The Impact of Anthropogenic Activities On Avian Species: A Case Study of Amurum Forest Reserve and Surrounding Area

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ABSTRACT

Humans are as dependent on other species and their supporting ecosystems as when they first appeared. Threats from fire, livestock grazing, logging for timber and also wildlife hunting for bush meat, have caused a great negative impact (destruction) on flora and fauna habitats globally as humans appear to be exerting significant impact on the environment ever since their evolution on earth happened. The need therefore arise to understand the extent of the impact of human activities on avian species diversity, and the result of this study will help to shape conservation actions and also throw more light on the effects of man's act on his immediate environment. This study to evaluated the impact of anthropogenic activities on avian species using Amurum Forest Reserve and surrounding areas as case study. The study compared the avian species diversity between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village with the objective amongs others of comparing e the anthropogenic activities between the Reserve, surrounding farmlands, and inhabited areas based on anthropogenic activities in those areas as well as determined the effect of vegetation variables on avian species diversity across the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.

Keywords: Anthropogenic Activities, Avian Species, Amurum Forest Reserve, Humans, Nigeria and Farmlands

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1. INTRODUCTION

Humans appear to be exerting significant impact on the environment ever since their evolution on earth happened (Groombridge & Jekins, 2000). Nevertheless, humans are as dependent on other species and their supporting ecosystems as when they first appeared (Groombridge & Jekins, 2000). Threats from fire, livestock grazing, logging for timber and also wildlife hunting for bush meat, have caused a great negative impact (destruction) on the flora and fauna habitat (Manu et al., 2010). This study is going to base on biogeographic regions which is defined as an area of the earth determined by the distribution of flora and fauna (Fada, 2016). Avian species have been in close association with natural habitats as long as birds exist (Sereno & Chenggang, 1992). Over the years, birds have formed a tight relationship between their habitat and prey, and also exhibited an intimate symbiotic relationship such as pollinators of flowers (Sekercioglu, 2006)).

However, when food and habitat are limited, survival is threatened due to lack of adaptability (Fada, 2016). The importance of natural habitat to avian species cannot be over-emphasized as it serves as home and primary foraging grounds to most of these species (Sekercioglu et al., 2004). Protected areas such as reserves, which conserve natural habitats, provide important resource materials for necessary completion of life cycles, including provision of food and shelter for both young and adult birds for their survival (Sekercioglu et al., 2004).

1.1 Research Justification

There is a need to understand the extent of the impact of human activities on avian species diversity, and the result of this study will help to shape conservation actions and also throw more light on the effects of man's act on his immediate environment. The aim of this study was to evaluate the impact of anthropogenic activities on avian species using Amurum Forest Reserve and surrounding areas as case study. The objectives for this study were;

- To compare the avian species diversity between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.
- To ascertain and compare the species content between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.
- To compare the anthropogenic activities between the Reserve, surrounding farmlands, and inhabited areas based on anthropogenic activities in those areas.
- To compare vegetation parameters between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.
- To determine the effect of vegetation variables on avian species diversity across the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.

1.3 Hypotheses

The following hypothesis are formulated to drive the research

- There is no significant difference in the avian species richness between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.
- There is no significant difference in the avian species content between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.
- There is no significant difference in anthropogenic activities between the Reserve, surrounding farmlands and inhabited areas.
- There is no significant difference in the vegetation parameters content between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.
- Variation in vegetation parameters will cause a variation in avian species content and avian species richness between the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village this is because no species exist everywhere.

2. MATERIALS AND METHODS

2.1 Study Site

This study was carried out in Amurum Forest Reserve, the farmlands surrounding the Reserve and the Laminga Village as the human inhabited area. Amurum Forest Reserve is located on the Jos Plateau, at latitude and longitude (9°53´N, 8°59´E). It covers an area of about 300 ha, mostly savannah scrubland, gallery forest and rocky outcrop (Ezealor, 2002) and lies at 1300 m above sea level. Most rain occur from around May to August, while the dry season is between October and March, with an average rainfall of 1400mm per year; temperature range is 20–25 °C (< 10 °C in extreme cases) during the coldest months and 30–35 °C during warm and dry months (Payne, 1998). Some plant species in the area are Parkia biglobosa, Ficus abutilifolia and Mucuna prurens. Some of the common bird species found in the reserve include Tropical Boubou Laniarius aethiopicus, Adamawa Turtle Dove Streptopelia hypopyrrha e.t.c, and the endemic avian species are; the Jos Plateau Indigobird Vidua maryae, Rock Firefinch Lagonosticta sanguinodorsalis. The Laminga village is located on the Jos Plateau, at latitude: 9o56'17.8'' (9.0383o) north and at Longitude: 9o8'16.4'' (9.1379o) east at an average elevation of 1,039m (3,409feet) with land area of about 2000ha. It is nearby to Nujap, Kabu and Ferum and shares boundary with Kyer Kyer village on the Eastern part and Zarazong village on the North-Western part.

The Laminga village (Afizere tribe) has a dispersed form of settlement because almost every house is surrounded by farmland (for farming, which is their major means of survival: subsistence and commercial farming). The surrounding and distant farmlands are cultivated by the Laminga people. Major crops grown include (Sorghum bicolor, Zea mays, Ipomea batatas, Cucumis sativum, Lycopersicon esculentum). Though as farmers and hunters, the Afizere people do not have many taboos in terms of what they eat, most of them abhor the eating of dog meat, unlike other ethnic groups in the State of Plateau especially their immediate neighbours, the Beroms, who consider it a delicacy. The cultural behaviour of the Laminga people for e.g hunting of big birds as source of meat for consumption and also for fame, is perceived by me to also have an impact on the avian species richness that is why it will be put into proper consideration during anthropogenic activities observation in the cause of the research.

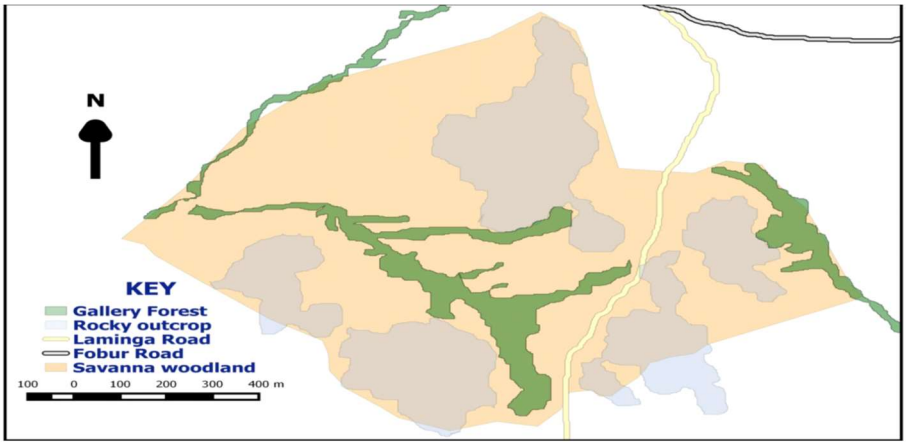

Figure 1: Map of Amurum Forest

2.2 Sampling Techniques

Line Transect

Line transect method was used for bird survey (Bibby et al., 2000). A total of six transects, two per study site, were laid. Each transect was 1000m long; summing to 6000m for all three sites. Each of these transects were divided into 200m sections. Data collection commenced every day at 6:00am-10:30am. A pair of binoculars was used to identify birds species sighted (both perched and in flight), and a field guide (Demey and Borrow, 2004) was used to confirm birds identified where there was difficulty. Birds both seen and heard were recorded. Birds were recorded separately per 200m section of each transect. The start and end time of each 200m section was noted. Anthropogenic activities were also noted as I walked along the transects.

Vegetation Measurements

Vegetation measurements were carried out to determine any effects of the vegetation on species diversity at each site. Vegetation parameters measured included: number of trees (height above 1.3m after Brack, 1999), number of shrubs (height below 1.3m after Brack, 1999), percentage canopy cover and bare ground cover. Percentage canopy cover was determined by getting an average of the canopy cover which was obtained randomly at four points within each 200m section as seen through the wrong end of the binoculars (Manu et al., 2010). It was done within a 10m x 10m quadrat; 10 meters was counted forward, and randomly left or right perpendicular to that initial line, which determined where the vegetation parameters were measured (this was done on my way back from the end point of each transect) at each of the 200m sections of the transect. Percentage ground cover was determined by randomly placing five (5) 1m x 1m quadrats in the 200m section and an average of the ground cover was calculated therefrom.

Anthropogenic Activities

Information on anthropogenic activities was collected by rating the severity/intensity of the activity in that area. The closest estimates of the date and time of occurrence of all anthropogenic activities (like Grazing, Farming, Fire/bush burning, Logging, and Environmental Noise) observed were recorded at each site using a rating of Present or Absent. Also the number of individuals seen at every 200m section was recorded as this seemed to have an effect on the rate of anthropogenic activities happening at the site at the moment. The following parameters were used to analyse the rate of anthropogenic activities observed.

Where: 1----Present
0----Absent

Time Frame

The survey was carried out within a period of three weeks. Data was collected randomly from each of the different sites six times a week for three weeks. Vegetation measurements were taken once for every 200m section in each transect. And all transects were visited six times within the three weeks' frame.

3. DATA ANALYSIS

Microsoft Excel was used to input all data collected. Variables collected include: site, avian species diversity (and content), anthropogenic activities, tree density, shrub density, canopy cover, and ground cover. The variable 'site' had three factors: Amurum Forest reserve, Farmland, and Inhabited areas. The avian species richness and vegetation measurements were continuous, except for the percentage bare ground and canopy covers, which fell between 0 and 100(%). The measure of anthropogenic activities were twofold: a factor with two levels - 0 and 1, and a count of humans present at every 200m section of the transects.

The data was analysed using R statistical package (version 3.1.2). General Linear Models was ran to test for significantly different effects of the independent variables (vegetation parameters and anthropogenic activities) on the dependent variable (avian species diversity) between the three sites.

- For Objective one, effects of site on avian species diversity was tested using:
  model1 <- lm (sp.diversity ~ site, data=Jennifer)
- For Objective two, a Venn diagram was composed to show the Species contents across the three sites.
- For Objective three, effects of rate of anthropogenic activities on avian species content were tested using:
  model2 <- lm (sp. diversity ~ anthro, data=Jennifer)
- For Objective four, effects of site on various vegetation parameters was tested using.
  Model4a <- lm (tree ~ site, data=Jennifer)
  Model4b <- lm (shrub ~ site, data=Jennifer)
  Model4c <- lm (canopy ~ site, data=Jennifer)
  Model4d <- lm (grass ~ site, data=Jennifer)

These models were ran with the full data set to test for significance of the vegetation parameters without exclusion of any of the sites.

For Objective five, to determine the effect of vegetation variables on avian species diversity across the Amurum Forest Reserve, the surrounding farmlands, and the human inhabited Laminga Village.

Then the data was grouped by site, and each subset tested for variations in the avian species diversity due solely to the various vegetation parameters:

```
Model5a <- lm (sp.diversity ~ tree, data=reserve)
Model5b <- lm (sp.diversity ~ shrub, data=reserve)
model5c <- lm (sp.diversity ~ canopy, data= reserve)
model5d <- lm (sp.diversity ~ ground, data= reserve)
model6a <- lm (sp.diversity ~ tree, data=farm)
model6b <- lm (sp.diversity ~ shrub, data= farm)
model6c <- lm (sp.diversity ~ canopy, data= farm)
model6d <- lm (sp.diversity ~ ground, data= farm)
model7a <- lm (sp.diversity ~ tree, data=inhabited)
model7b <- lm (sp.diversity ~ shrub, data= inhabited)
model7c <- lm (sp.diversity ~ canopy, data= inhabited)
model7d <- lm (sp.diversity ~ ground, data= inhabited)
```

4. RESULT

4.1 Species effort curves

Most of the bird species in the three study sites had been recorded as shown in the species accumulation curve. And based on the curves, it is evident that the reserve has a higher level than the farmland and Human inhabited areas which is an indication that the Reserve has more species than the others.

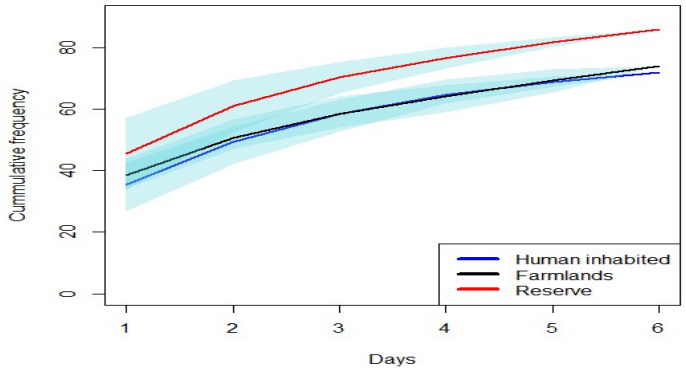

Figure 1: Species-effort curve showing number of bird species recorded in study area

Objective 1. Species diversity between sites

After using the Shannon-Wiener Diversity Index which was just another way to measure the diversity between the three sites, there was a significant difference in bird species diversity between the study sites. See figure 2 below.

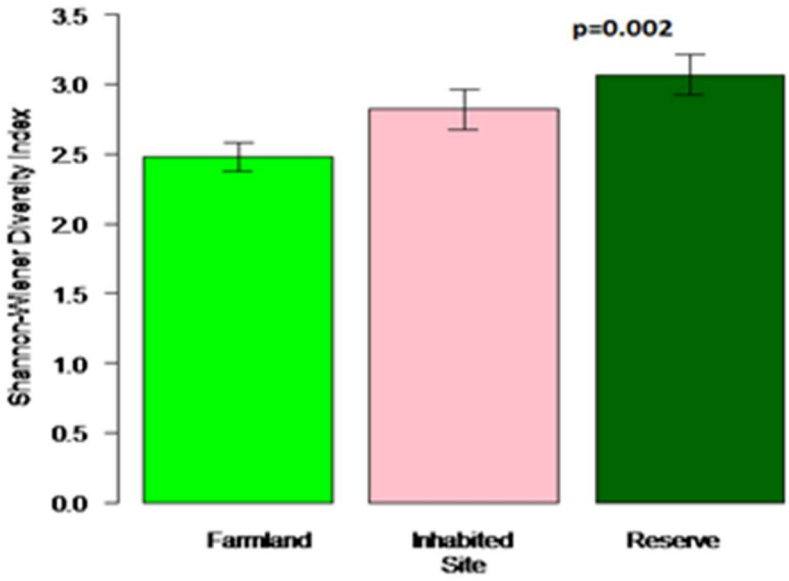

Figure 2: Species Diversity between sites

Objective 2.

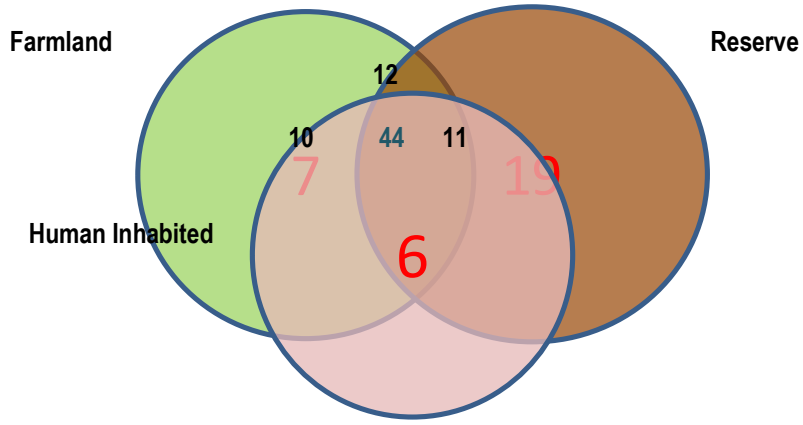

Figure 3. Species contents across the three sites.

From the Venn Diagram, I found that the Unique Species content in the Reserve is higher compared to the number. of unique species in the other two sites. This is because of the mixture in habitat type in the Reserve which gave room for diverse Species to carry out their activities. And also a large number of individuals of the Generalist species cut across all three study sites.

Objective 3.

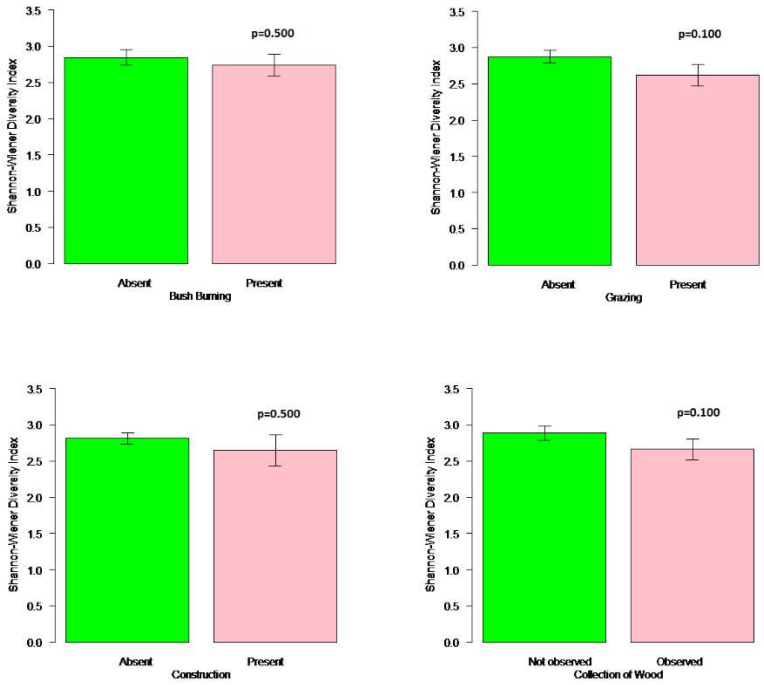

Figure 4a: Anthropogenic acts with insignificant impacts on Species Diversity

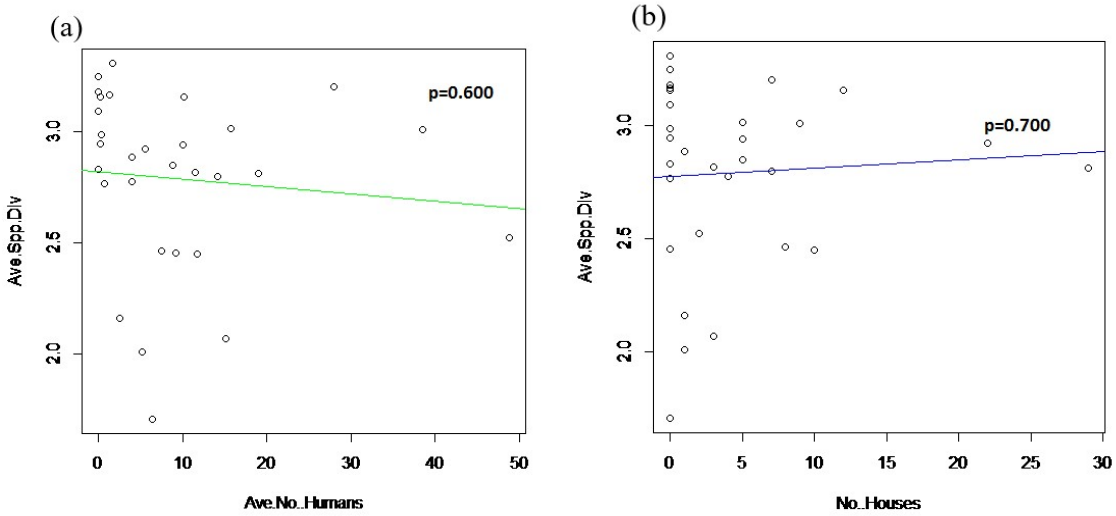

Figure 4b: Impact of No. of Houses and no. of Humans on Species Diversity

From all these, I noted that the anthropogenic activities had no significant effect on Avian Diversity because of the threshold impact. But there is from all indications, that if these acts are not controlled, there's a possibility that the threshold would be exceeded thereby leading to a significant change (Decrease) in Avian Diversity.

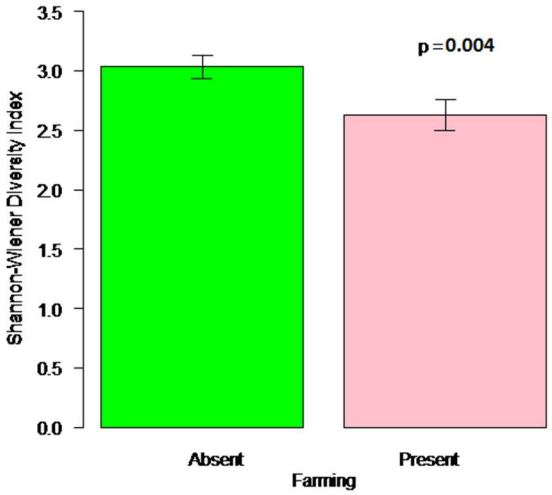

Figure 4c: Impact of Farming on Species Diversity

The graph above shows that Areas with Absence of Farming had higher Species Diversity while areas with Presence of Farming had lower Species Diversity.

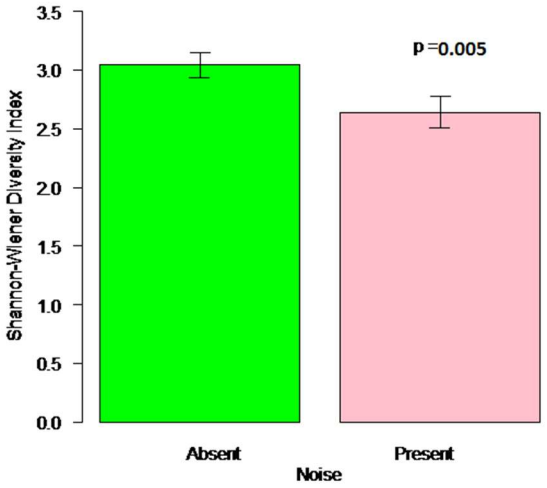

Figure 4d: Impact of Noise on Species Diversity

The graph shows that Areas with Absence of Environmental noise had higher Species Diversity while areas with Presence of Environmental noise such as surface motor vehicles, machines, construction acts and music performances, especially in some work places had lower Species Diversity.

OBJECTIVE 4

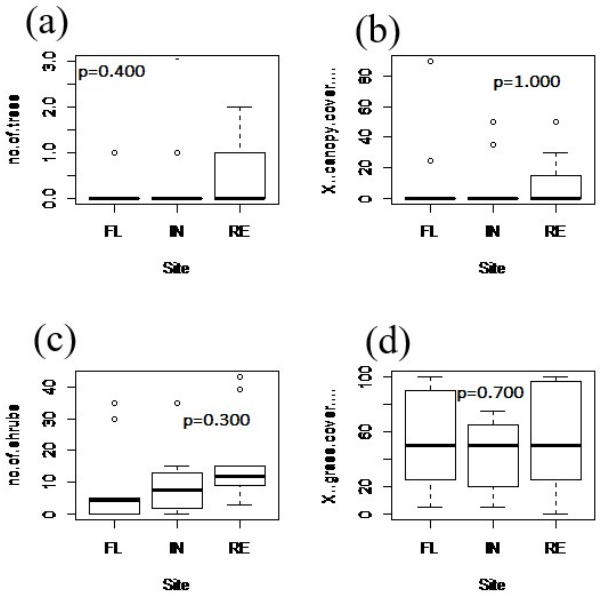

Figure 5: Vegetation Parameters across the three sites

From this graph, it's observed that vegetation parameters differed insignificantly across all three sites. But looking at the Shrubs, it shows a visible variation in means across all three sites except that its variation was not significant. While all other vegetation parameters had their mean bars on the same level.

OBJECTIVE 5

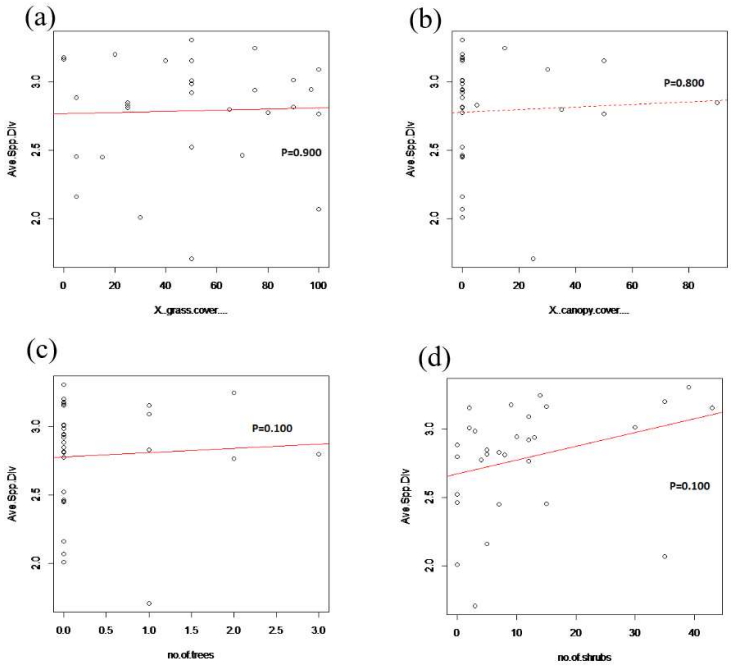

Figure 6: Impact of Vegetation Parameters on Species diversity

Due to the lack of Trees within the quadrat, it led to a corresponding low canopy cover. But in some of the sections on the transect, I had the canopy of some trees outside my 10m quadrat which increased the Percentage canopy cover. But this occurred in just two sections out of the 15 sections. Which still didn't have a significant effect on Avian Species diversity. From the Spearman's Correlation graph, it shows that where I had more trees, I had more canopy cover. However, some of them didn't correlate like shrub and grass were the least correlated

5. DISCUSSION

Figure 2: The Reserve had higher avian species diversity than the Farmlands and Human Inhabited areas. (Paillet et al., 2010 and Okland *et al., 2003*): This is probably due to the fact that the Reserve provided a variety of structures that support Avian life like Tress for Roosting, Less noisy environment and less/controlled interference from externalities; therefore, there is little or no bridge in communication between species leading to an increase in Diversity and Population.

Figure 3: The Reserve had higher avian species contents than the Farmlands and Human Inhabited areas. (Paillet et al., 2010 and Okland *et al., 2003*): This is probably due to the presence of a more serene and well vegetated structure and a mixed kind of habitat type in the Reserve as compared to the other two sites.

Figure 4a-4f: habitat disturbance did not significantly affect species diversity across habitat types. (IMONG 2007): From this, I noted that these anthropogenic activities based on number of houses, humans, wood collection for cooking, bush burning in small scale, construction and Grazing had no significant effect on Avian Diversity because of the threshold impact. But there is from all indication, a possibility that the threshold would be exceeded if these acts are not controlled thereby leading to a significant change (Decrease) in Avian Diversity.

Farming: Land abandonment showed increase in avian species Diversity (Tobias et al., 2014): Most of the Farmlands had been abandoned due to the season of the year leading to more of Grass covers and shrubs on them instead of a particular type of crop. Which eventually leads to a mixture or variety of avian species foraging, nesting or carry out different activities on that site at that particular point in time.

Noise: It has impacts on animal communication systems and behavior by masking acoustic signals related to territorial defense, mate attraction, alarm calls, pair-bond maintaining calls, and begging calls of nestlings (Warren *et al.* 2006): Nearly anyone who has been near a busy roadway, an airport, or industrial equipment can attest to the intensity of sounds produced by human activities. Many of these anthropogenic sounds can be physically harmful or distracting to humans and/or wildlife and are considered noise pollution (hereafter referred to as noise). Some of the effects of noise could result in the following; Bridge in Communication during; Breeding, Alarm calls for; Predator (Flocking alarm call, and It makes the female bird species bad mums by reducing the rate of interaction), Foraging sites, Reduces the rate of acoustic flow in males when displaying to please female birds in some species.

Figure 6a-6d; Species Diversity did not vary greatly because of Vegetation parameters, but there was a significant difference in species diversity between sites. (Andrew Siefert 2005): This is probably due to the presence of a more serene and well vegetated structure and a mixed kind of habitat type in the Reserve as some of the transects cut through the Gallery, Savanah and Gullies compared to the other two sites which were relatively flat.

6. CONCLUSION

In conclusion and from all indications, efforts to curb the loss of biodiversity has intensified in recent years, but they have not kept pace with the growing encroachment of human acts. Meaning that there is a Great need for us to speed up the rate at which we fight against Habitat loss caused by anthropogenic activities in order to stabilize our Environment. Finally, we should note that, “everywhere” was once a good home for both flora and fauna just like Laminga before Human acts exceeded the threshold and became too much for the environment to bear which might eventually lead to Habitat loss, Extinction, and Ultimately Loss of Ecological System.

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