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# COMPARATIVE ASSESSMENT OF FLORAL AND FAUNAL DIVERSITY OF TWO PROPOSED PROJECT SITES IN THE NIGER DELTA REGION OF NIGERIA

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**ABSTRACT :** Developmental projects are multiplying in the Niger Delta Region of Nigeria with their accompanying deleterious impacts on biodiversity. The study was conducted to evaluate the tree and animal species diversity of two proposed project sites – The Rivers State Sports Complex (RSSC) and the Rivers Songhai Initiative (RSI) – located in Obi/Akpor and Tai Local Government Areas of Rivers State respectively, in order to provide baseline data necessary for the monitoring of future impacts. Tree enumeration was carried out using twenty 35m x 35m quadrats randomly distributed in each of the sites while the animal species enumeration was done using 10 systematically established counting points in each of the sites. A total of 231 individuals belonging to 17 tree species were encountered in the RSSC Site while 303 individuals belonging to 7 tree species were encountered in the RSI Site. *Elaeis guineensis* was the most abundant tree species in both sites with a density of 104.08 and 46.12 trees/hectare in the RSI and RSSC Sites respectively. The RSSC Site compared better than RSI Site in terms of tree diversity. A total of 167 individuals belonging to 17 and 10 animal species were encountered in the RSSC Site and RSI Site respectively. *Cephalophus sp*. with a frequency of 14.97% was the most abundant animal species in the RSSC Site while *Ploceus aurantius* with a frequency of 32.93% was the most abundant animal species in the RSI Site. In terms animal species diversity, the RSSC Site also compared better than the RSI Site. Animal species similarity (Sorensen's Index: 47.06) for both sites was higher than tree species similarity (Sorensen's Index: 26.32). The proposed projects are most likely to exacerbate the poor status of tree and animal diversity in the study sites. The use of low impact techniques to ensure minimal damage to the residual vegetation during clearance was suggested.

**Key Words:** Proposed projects; tree diversity, animal diversity, Niger Delta Region

## INTRODUCTION

The term biological diversity or biodiversity refers to all plants, animals, microorganisms, the ecosystems of which they are part, and the diversity within species, between species, and of ecosystems. Biodiversity underlies the goods and services provided by ecosystems that are crucial for human survival and well being [5]. These include among others: nutrient cycling; primary production; regulation of air quality, climate, floods, soil erosion; provision of food, fuelwood, fibre, biochemicals, natural medicines, genetic resources, spiritual and religious values, educational values and recreation.

The Niger Delta Region (NDR) covers a total land area of about 112,110km$^2$ which represents about 12 % of Nigeria's total surface area and by 2005 the region controls over 31 million inhabitants or 22.30% of Nigeria's population [1]. The region is the 7$^{th}$ largest producer of crude oil in the world and the largest in Africa and has 4.5 trillion cu. metres of proven natural gas reserves. Other economically significant resources of the region include timber, vast amount of fallow cultivable land, solid minerals such as granite, marbel, clay, limestone and gravel, and so on.

However, the case of this region that is naturally endowed with abundant human and material resources has been described by Adeyemo [1] as 'a paradox of poverty amidst plenty'. The region's ecosystems which used to be highly productive and serve as sources of livelihood to the rural dwellers are being threatened by anthropogenic activities ranging from urbanisation, logging, oil exploration and exploitation, and their associated negative consequences [3].

Rivers State which is one of the core Niger Delta States of Nigeria is not left out in this ugly trend. Indeed, developmental projects are multiplying in the State with their accompanying deleterious impact on biodiversity. Even areas known to have been seriously degraded over the years are still being earmarked and subjected to further developmental projects. However, the principle of sustainable development recognises a direct relationship between economic growth and the environment and that economic and environmental well-being are mutually reinforcing goals that must be pursued simultaneously if either of the two is to be reached.

In line with the Environmental Impact Assessment (EIA) Policy of Nigeria, the study was conducted as part of an EIA of two intended projects with varying site histories and degrees of exploitation– the new Rivers State Sports Complex (RSSC) and the Rivers Songhai Initiative (RSI) to ascertain the status of some aspects of biodiversity, establish baseline data for monitoring the impacts of the proposed projects on the tree and animal species populations, to identify the probable impacts of the projects, and to suggest ways of mitigating some of the impacts.

It is known that floral diversity of a particular landscape encompasses tree, shrub, herb, etc. diversity. Sometimes however, (depending on interest and objectives of a study), these component parts of floral diversity could be considered individually. Hence, in this study, animal species diversity was measured for the various taxonomic classes while tree diversity was the only aspect of floral diversity considered.

## MATERIALS AND METHODS

### Description of the Study Area

The study was conducted at Obio/Akpor and Tai Local Government Areas of Rivers State. Obio/Akpor Local Government Area lies between latitude 4° 3' to 5° 00N and longitude 6° 45' to 7° 00E [12]. It covers an area of 260 km$^2$ and had a population of 464,789 people at the 2006 Census. Tai Local Government Area lies between latitude 4°43′0″ to 4.716667°N and longitude 7°18′0″ to 7.3° E (http://en.wikipedia.org/wiki/Tai _Rivers). It covers an area of 159 km$^2$ and had a population of 117,797 people at the 2006 Census. Most of the people are Ogoni, speaking the Tee and Baan languages. The study site at Obio/Akpor L.G.A. is the proposed site for the new Rivers State Sports Complex (RSSC) while that at Tai L.G.A. is the proposed site for Rivers Songhai Initiative (RSI) – a modern agricultural initiative which is part of the Rivers State Sustainable Development Programme (RSSDP).

With an average temperature of 27$^0$C¸the inland part of Rivers State consists of tropical rainforest. Towards the coast, the typical river delta environment features many mangrove swamps. However, like many primary forests in the tropical regions of the world, the original vegetation of the study areas has been extensively modified. The present vegetation of the RSSC Site is a secondary regrowth dominated by scattered stands of *Elaeis guineensis*, with dense undergrowth of shrubs that is characteristic of a modified tropical rainforest. Pockets of arable farmland bearing *Manihot esculenta* were also encountered. On the other hand, most parts of the RSI Site have been subjected to arable farming for several years. The present vegetation in the study area is mainly secondary regrowth dominated by scattered stands of *Elaeis guineensis*, with mainly undergrowth of *Chromolaena odorata, Panicum maximum, Aspilia africana and Ficus exasparata.* Arable farms were much more in the RSI Site than the RSSC Site. Observations revealed that the small-holders practise mixed cropping system. One of the farms observed in the RSI Site bore as many as six different crops namely Maize, Okra, Garden egg, Fluted pumpkin, Cassava and Cucumber.

## Method of Data Collection

### Identification and Enumeration of Trees Species

To gain an insight into the tree species composition of the sites, twenty 35m x 35m quadrats were randomly distributed in each of the sites. This quadrat size falls within the range specified in literature for ecological studies in the humid tropics [15]. Narrow cut lines were made to demarcate the plot boundaries. All tree species within the plots were identified to species level and counted. Species identification was done using the keys provided by Keay [10]. Specimens of tree species that could not be identified in the field were taken to the University of Port Harcourt Herbarium for identification. A tree in this study was regarded as a woody plant of erect posture with a minimum breast circumference of 10cm and a minimum height of 5m.

### Wildlife Survey

Point Count Method as described by Colin and Neil [4] was used for the assessment of the fauna of the study areas. Counting points were established systematically such that the distance between every two points was 200 metres. 10 points were established on the whole in each site. Upon arrival at a counting point, a time interval of 5 minutes was allowed before counting to enable the animals settle down following the disturbance caused by the presence of the enumerator. 20 minutes were spent at each counting point after which the number of each animal species sighted was recorded. The identification of birds in the field was done with the aid of Borrow & Demey [2]; while the mammals were identified with the aid of Kingdon [11].

### Method of Data Analysis

### Measurement of Alpha Diversity

Two common approaches for measuring alpha diversity are species richness and evenness/heterogeneity [13]. Species richness simply refers to the number of species in the community while evenness/heterogeneity refers to the distribution of individuals among the species. In this study, the PAlaeontological STatistics (PAST) software was used to generate relevant alpha diversity indices for both tree and animal species at both study sites.

### Measurement of Similarity of Sites in terms Species Composition

Sorensen's similarity index was used to measure beta diversity. Wolda [16] suggested the use of similarity indices for measuring beta diversity. Jansen and Vegelius [9] had earlier opined that, of the many similarity indices, only three of them (the Ochiai, the Jaccard and the Sorensen) are worth considering.

Sorensen's index is expressed as:

$RI = a / a + b + c * 100$

Where:

a = number of species present in both sites under consideration
b = number of species present in Site 1 but absent in Site 2
c = number of species present in Site 2 but absent in Site 1

### Computation of Species Frequency

Animal species percentage frequency was computed by dividing the number of individuals encountered for a particular species by the total number of individuals encountered for all the species and multiplying by 100.

### Computation of Tree Density (per hectare)

Tree species density (per hectare) was computed by dividing a hectare ($10000m^{2)}$ with the total area sampled (24500 $m^2$) and multiplying by the number of individuals of that particular species encountered in the sampled area.

## RESULTS

### Tree Species Composition of the two Sites

The tree species composition of the two sites is shown in Table 1. A total of 231 individuals belonging to 17 species were encountered in the RSSC Site while 303 individuals belonging to 7 species were encountered in the RSI Site. Tree density in both sites was generally low except for *Elaeis guineensis* which was the most abundant tree species with a density of 104.08 trees/hectare in the RSI Site, and 46.12 trees/hectare in the RSSC Site. Average tree girth was highest for *Ceiba pentandra* in both sites.

**Table 1: Checklist of tree species encountered in the two sites**

| | RSSC Site | | | RSI Site | | |
|---|---|---|---|---|---|---|
| Scientific name | No. | Density per Hectare | Average Girth (m) | No. | Density per Hectare | Average Girth (m) |
| *Elaeis guineensis* | 113 | 46.12 | 0.98 | 255 | 104.08 | 1.3 |
| *Enanthia chlorentha* | 3 | 1.22 | 0.50 | 0 | 0 | 0 |
| *Funtumia africana* | 8 | 3.27 | 0.75 | 0 | 0 | 0 |
| *Irvingia gabonensis* | 5 | 2.04 | 1.00 | 0 | 0 | 0 |
| *Ceiba pentandra* | 7 | 2.86 | 2.45 | 5 | 2.04 | 2.25 |
| *Psidium guajava* | 8 | 3.27 | 0.70 | 2 | 0.82 | 0.1 |
| *Entandrophragma cylindricum* | 6 | 2.45 | 0.95 | 0 | 0 | 0 |
| *Terminalia superba* | 14 | 5.71 | 1.02 | 0 | 0 | 0 |
| *Pentachlethra macrophylla* | 10 | 4.08 | 1.15 | 0 | 0 | 0 |
| *Heavea brasilensis* | 15 | 6.12 | 0.73 | 0 | 0 | 0 |
| *Dennettia tripetala* | 3 | 1.22 | 0.40 | 0 | 0 | 0 |
| *Nauclea diderrichii* | 7 | 2.86 | 0.80 | 0 | 0 | 0 |
| *Milicia excelsa* | 5 | 2.04 | 1.20 | 0 | 0 | 0 |
| *Funtumia elastica* | 10 | 4.08 | 0.65 | 0 | 0 | 0 |
| *Dacryodes edulis* | 5 | 2.04 | 0.68 | 2 | 0.82 | 0.5 |
| *Annona muricata* | 4 | 1.63 | 0.55 | 0 | 0 | 0 |
| *Mangifera indica* | 8 | 3.27 | 1.00 | 10 | 4.08 | 1.5 |
| *Chrysophyllum albidum* | 0 | 0 | 0 | 1 | 0.41 | 0.2 |
| *Vernonia conferta* | 0 | 0 | 0 | 28 | 11.43 | 1.2 |

### Similarity and Dissimilarity of Sites in terms of Tree Species Composition

There was a great dissimilarity in tree species composition of the two sites. Sorensen's index for the two sites was low (26.32%). Only 5 tree species were common to both sites. 12 tree species found in the RSSC Site were not found in the RSI Site while 2 tree species found in the RSI Site was not found in RSSC Site.

### Diversity of Tree Species at the two Sites

The tree diversity indices for the two sites are shown in Table 2. The RSSC Site compared better than RSI Site in terms of tree species richness and evenness/heterogeneity, although, more individuals were found in the RSI Site.

**Table 2: Tree diversity indices for the two study sites**

| | RSSC Site | RSI Site |
|---|---|---|
| Taxa S | 17 | 7 |
| Individuals | 231 | 303 |
| Dominance D | 0.2591 | 0.7183 |
| Shannon H | 2.0570 | 0.6307 |
| Simpson 1-D | 0.7409 | 0.2817 |
| Evenness e^H/S | 0.4602 | 0.2684 |
| Menhinick | 1.1190 | 0.4021 |
| Margalef | 2.9400 | 1.0500 |
| Equitability J | 0.7261 | 0.3241 |
| Fisher alpha | 4.2310 | 1.2790 |

## Animal Species Composition of the two Sites

The animal species composition of the two sites is shown in Table 3. A total of 167 individuals belonging to 17 and 10 species were encountered in the RSSC Site and RSI Site respectively. *Cephalophus sp.* with a frequency of 14.97% was the most abundant animal species in the RSSC Site while *Ploceus aurantius* with a frequency of 32.93% was the most abundant animal species in the RSI Site. Generally, fewer animal species were encountered in the RSI Site than in the RSSC Site.

**Table 3: Checklist of animal species encountered in the two sites**

| Scientific name | RSSC Site | | RSI Site | |
|---|---|---|---|---|
| | Frequency | Frequency % | Frequency | Frequency % |
| *Cephalophus sp.* | 25 | 14.97 | 0 | 0 |
| *Thryonomys swinderianus* | 17 | 10.18 | 0 | 0 |
| *Potamochoerus porcus* | 1 | 0.60 | 0 | 0 |
| *Cricetomys gambianus* | 5 | 2.99 | 1 | 0.60 |
| *Thrasops occidentalis* | 6 | 3.59 | 0 | 0 |
| *Atherurus africanus* | 8 | 4.79 | 0 | 0 |
| *Francolinus bicalcaratus* | 12 | 7.19 | 6 | 3.59 |
| *Numida sp.* | 7 | 4.19 | 0 | 0 |
| *Epixerus epli* | 15 | 8.98 | 15 | 8.98 |
| *Cercopithecus sp.* | 3 | 1.80 | 0 | 0 |
| *Kinixys erosa* | 2 | 1.20 | 0 | 0 |
| *Archachatina marginata* | 14 | 8.38 | 14 | 8.38 |
| *Ardeola ibis* | 10 | 5.99 | 12 | 7.19 |
| *Bufo sp.* | 6 | 3.59 | 6 | 3.59 |
| *Heplobatrachus occipitalis* | 4 | 2.40 | 4 | 2.40 |
| *Mivus migrans* | 20 | 11.98 | 14 | 8.38 |
| *Ploceus aurantius* | 12 | 7.19 | 55 | 32.93 |
| *Goose* | 0 | 0 | 40 | 23.95 |

**Similarity and Dissimilarity of Sites in terms of Animal Species Composition**

Sorensen's similarity index for both sites is 47.06. Nine (9) animal species were common to both sites while 8 species found in the RSSC Site were not found in the RSI Site. Only 1 species found in the RSI Site was not found in the RSSC Site.

**Diversity of Animal Species at the two Sites**

The animal species diversity indices for the two sites are shown in Table 4. The RSSC Site compared better than RSI Site in terms of species richness and evenness/heterogeneity, although, the same number of individuals were found in both the RSSC and RSI Sites.

**Table 4: Animal species diversity indices for the two sites**

| | RSSC Site | RSI Site |
|---|---|---|
| Taxa S | 17 | 10 |
| Individuals | 167 | 167 |
| Dominance D | 0.08473 | 0.1963 |
| Shannon H | 2.61000 | 1.8880 |
| Simpson 1-D | 0.91530 | 0.8037 |
| Evenness e^H/S | 0.80000 | 0.6609 |
| Menhinick | 1.31500 | 0.7738 |
| Margalef | 3.12600 | 1.7590 |
| Equitability J | 0.92130 | 0.8201 |
| Fisher alpha | 4.73400 | 2.3340 |

## DISCUSSION

More tree species were encountered in the RSSC Site than the RSI Site. Although, the RSI Site had more individual tree species than the RSSC Site, about 84% of the individuals in RSI Site belong to a single species - *Elaeis guineensis*. This could be responsible for the higher species dominance in the RSI Site. It appears that clearance for arable cropping in both sites over the years has neglected this tree species especially in the RSI Site which appears to be generally more degraded. This could be most probably attributed to its high economic importance to the rural dwellers in these areas. *Elaeis guineensis* is a multipurpose tree from where produce like oil palm, broom, palm kernel, palm kernel oil; and materials for making basket, and fencing are derived.

Although tree species diversity was generally low in the two sites, all tree diversity indices computed indicated that the RSSC Site is more diverse than the RSI Site. This could be attributed to varying levels of exploitation of the sites. Like many primary forests in the tropical regions of the world, the original vegetations of the study areas have been extensively modified, though the RSSC Site appears to be relatively less disturbed, with dense shrubby undergrowths. The RSI Site is dominated by undergrowth of *Chromolaena odorata, Panicum maximum, Aspilia africana and Ficus exasparata.* Pockets of arable farmlands and human settlements are also more in and around the RSI Site than the RSSC Site. One of the most important factors known to influence the use of land and other natural resources, including forests, is human population growth. Coomes *et al*. [6] showed that with expanding populations and increased competition for land in the Peruvian Amazon, people increased their holdings in forest fallow, yet decreased the length of fallow. Hence, lower tree species richness and diversity in the RSI Site could be attributed to higher human influences and several years of continuous arable cropping in the study area. It should be noted that the site was previously used for the School-to-Land programme, which was an agricultural programme that lasted for several years. Clearance, fragmentation and degradation of tropical forests have resulted in declines of biodiversity. IUCN [8] equally observed that habitat loss is responsible for biodiversity loss and ultimate extinction of species.

More animal species were also encountered in the RSSC Site than the RSI Site. A total of 17 species comprising mammals, aves, amphibians, and reptiles were observed in the RSSC Site. Among all the animals observed in this site, the duikers had the highest frequency (14.97%) followed by the Black kite (11.98%) while the Bush pig had the lowest frequency (0.60%). Among all the 10 animal species observed in the RSI Site, the Orange weaver birds had the highest frequency (32. 93 %) followed by the Geese (23.95 %) and the Palm squirrel (8.98 %) while the Giant rat had the lowest frequency (0.60 %). Although, *Cephalophus spp. (*Duikers*)* and *Thryonomys swinderianus* (Grasscutters) were not observed in the RSI Site, the farmers interviewed during the field work, confirmed their presence in the area. There seems to be paucity of animal species in the RSI Site. This could be attributed to habitat destruction arising from several years of deforestation and continuous arable cropping.

Animal species diversity compared better in the RSSC Site than the RSI Site. Due to habitat destruction associated with the developing nature of several areas in Port Harcourt, the remaining vegetations including the RSSC Site tend to act as a refugium for displaced wildlife. This could be responsible for the higher animal species diversity in the RSSC Site. Moreover, higher tree diversity in the RSSC Site than the RSI Site could result to more habitat and food for wildlife. There are a number of mechanisms that could potentially explain a positive relationship between food plant and animal consumer species richness and diversity. One possible explanation for a positive relationship between food plant and animal species richness is that a greater number of plant species could potentially provide more niches for the coexistence of animal species ('niche assembly hypothesis'; Hutchinson, [7]. Perrins *et al.,* [14] equally asserted that the distribution of any species is restricted by the distribution of its habitat and within that habitat the availability of food and other resources.

## CONCLUSION

Although, the two sites are apparently species poor, the RSSC Site compared better than the RSI Site. However, the proposed projects are most likely to exacerbate the poor status of tree and fauna in the studied sites. The impact of the proposed projects will include habitat destruction, loss of flora and fauna, displacement and/or migration of fauna, impairment of ecological processes and ecosystem functions, loss of medicinal and other plants useful to the rural dwellers, and secondary impact of the influx of people into the areas due to increased accessibility and opportunities. Care should be taken to ensure minimal damage to the residual vegetation during clearance. Adjacent and surrounding vegetations should be protected. Escaping animals should not be killed but allowed to migrate to the surrounding vegetations or areas during clearance of the site.

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