken to the Herbarium in the University for Proper Identification.

Species composition of plants were determined by identifying the plant species while the population of individual species were determined by direct counting of the population of each species in the sampled roads and control sites. Plant species similarity index using Jaccard Index was used to ascertain the degree of plant species homogenization missing from urban greening activities in the study area. The impact of urban greening induced species homogenization on ecosystem functions and services were discussed based on the use of checklist of the plants. Both descriptive and inferential statistics were used for the data analysis. Levene Statistics Homogeneity of variance was used to determine the difference in the number of plant species

identified and level of homogenization among sampled sites and control sites in the study area. The analysis was computed using SPSS version 24.0.

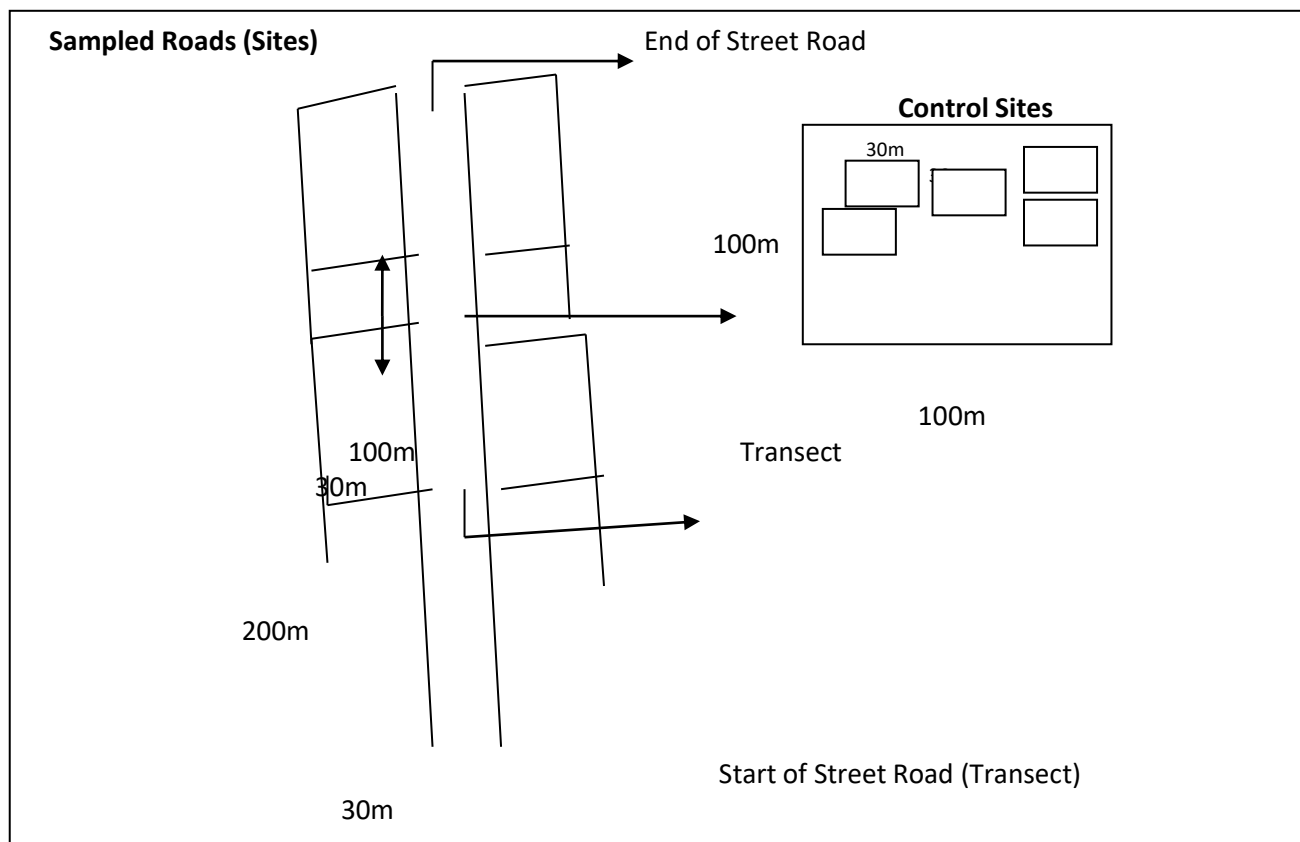


Figure 2: Method of collection of plant species types and composition in the study area

Table 1: Study Areas/Sampled Streets/Roads Names and Locations

State	Capital Cities	GRA	Selected Street name/Sampled Sites	Location	
				Northings	Eastings
Akwa Ibom	Uyo	Ewet Housing	Godwin Abe/1	5.01188 ⁰	7.95012 ⁰
			G-Lane/2	5.01677 ⁰	7.94520 ⁰
			Lagos Street/3	5.01281 ⁰	7.94528 ⁰
Bayelsa	Yenagoa	Otitio GRA	Biogbolo/1	4.93921 ⁰	6.32203 ⁰
			Erepa/2	4.93361 ⁰	6.32187 ⁰
			Otitio/3	4.93638 ⁰	6.31922 ⁰
Control Sites					
Akwa Ibom	Uyo (Secondary Forest)			5.05422 ⁰	7.92774 ⁰
Bayelsa	Yenagoa (Okordia clan secondary forest)			5.14036 ⁰	6.44856 ⁰

3. RESULTS AND DISCUSSIONS

Plant Species Identified along Sampled Roads across the Selected Cities

In Uyo, the information for the plant species types identified sampled and control sites are displayed on Table 2 and Figure 3. In the first sampled site, it was displayed that *Caesalpinia pulcherrima* recorded 4.7% individuals, *Carica papaya* recorded 8.2% individuals, *Cocos nucifera* recorded 8.2% individuals, *Cuphea California Torr* recorded 3.5% individuals, *Ficus benjamina* L. and Nutt. recorded 4.7% and 5.9% individuals respectively; *Hibiscus arnottianus* recorded 2.4% individuals, *Hura crepitans* was 3.5% individuals, *Mangifera indica* was 12.9% individuals, *Musa sapientum* was 10.6% individuals, *Nerium oleander* L. recorded 4.7% individuals, *Polyalthia longifolia* recorded 15.3% individuals, *Psidium guajava* recorded 7.1% individuals, *Syagrus romanzoffiana* also recorded 4.7% individuals, while *Terminalia mantalis* recorded 3.5% individuals from total percentage of identified plants. The study discovered that *Polyalthia longifolia* (15.3%) recorded the highest number of individual plant species. A total of 15 individuals of different plant species with an overall total number of 85 individual plant compositions were identified.

In second sampled site, it was revealed that *Carica papaya* recorded 4.0% individuals, *Delonix regia* recorded 4.0% individuals, *Ficus nitida* recorded 2.3% individuals, *Hibiscus arnottianus* recorded 2.8% individuals, *Musa paradisiacal* recorded 5.2% individuals, *Musa sapientum* was 6.9% individuals, *Polyalthia longifolia* recorded 10.4% individuals, *Psidium guajava* recorded 7.5% individuals, *Rhizophora mangus* recorded 1.7% individuals, *Terminalia cattapa* recorded 3.5% individuals, while the remaining percentage from the total of identified plant species was *Vossia cuspidata* and it recorded 51.4% number of individuals in the study area. For sampled trees and shrubs, *Psidium guajava* recorded the highest while only one type of grass (herbs) was identified (*Vossia cuspidata*). A total of 11 individuals of different plant species with an overall total of 173 individual plant compositions were identified.

In the third sampled site displayed in Table 6, *Albizia zygia* recorded 3.0% individuals, *Anacardium occidentale* recorded 4.5% individuals, *Anona nuricata* recorded 4.5% individuals, *Carica papaya* recorded 11.9% individuals, *Citrus spp* recorded 9.0% individuals, *Cocos nucifera* recorded 9.0% individuals, *Cycas revolute* recorded 6.0% individuals, *Elaeis guineensis* recorded 9.0% individuals, *Erythrophlem ivorensis* recorded 6.0% individuals, *Ficus benjamina* recorded 7.5% individuals, *Ficus carica* recorded 6.0% individuals, *Mangifera indica* recorded 9.0% individuals, *Persea Americana* recorded 3.0% individuals, *Ralphia hookeri* recorded 9.0% individuals, while *Spondiae cythera* recorded 3.0% individuals in the study area. An overall total of 67 individuals of plant species from 15 individuals of different species were identified in the third sampled site.

In the control site, the plant composition revealed that *A.laxiflora* recorded 1.9% individuals, *Acioa barteri* recorded 1.0% individuals, *Albizia adianthifolia* recorded 1.0% individuals, *Alstonia boonei* recorded 2.2% individuals, *Anacardium occidentale* recorded 1.0% individuals, *Anthocleisti vogelii* recorded 1.3% individuals, *Anthonotha macrophylla* recorded 0.6% individuals, *Antiaris Africana* recorded 1.0% individuals, *Bambusa vulgaris* recorded 1.3% individuals, *Baphia nitida* recorded 1.6% individuals, *Bombax buonopozense* recorded 0.6% individuals, *Centrosema pubescens* recorded 13.5% individuals, *Chromolaena odorata* recorded 9.0% individuals, *Cleistopholis patens* recorded 7.1% individuals, *Cola acuminata* recorded

10.6% individuals, *Combretum albidum* recorded 8.7% individuals, *Costus afer* recorded 11.2% individuals, *Dracena sp* recorded 1.3% individuals, *Elaeis guineensis* recorded 3.8% individuals, *Ficus exasperata* recorded 2.2% individuals, *Garcinia manii* recorded 0.6% individuals, *Harungana madagascariensis* recorded 2.6% individuals, *Leea guineensis* recorded 1.9% individuals, *Musanga cecropioides* recorded 3.5% individuals, *Myrianthus arboreus* recorded 2.2% individuals, *Pterocarpus mildbraedii* recorded 0.6% individuals, *Raphia spp* recorded 1.6% individuals, *Senna alata* recorded 2.9% individuals, *Terminalia ivorensis* recorded 1.0% individuals, while *Urena lobata* recorded 0.6% individuals.

Table 2: Identified Plant Species in Sampled and Control Site in Uyo, Akwa Ibom State

Site 1	Plant Species Types	Frequency	%
1	<i>Caesalpinia pulcherrima</i>	4	4.7
2	<i>Carica papaya</i>	7	8.2
3	<i>Cocos nucifera</i>	7	8.2
4	<i>Cuphea californica Torr.</i>	3	3.5
5	<i>Ficus benjamina L.</i>	4	4.7
6	<i>Ficus benjamina Nutt.</i>	5	5.9
7	<i>Hibiscus arnottianus</i>	2	2.4
8	<i>Hura crepitans</i>	3	3.5
9	<i>Mangifera indica</i>	11	12.9
10	<i>Musa sapientum</i>	9	10.6
11	<i>Nerium oleander L.</i>	4	4.7
12	<i>Polyalthia longifolia</i>	13	15.3
13	<i>Psidium guajava</i>	6	7.1
14	<i>Syagrus romanzoffiana</i>	4	4.7
15	<i>Terminalia mantaly</i>	3	3.5
	Total	85	100.0
Site 2	Plant Species Types	Frequency	%
1	<i>Carica papaya</i>	7	4.0
2	<i>Delonix regia</i>	7	4.0
3	<i>Ficus nitida</i>	4	2.3
4	<i>Hibiscus arnottians</i>	5	2.9
5	<i>Musa parasidiaca</i>	9	5.2
6	<i>Musa sapientum</i>	12	6.9
7	<i>Polyalthia longifolia</i>	18	10.4
8	<i>Psidium guajava</i>	13	7.5
9	<i>Rhizophora mangus</i>	3	1.7
10	<i>Terminalia cattapa</i>	6	3.5
11	<i>Vossia cuspidata</i>	89	51.4
	Total	173	100.0
Site 3	Species Types	Frequency	%

1	<i>Albizia zygia</i>	2	3.0
2	<i>Anacardium occidentale</i>	3	4.5
3	<i>Anona nureicata</i>	3	4.5
4	<i>Carica papaya</i>	8	11.9
5	<i>Citrus spp</i>	6	9.0
6	<i>Cocos nucifera</i>	6	9.0
7	<i>Cycas revoluta</i>	4	6.0
8	<i>Elaeis guineensis</i>	6	9.0
9	<i>Erythrophlem ivorensis</i>	4	6.0
10	<i>Ficus benjamina</i>	5	7.5
11	<i>Ficus carica</i>	4	6.0
12	<i>Mangifera indica</i>	6	9.0
13	<i>Persea americana</i>	2	3.0
14	<i>Ralphia hookeri</i>	6	9.0
15	<i>Spondiae cythera</i>	2	3.0
	Total	67	100.0
Control Site	Plant Species Types	Frequency	%
1	<i>A. laxiflora</i>	6	1.9
2	<i>Acioa barteri</i>	3	1.0
3	<i>Albizia adianthifolia</i>	3	1.0
4	<i>Alchornea cordifolia</i>	5	1.6
5	<i>Alstonia boonei</i>	7	2.2
6	<i>Anacardum occidentale</i> Linn	3	1.0
7	<i>Anthocleista vogelii</i>	4	1.3
8	<i>Anthonotha macrophylla</i>	2	0.6
9	<i>Antiaris africana</i>	3	1.0
10	<i>Bambusa vulgaris</i>	4	1.3
11	<i>Baphia nitida</i>	5	1.6
12	<i>Bombax buonopozense</i>	2	0.6
13	<i>Centrosema pubescens</i>	42	13.5
14	<i>Chromolaena odorata</i>	28	9.0
15	<i>Cleistopholis patens</i>	22	7.1
16	<i>Cola acuminata</i>	33	10.6
17	<i>Combretum albidum</i>	27	8.7
18	<i>Costus afer</i>	35	11.2
19	<i>Dracena sp. Linn.</i>	4	1.3
20	<i>Elaeis guineensis</i>	12	3.8
21	<i>Ficus exasperata</i>	7	2.2
22	<i>Garcinia manii</i>	2	0.6
23	<i>Harungana madagascariensis</i>	8	2.6

24	<i>Leea guineensis</i>	6	1.9
25	<i>Musanga cecropioides</i>	11	3.5
26	<i>Myrianthus arboreus</i>	7	2.2
27	<i>Pterocarpus mildbraedii</i>	2	0.6
28	<i>Raphia spp</i>	5	1.6
29	<i>Senna alata</i>	9	2.9
31	<i>Terminalia ivorensis</i>	3	1.0
32	<i>Urena lobata</i>	2	0.6
Total		312	100.0

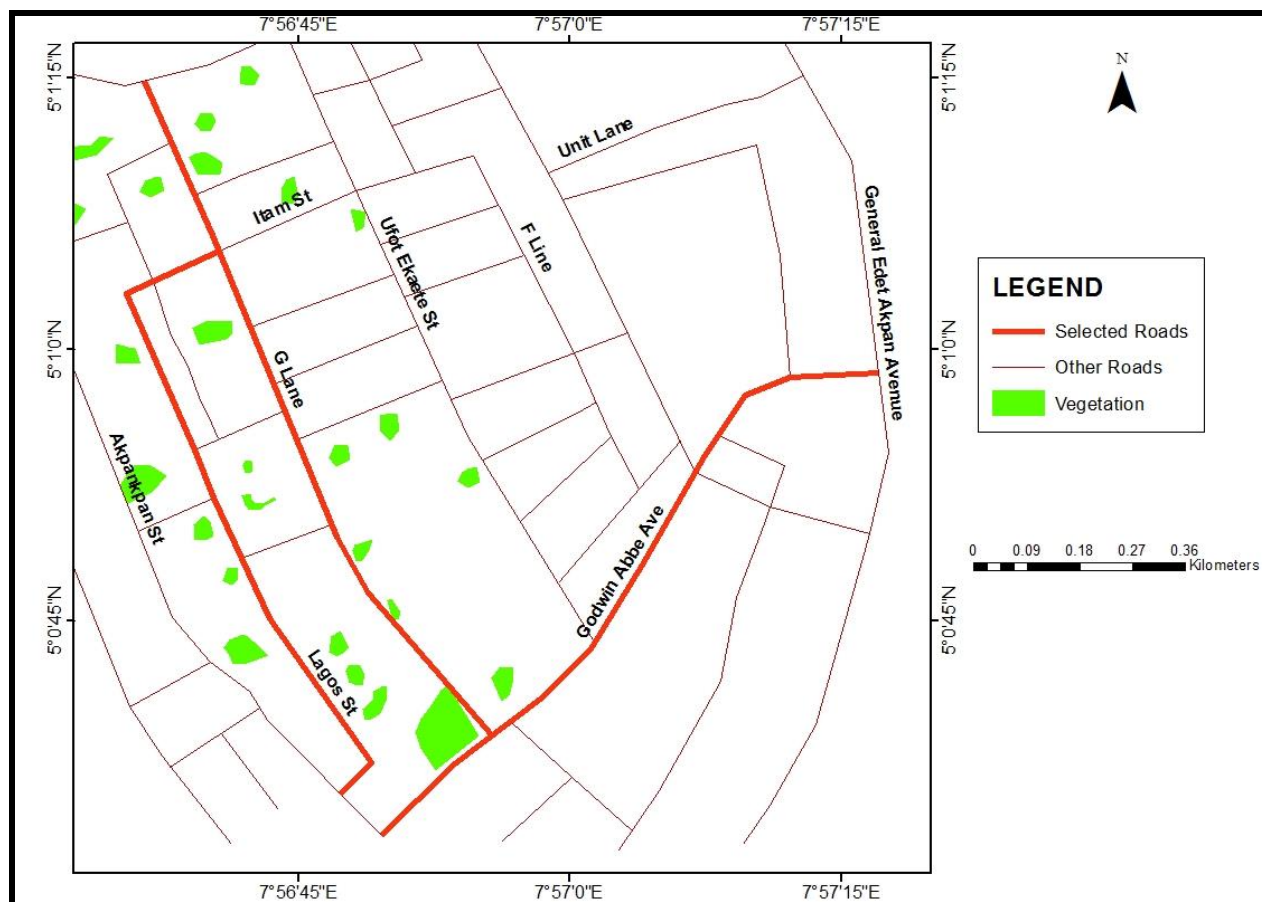


Figure 3: Selected Sampled Sites (Roads) in Ewet Housing Estate (GRA), Uyo, Akwa Ibom

In Yenagoa, the plant compositions in the selected road samples and control site are displayed in Table 3 and Figure 4. In sample site 1, the distribution revealed that *Carica papaya* recorded 3.7% individuals, *Cocos nucifera* recorded 3.7% individuals, *Cycas cecenalis* recorded 1.7% individuals, *Cynodon dactylon* recorded 80.6% individuals, *Delonix regia* recorded 0.9% individuals, *Mangifera indica* recorded 2.3% individuals, *Musa sapientum* was 1.1% individuals,

Polyalthia longifolia recorded 2.3% individuals, *Psidium guajava* recorded 2.9% individuals, while *Thuja sinensis* recorded 0.9% individuals from total percentage of identified plants. A total of 10 individuals of different plant species with an overall total number of 350 individual plant compositions were identified.

The information for the plant species types identified under sampled sites 2 revealed that *Carica papaya* recorded 4.0% individuals, *Delonix regia* recorded 4.0% individuals, *Mangifera indica* recorded 8.0% individuals, *Musa paradisiaca* recorded 17.3% individuals, *Polyalthia longifolia* recorded 24.0% individuals, *Psidium guajava* recorded 10.7% individuals, *Spondias cethera* recorded 4.0% individuals, while *Terminalia mantaly* recorded 16.0% individuals. A total of 9 individuals of different plant species types with an overall total of 75 individual plant compositions were identified.

In the third sampled site in Yenagoa; *Alchornea cordifolia* recorded 16.2% individuals, *Bambusa vulgaris* recorded 6.8% individuals, *Carica papaya* recorded 4.1% individuals, *Citrus spp* recorded 5.4% individuals, *Delonix regia* recorded 13.5% individuals, *Elaeis guineensis* recorded 13.5% individuals, *Mangifera indica* recorded 4.1% individuals, *Musa paradisiaca* recorded 8.1% individuals, *Musa sapientum* recorded 5.4% individuals, *Psidium guajava* recorded 10.8% individuals, *Terminalia cattapa* recorded 5.4%, while *Terminalia mantaly* recorded 6.8% individuals in the study area. An overall total of 74 individuals of plant species from 15 different plant species types were identified in the third sampled site.

The identified plant species types recorded under the control site were showed that *Alchornea cordifolia* recorded 2.7% individuals, *Alstonia boonei* recorded 3.4% individuals, *Alstonia congesis* recorded 2.7% individuals, *Anthocleistii vogelii* recorded 2.7% individuals, *Anthonotha macrophylla* recorded 2.0% individuals, *Bambusa vulgaris* recorded 8.7% individuals, *Bridella micrantha* recorded 2.0% individuals, *Cleistopholis patens* recorded 2.0% individuals, *Combretum micranthia* recorded 7.4% individuals, *Elaeis guineensis* recorded 14.8% individuals, *Endodesima calophylloides* recorded 3.4% individuals, *Erasmopatha microcapa* recorded 2.7% individuals, *Garcinia kola* recorded 2.0% individuals, *Guarea cedrata* recorded 5.3% individuals, *Harungana madagascariensis* recorded 2.0% individuals, *Hevea brasiliensis* recorded 4.7% individuals, *Lophira Alata* recorded 2.7% individuals, *Militia aboensis* recorded 1.3% individuals, *Musanga cecropioides* recorded 3.4% individuals, *Newbouldia laevis* recorded 1.3% individuals, *Picanthus agolensis* recorded 4.2% individuals, *Psidium guajava* recorded 6.7% individuals, *Raphia manii* recorded 2.7% individuals, *Raphia vinifera* recorded 5.4% individuals, *Rauwolfia vomitoria* recorded 2.7% individuals, while lastly *Rhizophora racemosa* recorded 1.3% individuals in the study area.

Table 3: Identified Plant Species in Sampled Sites 1, 2 and 3 in Yenagoa, Bayelsa State

Site 1	Species Types	Frequency	%
1	<i>Carica papaya</i>	13	3.7
2	<i>Cocos nucifera</i>	13	3.7
3	<i>Cycas cecenalis</i>	6	1.7
4	<i>Cynodon dactylon</i>	282	80.6

5	<i>Delonix regia</i>	3	0.9
6	<i>Mangifera indica</i>	8	2.3
7	<i>Musa sapientum</i>	4	1.1
8	<i>Polyalthia longifolia</i>	8	2.3
9	<i>Psidium guajava</i>	10	2.9
10	<i>Thuja sinensis</i>	3	0.9
	Total	350	100.0
Site 2	Species Types	Frequency	%
1	<i>Carica papaya</i>	5	6.7
2	<i>Cycas cecenalis</i>	7	9.3
3	<i>Delonix regia</i>	3	4.0
4	<i>Mangifera indica</i>	6	8.0
5	<i>Musa paradisica</i>	13	17.3
6	<i>Polyalthia longifolia</i>	18	24
7	<i>Psidium guajava</i>	8	10.7
8	<i>Spondias cethera</i>	3	4.0
9	<i>Terminalia mantaly</i>	12	16.0
	Total	75	100.0
Site 3	Species Types	Frequency	%
1	<i>Alchornea cordifolia</i>	12	16.2
2	<i>Bambusa vulgaris</i>	5	6.8
3	<i>Carica papaya</i>	3	4.1
4	<i>Citrus spp</i>	4	5.4
5	<i>Delonix regia</i>	10	13.5
6	<i>Elaeis guineensis</i>	10	13.5
7	<i>Mangifera indica</i>	3	4.1
8	<i>Musa paradisica</i>	6	8.1
9	<i>Musa sapientum</i>	4	5.4
10	<i>Psidium guajava</i>	8	10.8
11	<i>Terminalia cattapa</i>	4	5.4
12	<i>Terminalis mantaly</i>	5	6.8
	Total	74	100.0
Control Site	Species Types	Frequency	%

1	<i>Alchornea cordifolia</i>	4	2.7
2	<i>Alstonia boonei</i>	5	3.4
3	<i>Alstonia congesis</i>	4	2.7
4	<i>Anthocleistii vogelii</i>	4	2.7
5	<i>Anthonotha macrophylla</i>	3	2.0
6	<i>Bambusa vulgaris</i>	13	8.7
7	<i>Bridella micrantha</i>	3	2.0
8	<i>Cleistopholis patens</i>	3	2.0
9	<i>Combretum micranthia</i>	11	7.4
10	<i>Elaeis guineensis</i>	22	14.8
11	<i>Endodesima calophylloides</i>	5	3.4
12	<i>Erasmopatha microcapa</i>	4	2.7
13	<i>Garcinia kola</i>	3	2.0
14	<i>Guarea cedrata</i>	8	5.4
15	<i>Harungana madagascariensis</i>	3	2.0
16	<i>Hevea brasiliensis</i>	7	4.7
17	<i>Lophira Alata</i>	4	2.7
18	<i>Militia aboensis</i>	2	1.3
19	<i>Musanga cecropioides</i>	5	3.4
20	<i>Newbouldia laevis</i>	2	1.3
21	<i>Picanthus agolensis</i>	6	4.0
22	<i>Psidium guajava</i>	10	6.7
23	<i>Raphia manii</i>	4	2.7
24	<i>Raphia vinifera</i>	8	5.4
25	<i>Rauvolfia vomitoria</i>	4	2.7
26	<i>Rhizophora racemosa</i>	2	1.3
	Total	149	100.0

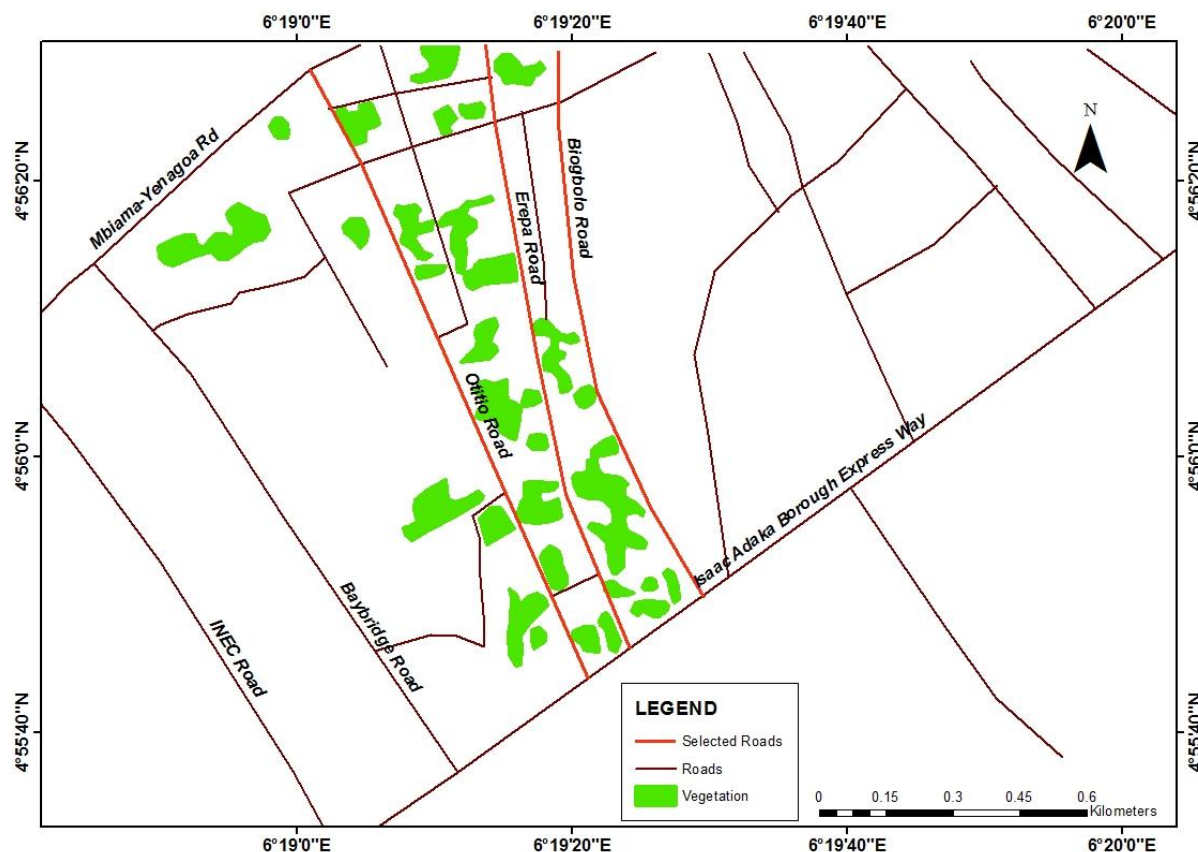


Figure 4: Selected Sample Sites (Roads) in Yenagoa, Bayelsa State

Degree of Plant Species Homogenization and Implication to Ecosystem Functions and Services

The degree of plant species homogenization in the study area was computed using the Jaccard Index of Similarity Coefficient which is a range between 0% and 100% (higher percentages indicate more similarity between two populations or community of species). Aside computing their similarity index, the $J(X, Y) = X \cap Y$ formula was used to ascertain the missing plant species as affected by urban greening activities. Thus, all sampled sites within each study site were compared with their control sites. Thereafter, their percentage compositions were determined to evaluate the degree of missing plants. The information on Tables 2 and 3 were used for this analysis. The results of the similarity index computed for all study sites displayed in Table 4 showed that the similarity index between sampled sites and control sites in Uyo study sites was 1.6% which indicated a very low index. This was because 96.9% of identified plant species in both sampled sites and control sites were non-native plant. The study discovered that a total of 30 plant species in the control sites are different from those found in the sampled sites. Thus, 96.8% of identified plants are missing in Uyo (GRA) sampled sites (roads). In Yenagoa study site, 77.8% from the total identified plant from both sampled sites and control sites are non-native plant species. It was discovered that 84.6% of native plant species identified in the control sites are missing from the urban sampled sites.

With the ecosystem functions and services in Table 5, the study has shown that for the erosion control and reclaiming of land, control sites recorded 2.7% plants while sampled sites recorded 2.3% plants. However, in relation to their ornamental functions, 11.0% was recorded for sampled sites against 3.2% for control sites. This means that sampled sites due to the nature of plants have more ornamental plants than identified plant species in the control sites. For their ethno medicinal values and functions, control sites recorded 11.9% plants while it showed that only 6.9% of plants under the sampled sites have these functions. The implication here is that plants grown in urban areas favours mostly non-native plant species that promotes species homogenization and most times these practices have direct impacts on plant species diversity, richness and similarity index. Therefore, it can be concluded that more diverse plant species with no disturbance will have higher ecosystem functions. Urban greening promotes the introduction of exotic plant species that have higher ornamental functions and values; of which most species introduced are invasive and could lead to habitat loss and fragmentation of native plant species. The Levene statistics have shown that there is a significant difference in the number of plant species identified and level of homogenization between sampled sites and control sites in the study area ($F=34.857$; $p<0.05$).

Table 4: Similarity Index and Degree of plant species Homogenization between Sampled Sites and Control Sites in the Study Area

S/N	Study Sites	Sampled Sites (X) and Control Sites (Y)	Number of different plants	Total no missing	% of plant species homogenization	% missing
1	Uyo	$X \cap Y = 1$ $X \cup Y = 62$ $X \cap Y / X \cup Y * 100$ J = 1.6%	31	30	96.9	96.8
2	Yenagoa	$X \cap Y = 4$ $X \cup Y = 40$ $X \cap Y / X \cup Y * 100$ J = 10%	14	22	77.8	84.6

Table 5: Checklist for Uses, Functions and Services of Identified plant Species in all Study Sites

S/N	Uses, Functions & Services rendered by Identified plant species	Sampled Sites (SS)	Control Sites (CS)	% SS	% CS
1	Environmental pollution reduction & phyto-remediation	1 (18, 67)	4(75,78,113,115)	0.5	1.8
2	Erosion control and reclaiming of land	5 (9, 10, 13, 14, 18,)	6(51,67,71,108,113, 114)	2.3	2.7
3	Ornamental functions	24(2, 7, 8, 9, 12, 17, 21,22,24,26,27,34,41, 44,46,51,55,57,61,68,69,70,71 80)	7(48,51,58,66,67,73,93)	11	3.2
4	Ethno Medicinal use	15 (1, 3, 4, 6, 11, 14, 20, 28, 31, 37, 50, 57, 64, 82, 76)	26(1,4,7,10,11,14,19,46,59, 63,64,66,69,87,89,90,92,94, 95,106,112, 115,116,118,119,121)	6.9	11.9

Figures in parentheses are serial numbers given to identified plants in sampled sites and control sites

4. DISCUSSION OF FINDINGS

Findings showed that the identified plant species under the sampled sites are lower than that of control site with respect to species composition and individual plant species. However, the sampled sites composed of both native and non-native (exotic) plant species with more of exotic and ornamental plant species. The low plant species composition and individual plants in the sampled sites may be due to urbanization and construction. The study conducted by Mellinger et al., (2018) on diverse effect of degree of urbanization on species diversity revealed that even distribution of plant species type reduced with level of urbanization. Findings of Alexis (2013) also corroborates with these findings that the introduction of non-native plants have been on the increase in urban centers and has continued to affect plants biodiversity. Furthermore, with reference to type of identified plants more of native plants were observed in the control sites. This may have favoured species compositions because of low habitat fragmentation as urban centers are known for their high socio-economic that most times do not consider ecosystem formations.

The degree of homogenization of plant species showed that the similarity index within sampled sites revealed index as low as 40%. Thus, more non-native species were experienced in the sampled sites and this explains the degree to which more plant species are homogenized and are missing from urban greening activities. Findings are in line with Pearse *et al.*, (2018) that urban ecosystems are widely more ecologically homogeneous than natural ecosystems and the urban

greening practices favours plant communities that assemble from a complex mix of horticultural and regional species pools. Aronson *et al.*, (2014) also concluded that there is strong evidence that the cultivated and spontaneous species pools in urban centers are homogenized across regions relative to the natural habitat in terms of both species and phylogenetic compositions. Groffman *et al.* (2014) had hypothesized that differences in plant community composition and aboveground biomass between biophysically dissimilar regions are reduced by urbanization because residential areas in different regions have more similar landscaping, and therefore plant community composition, relative to the composition of native ecosystems in these regions. Findings showed that more plant species in the control site were observed for ecosystem functions and services except ornamental functions and aesthetics and cultural diversity. These have shown that the ecological balance of the urban landscape has been affected because of the human influence in the richness and diversity of plants that are able to survive the ecological change. Alberti (2005) also reported that urban development fragments, isolates, and degrades natural habitats and as a result simplifies and homogenizes species composition; disrupts hydrological systems; and modifies energy flow and nutrient cycling. However, in general, urban landuse change has influenced on other environmental occurrences. Furthermore, Foley *et al.* (2005), Grimm *et al.* (2005) and Groffman *et al.* (2014) have reported that urban land-use change has been identified as one of the major components of environmental change because of its effects on climate, water, biodiversity, carbon (C), and nutrients across large areas of the globe. Groffman *et al.* (2014) however, stated that homogenization would be exhibited in biophysical structure, where neighbourhoods across biophysically different regions come to have similar patterns of human infrastructure (including roads, residential lots, and commercial areas), vegetation structure, and aquatic features which is being discovered in the sampled sites of this study. This homogenization may also result in ecological transformation, with replacement of natural vegetation assemblages by turfgrass, popular or weedy plant species, and impervious surfaces.

5. CONCLUSION AND RECOMMENDATIONS

It can be concluded that introduction of non-native plants as a result of urban greening activities have altered ecosystem functions and services. This explains why most plants grown in urban center promotes species homogenization which negative impacts will always outweigh the positive impacts. Thus, urban greening without proper consideration for habitat conservation will only encourage species homogenization and reduce ecosystem functions and services. The study recommended that urban greening projects and activities should be managed effectively by the city authorities, so as to reduce its impacts on the plants species diversity in order to improve the vegetation status and also encourage good environmental practices that will promote ecosystem functions and services.

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