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EVALUATION OF THE SIZE AND CHANGE PATTERNS OF GREEN AREAS, BUILT UP AREAS AND EXURBAN OF UGEP, CROSS RIVER STATE, NIGERIA

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ABSTRACT: Urban green areas are important part of dynamic and complex urban ecosystem and provide significant ecosystem services. Less attention is often given to the potential urban green areas serve in urban biodiversity conservation in most developing areas. This paper identify and mapped urban green areas of Ugep, the largest 'native' town in West Africa and further examine the size and change pattern of the green areas in comparison to the built-up areas and exurban from 1999 to 2013. Using aerial photograph and ground truthing helped to identify and map land uses while graphs and tracing papers served in calculating the size and change pattern of the urban green areas, built-up areas and exurban. Ten urban green areas depleted by anthropogenic activities were located in the study area. The Analysis of Variance (ANOVA) tested the validity of the size and change pattern of the green areas, built-up areas and exurban. Results showed that significant differences occur in the size and change pattern among green areas, built-up areas and exurban. The area covered by the green areas, built-up areas and exurban was calculated and then converted to percentage of site covered. Green areas decrease in size from 23.65% in 1999 to 18.19% in 2013, and exurban, 60.13% to 49.01%. During the period of study, built-up areas increased from 16.23% to 32. 80%. Hence, built-up areas consistently expanded at the detriment of green and exurban areas. The vestiges of natural vegetation remain primarily along stream buffers and pristine sites. The most evident problem in the study area is that emphases are not laid on the ecological values the green areas possess hence increased built-up areas has caused biodiversity imperilment in the area under study. It is therefore recommending that conservation planning should specifically address the issue of human settlement and development to underline the values of unprotected green areas for nature conservation within the urban setting.

KEYWORDS: Green areas, Sub-watershed, Exurban, change pattern, biodiversity, conservation.

INTRODUCTION

Humans are continually altering natural ecosystems through various means including farming, constructions and building of new settlements. These anthropogenic activities change the landscape of an area, hence increased urban and sub urban development and its subsequent sprawl can lead to huge conservation challenges. The requirement of space, food and raw materials for expanding human establishments are some of the most important singular causes of rapid decline in natural ecosystems. Where habitats are not completely destroyed, they are fragmented into smaller patches, creating islands of habitats in a sea of development. The pressure of human activity, population and development are fragmenting biological communities into smaller patches surrounded by urban and agricultural land (Asthana and Asthana, 2005). Consequently, urban areas encompass a full range of manipulation from highly altered open-space area to highly developed commercial districts.

Urban environments provide leisure and sporting activities, aesthetic value and avenue for scientific research. However, within cities diverse range of artificial, semi- natural and natural habitats exist. Some cities for instance have within their boundaries, remnants of native vegetation as sanctuaries. Singapore is a city that leaves nothing to chance but has developed

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an extensive planning and conservation culture. Singapore has 2,158ha of protected watershed in the middle of the island and the watershed provides half of the city's freshwater needs. With four million people in an area of just 647Km^2, Singapore's urban planners have been able to control sprawl, and expand parks and protected areas (Tuan, 2001). Growing interest in the ecological functioning of Ugep coincide with the realization that Ugep is no longer a rural settlement.

Within the green areas of Ugep are relics of vascular tree species, which shows that the original natural vegetation was evergreen forest. This appears quite different from those of the exurban with park-like landscape of grasses and trees characteristics of tropical savanna dominated by palm trees, Gmelina and shrubs. Relatively, pristine habitats are being lost at unprecedented rates as an expanding human population converts the land to agricultural, residential and recreational uses.

In recent times, the protection of the global environment has become an issue of great concern. This is associated with the threat to environmental degradation following the activities of man in a bid to satisfy his needs. According to Hansen *et al.* (2005), land use and land-cover change due to sprawl are currently causes of habitat loss in urban areas. As settlement expands with time, the general level of human activity at broader spatial scales increase and human influence grows throughout the landscape by selecting more biologically rich habitats and fragmenting landscapes with roads (Theobald, 2003).

Rapid growth of the urban centres eventually leads to mounting pressure on environmental resources. Udo asserted in Mamman (1996) that at a growth rate of 3.3 per cent (1991 National census) the Nigerian population will double by the year 2013 leading to further negative consequences on the environment. Maiwada (2000) highlight that almost all the green areas in Kano Metropolis have been converted to other uses. Akpu and Ahmed (2007) observe that 50 per cent of the area allotted to green areas in Wuse-1, Abuja, has been converted to residential quarters. Recent study by Akpu and Ahmed (2007) further reveal that green areas in Zaria have shown similar trend of encroachment as observed along the drainage corridors of Kubanni River. This trend, Akpu and Ahmed (2007) conclude that allowing further encroachment implies that soon the entire green areas would give way to other land uses.

Some areas of natural vegetation in Ugep appear to be untouched but dominated by man in a subtle manner. Some of the green areas protected for many decades have been put into other uses when compared to their original state as natural ecosystems. Under the present intensive use of land, Ugep is in danger of a mass extinction of most of the biodiversities in the green areas. The green areas in Ugep have shown trends of encroachment as observed along the drainage corridors of local streams (*Loblo, Isayi, Mma Oden*, and *Kiweyi*). Physical developments for instance, are rapidly taking over the green areas presumably due to planning limitations of development control or the general failure by planning agencies to recognize the importance of green areas in the environment.

Land use and land cover changes due to sprawl are one of the main issues of biodiversity loss within urban green areas (Hansen *et al*., 2005). Bell and Slade (2004) explained further that deleterious effects of roads, lawns and other aspects of residential development as well as spatial and temporal dynamics of sprawl have long been the subject of study. The construction of the Calabar - Ikom Highway created a major land use and land cover change pattern in Ugep; green areas transformed into residential, commercial administrative land uses. To Brown and Laband (2006) the degree of activities, not the variation in spatial distribution of activities, best explains the endangerment of native species. Baldwin *et al.* (2007) in response to Brown and Laband (2006) acknowledged that higher levels of activities inside any unit leads to a greater conflict with biodiversity, but disagree with the conclusion that the pattern and process of sprawl is not a leading cause of species imperilment. Bell and Irwin (2002) further ascertain that sprawl is more of time-dependent process that result in particular sprawling spatial distribution visible at varying spatial scale.

Land use type varies over space and different land uses influences residential biota differently (Sanderson *et al.* 2002) while areas with highly clumped settlement are characterized by high-intensity resources uses. Fleischer (1998) and Wilcove *et al.* (1998) pointed out that such activities are likely to be responsible for the shrinking of green areas and biodiversity. Over time, land use changes due to sprawl constitute a leading threat to green areas subtly.

To give this paper a focus, the following objectives are of great importance: (1) to identify and map green areas in study area, (2) to examine the size of and change pattern of green areas in Ugep. This paper is an attempt to identify the green areas in a growing urban centre and further encourage planners to focus attention on the restoration and rehabilitation of urban green areas to generate new values from such spaces in the bid to promote tourism and sustain cultural heritage. The paper will further provide baseline information that can be used for further scientific inquiry on urban biodiversity on a small spatial scale.

STUDY AREA

Ugep the largest native town in West Africa, lies between longitude 08°03'40"E and latitude 05°47'30" and 05°48'33" N occupying a land mass of about 48km2. The relief of the area is gentle except in places where granite extrusions rise above the general level of the surface; the slope southward is in sympathy with the dip of the rocks from about 200m — 300m micro relief. The study areas have very low drainage density with several steams in radial network. Among these are *Loblo, Isayi,Mma Oden, Kiweyi* and *Oganawen*. Subsequently, urban development has followed the sub-watersheds between the streams resulting in continuous reduction of the existing green areas. A step escarpment southward constitutes a significantbarrier to urban expansion hence providing habitat for wildlife around *Loblo* watershed. Temperature varies between an average of 27^0C to 31^0C, with a variation in annual rainfall between 2500mm to 3 000mm. The National Population Census, Nigeria (2006) show that for the periods of 1991 to 2006, the population has risen to a total of 78,580. This increase corresponds to a demand for extra residential and land uses of urban means that has caused a shrinking effect on the green areas. As settlement expands with time, the general level of human activities at broader spatial scales increases thus resulting in conflict with biodiversity. The traditional economy of the indigenous people is farming and market gardening which has great impact on the existing green areas and biodiversity. The indigenous people further engage in lumbering and hunting resulting in the destruction of natural habitat of the wildlife. Over 60 per cent are not involved in agriculture (National Population Commission, Nigeria, 2006).

METHODOLOGY

A preliminary visit was undertaken to obtain prior permission from community leaders to gain access into the residential neighborhoods in the study area. This visit also created opportunity to meet with local experts that served as guides, and created opportunity to ascertain the actual location of green areas earlier marked on the procured orthophoto map of the study area.

From recent aerial photograph provided by Cross River State survey department (2003) the orthophoto map of the study area, the limits of the green areas were outlined on a tracing paper and dipped on a graph paper (Scale: l0 x 10mm). Hence, the result from the land use map, 1999 and the orthophoto map, 2003 served as computation instruments for change in size over time. Empirical observations provided guide to identify changes resulting from human intervention and in computing for the significant difference in the size of the green areas, built-up area and exurban at 0.05 level of significance, ANOVA was used. As a means of preserving ample but regulated land for future urban development and for the avoidance of conflict between development and the ecosystem, six major land uses characterized the study area as shown in Figure 1.

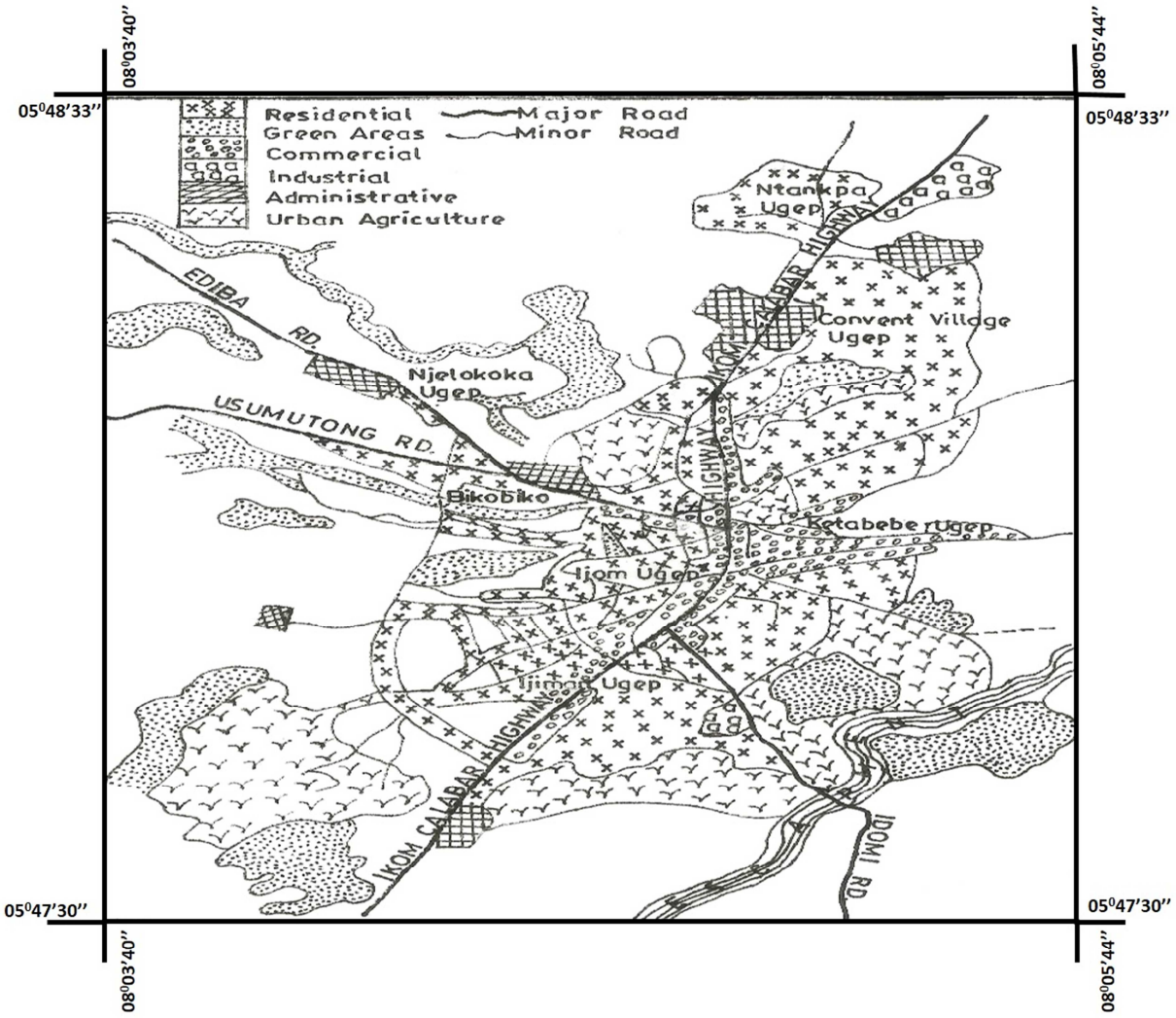

Fig.1. Six major land uses in Ugep metropolis, Nigeria

Source: Authors' field research, 2015

RESULT

The balance between built-up area and green area shifted in favour of the built-up area. The actual ratio between the two depends on the stability of the land for agriculture and the local pressure to use more land for other developmental purposes. In the early stages, reasonably predictable pattern of the green areas correspond to the physiographic of the stream buffers with emergent trees. The most fundamental green areas have hierarchical structures that follow networks formed by stream systems in the study area (Fig. 2).

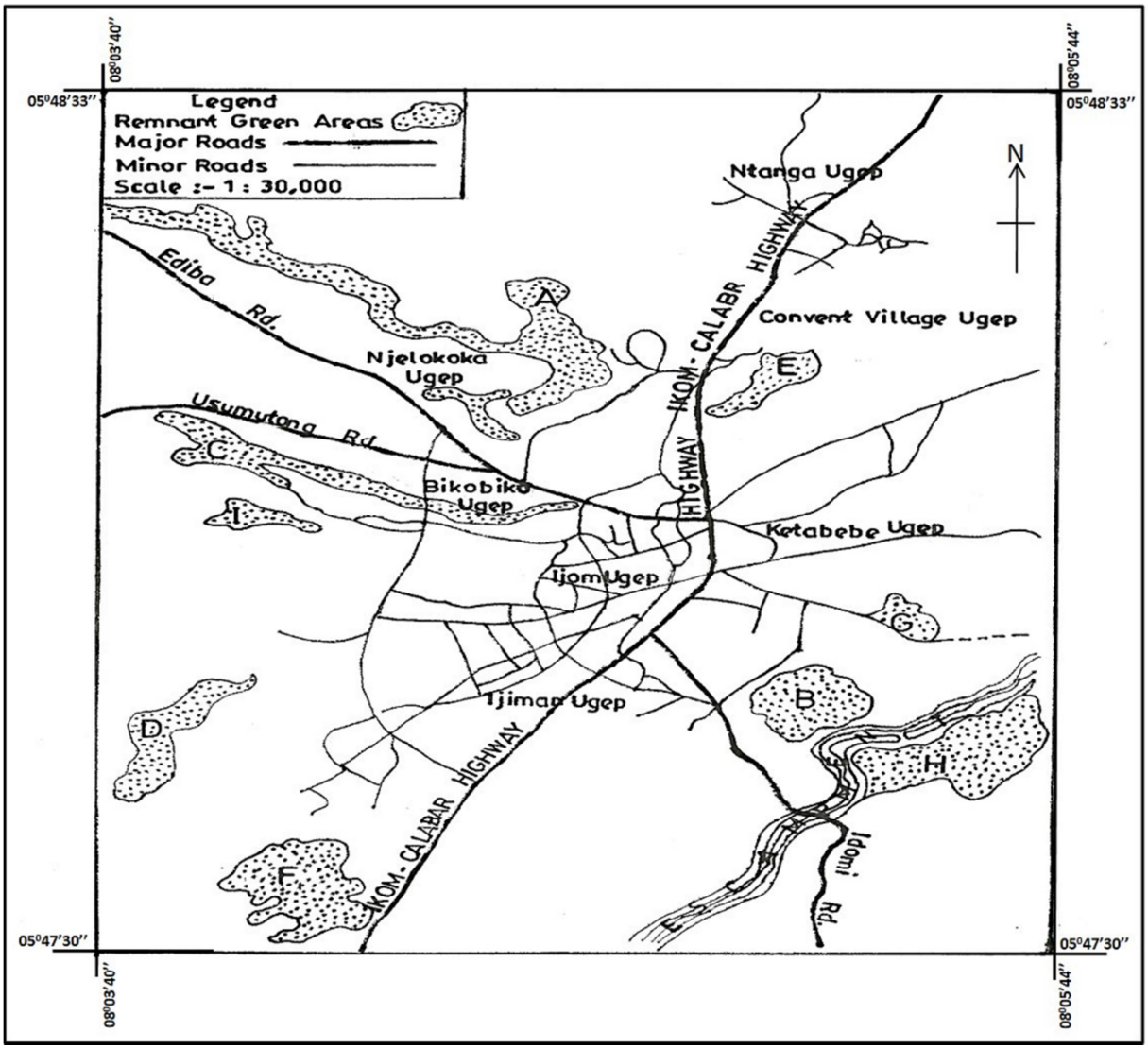

Fig.2. Pristine habitats in Ugep metropolis, Nigeria.

Source: Authors' field research, 2015

Table 1 shows the size and change pattern that has existed from 1999 - 2013 in the study area. Temporal changes in land use and spatial growth of Ugep shows a change rate of -2 per cent, 5 per cent and -2.6 per cent in the green areas, built-up areas and exurban respectively. The change pattern clearly reflects that the green areas, built-up areas and exurban occupies 23.65 per cent, 17.27 per cent and 59.08 per cent respectively in 1999 and have reduced in the green area and exurban but increased in the built-up area over time. In 2013, the green area reduced to 17.82 per cent and exurban, 34.42 per cent while the built-up area increased to 47.76 per cent.

Table 1. Size and change pattern of the green areas, built-up and exurban in the study area.

Year	Green Area (hectares)	Percentage change of Green area	Built-up area (hectares)	Percentage of change of Bulit-up area	Exurban (hectares)	Percentage change of exurban
1999	1,350.00	23.65	829.00	17.27	2,826.00	59.08
2000	1,112.30	23.17	917.95	19.13	2,769.75	57.70
2001	1,090.05	22.71	1,008.85	21.02	2,701.10	56.27
2002	1,068.25	22.26	1,101.79	22.96	2,629.96	54.78
2003	1,046.89	21.81	1.196.88	24.94	2,556.96	53.25
2004	1,025.95	21.37	1,294.22	26.96	2,479.83	51.66
2005	1,005.43	20.95	1,393.93	29.04	1,400.64	50.01
2006	985.32	20.53	1,496.13	31.17	2,318.55	48.30
2007	965.61	20.12	1,600.94	33.35	2,233.45	46.53
2008	946.30	19.71	1,708.48	35.59	2,145.22	44.69
2009	924.38	19.25	1,818.91	37.89	2,056.71	42.85
2010	908.83	18.93	1,932.35	40.26	1,958.82	40.81
2011	890.65	18.55	2,048.97	42.69	1,860.38	38.76
2012	872.84	18.18	2,168.92	45.19	1,758.24	36.63
2013	855.38	17.82	2,292.37	47.76	1,652.25	34.42

Source: Ugep Master Plan (1991), Authors' Field Report (2014)

TESTING OF HYPOTHESIS

H_0: There is no significant difference in the size of the green areas, built-up and exurban areas.
H_1: There is a significant difference in the size of the green areas, built-up and exurban areas.

The result in Table 2 indicates that the table F-value, 3.23 is less than the calculated F-values, 336.13 at 0.05 significant levels, therefore H_0 is rejected. Thus, H_1 is accepted, that is, there is a significant difference in the size and change pattern of the green area, built-up area and exurban.

Table 2. Analysis of variance of size and change pattern of exurban, built-up and green areas in the study area.

	Source	Sum of Squares	df	Variance Estimate	F-ratio
i	Between sample	22,792,696,40.2	2	11,396.484.70	
ii	Within sample	1,423,994.30	42	33,904.62	336.13
	Total	24,216,963.70	44	11,430,389.32	

Critical F-value = 3.23

Source: Author's Fieldwork (2014)

DISCUSSION OF FINDINGS AND RECOMMENDATIONS

There is a subtle change of pattern and size in urban green areas over the years under study in Ugep. Between the study years, 1999-2013, about 279.62 hectares of the urban green areas have been lost. When Ugep became the administrative headquarters of Yakurr Local Government Area in 1991, there was a surge in population growth, hence the shortage of residential accommodations. This gave rise to increased land values, causing large conversion of green areas to built-up areas. The result was an emergent environmental distress syndrome; loss of biodiversity and decline in pollinators, such as birds that are indispensable to the reproduction of flowering plants. The extent of natural vegetation varied significantly across the urban gradient from the exurban to the urban center and the vestiges of natural vegetation remain primarily along stream buffers and pristine sites.

The most evident problem in the study area is that green areas apart from being unevenly distributed, emphases are not laid on the ecological value if possesses. The spatial concept of the green areas in this study have shown two zones: the

"inner green areas" and the "outer green areas". The inner green areas are located at the transition between the city center and the new layout while the outer green areas are located between the inner green areas and the exurban. The expansion of the built-up areas have not only reduced the size and influenced the spatial spread of the urban green areas but has destroyed the habitats of biodiversity in the study areas giving rise to few surviving biodiversity to share available space. Hence, the loss of urban green areas due to land use changes and stress is clearly one primary cause of species imperilment in the study area during the period under study.

In line with finding of this paper:

1. It is important to investigate associated changes in land use over time to check change rates that might be taking place, deterrent to biodiversity.
2. Conservation planning should specifically address the issue of human settlement and development to underline the values of unprotected green areas for nature conservation.
3. The establishment of "transition zones" in which human activities are compatible with the conservation of biodiversity within the green areas.
4. Green areas need legal protection to avoid alteration or conversion to other uses.

CONCLUSION

Ugep has a network of remnant riparian corridors of green areas within built-up areas. These green areas have the potential for interior habitats for biodiversity. Urbanization induces clear changes in biodiversity as a whole. The slight development of a site can create more heterogeneities conditions that support more species but severe development apparently curtails the resources necessary for even the exurban adaptable invaders. Hence, the need arises of not just preventing the pristine habitats but also defending the green areas against pressure of alternative land uses and urban sprawl.

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