

Ecological Survey on a Recently Disturbed Plant Community in Nnamdi Azikiwe University Awka, Anambra State

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Received November 27, 2019; Revised January 9, 2020; Accepted January 13, 2020

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Abstract Ecological survey on a recently disturbed plant community in NnamdiAzikiwe University Awka premises was carried out using random sampling method. The species present within the quadrat were identified, counted and recorded. Only plants that were rooted within the quadrat were included. Abundance values obtained from quadrat samples for plot 1 showed that *Pennisetumpurpleum* had the highest density followed by *Bidenspilosa* and *Calapagoniummucunoides*, while *Chlorispilosa*, *Gomphrenacelosoides*, *Paspalumscrobiculatum* and *Sidalinifolia* were of the lowest density, followed by *Combretumhispidum*. Abundance values obtained from quadrat samples for plot 2 showed that *Aspiliabussei* had the highest density followed by *Sidaacuta*, then *Ageratum conizoides* while *Sidalinifolia*, *Combretumhispidum*, *Hiptislancoolata* and *Celosia leptoscachya* had the lowest density. Abundance values obtained from quadrat samples for plot 3 showed that *Aspiliabussei* had the highest density followed by *Calapagoniummucunoides*, then *Paspalumscrobiculatum*, while *Sidalinifolia*, *Hiptislancoolata*, *Panicum maximum* and *Chlorispilosa* had the lowest density. From the study, it was observed that plot 1 had the highest species diversity followed by plot 2 and plot 3. In general the mean value of this species diversity is 0.77 which confirms that the area is highly diverse and the species diversity are highly related. The species diversities are not significantly different from one another, showing how homogenous the three plots were.

Keywords Ecological, Species, Diversity, Density, Plants, Population, Community

Species distribution and abundance are fundamental to understanding patterns of communities and their relations to environmental conditions [1] [2]. One of the most basic steps in vegetation analysis is classification of community types. Classification is the process of grouping similar entities together into classes based on selected shared characteristics [3]. In the case of plant communities, vegetation and environmental features are used to describe units that are useful for management applications [4] [5].

In any ecological study, the vegetation is considered. [6] described vegetation as an assemblage with plants growing together in a particular location and may be characterized either by its component species or by the combination of functional and structural character that characterizes the appearance of the vegetation. This is an important distinction which is reflected by the range of methods available for describing the vegetation. Structural methods do not demand species identification and are often considered more meaningful for small-scale (large area) studies and for habitat description for scientists of other disciplines. Methods based on species composition or floristic are more useful for large-scale (small area) studies of a more detailed botanical nature.

Different vegetation types require different quadrat sizes. [7] noted that vegetation with smaller plants, greater plant density or greater species diversity needs smaller quadrat. He also stated that a better approach is to determine the particular quadrat type and size for a particular study. One common scenario faced in abundant species studies is that the species habitat lies along a boundary with complex geometry. Some examples include surveys conducted along coastlines, Rivers, Lake Shores and elevation contours. Many transect-quadrats designed in this setting gives size to uneven selection probabilities over the survey region. The

1. Introduction

non uniformity in sampling coverage must be properly accounted for in the estimation procedure to avoid introducing bias into the abundance estimate. [8] provided a simple solution to this, namely: by weighing each data point (quadrat in the correct context) using the inverse of the corresponding selection probability.

[9] noted that one qualitative method of analysis of a community is to list all the species present. He subsequently argued that such a check list is useful but it is rarely used alone because of its limited value, and that quantitative data are also required. In actual situation, it is not often possible to carry out a complete quantitative analysis because of its large size. It is better to choose a small area when detailed analysis is required. The method in which the samples are distributed is important. For instance, if the samples were systematically and evenly spaced out over the community, each sample should be placed at random. This is important because it is necessary to be able to estimate the mean or average values of various characters of the vegetation.

This study seeks to carry out quantitative analysis on a recently disturbed plant community, by; determining the species type and diversity in the community. Each community is composed of taxonomically different species and in determining species diversity, species richness and evenness will also be considered. Also the study will determine the stability of the community. For a community to be stable, it requires two components: Resilience and Resistance. *Resilience* is the ability of a community to recover after facing a disturbance or displacement. *Resistance*, on the other hand, is the ability of a community to avoid disturbance. The structure and composition of the community will also be determined. Each community has its own structure and composition. Community structure is often expressed in terms of its major growth form such as trees in forests or grasses in grasslands. The arrangement of different growth forms determines the structural pattern of the community.

2. Materials and Methods

2.1. Site Description

Awka is located between the coordinates $6^{\circ}12'25\text{N}$ and $7^{\circ}04'04\text{E}$. Awka is in the tropical rainforest zone of Nigeria and experiences two distinct seasons brought about by the predominant winds that rule the area. The Southwestern monsoon winds from the Atlantic Ocean and the Northeastern dry wind across the Sahara desert. The monsoon winds from the Atlantic creates seven months of heavy tropical rains which occurs between April and October and followed by five months of dryness November to March. The harmattan is particularly dry and dusty wind which enters Nigeria in late December or in early part of January and is characterized by gray haze limiting visibility and blocking the sun's rays. The temperature in Awka is

generally 27°C to 30°C between June and December 32°C to 34°C between January and April with the last few month of dry season marked with intense heat. The quantitative analysis study was carried out in a large area of plant community opposite the digital library complex of Nnamdi Azikiwe University Awka. The study area was of uniform elevation and homogeneous. This means that it has similar environmental parameters, vegetation and management history.

Three different study areas, measuring 8m by 8m were mapped out using pegs to map out the four corners of the plot and two 30m tape to measure 8m for each side of the plot, a cutlass for making small holes. The holes were for inserting the pegs. And a 1m by 1m quadrat was used. Before sampling, the sampling intensity was calculated which gave approximately 16%.



Figure 1. Photograph of plot 1



Figure 2. Photograph of plot 2 and 3

2.2. Sampling Technique

The random sampling method was used for sampling. Two coordinates AB (8m to represent 8 units) and BC (8 m to represent 8 units) were measured out in each plot (Refer Figs 1 and 2). Pieces of papers were used to write numbers 1 to 7 separately for each value of AB and BC. These numbers were folded and picked at random 10 times in order to get the random points where the quadrats will be placed. Number 8 was avoided in the written numbers to avoid edge effect i.e. getting the random points at the edge of the mapped out plots, or even outside it. At each random point, the quadrat was placed in such a way that the point of intersection is in the center of the quadrat. The species present within the quadrat

were identified, counted and recorded. Only plants that were rooted within the quadrat were included (refer to Figs 3, 4 and 5). This procedure continued till the ten random points (intersects) were sampled for each of plots 1, 2 and 3.

Coded alphabets were given to all plants that could not be

identified in the field. The unidentified plants were collected, properly labelled and taken to Department of Botany Herbarium NnamdiAzikiwe University for identificationDr. E.I. Mbaekwe and Mr C.F. Iroka. Floras, monographs and hand book of West African weeds by[10] [11] was used.

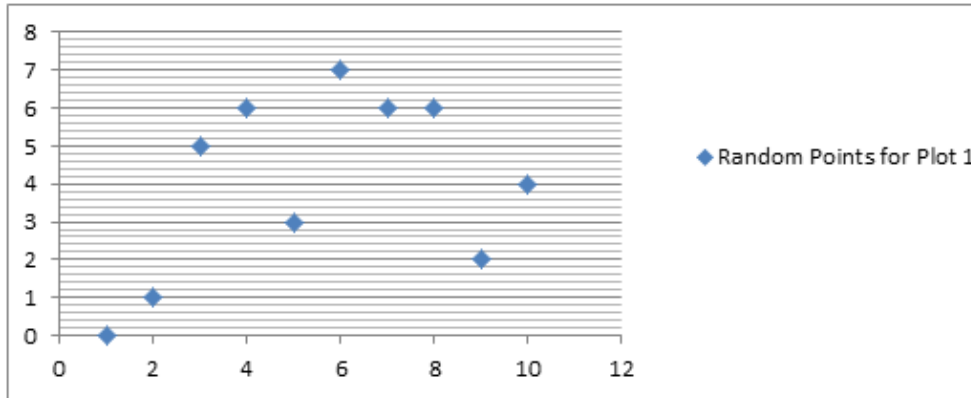


Figure3. Random Points Used for Sampling Plot 1

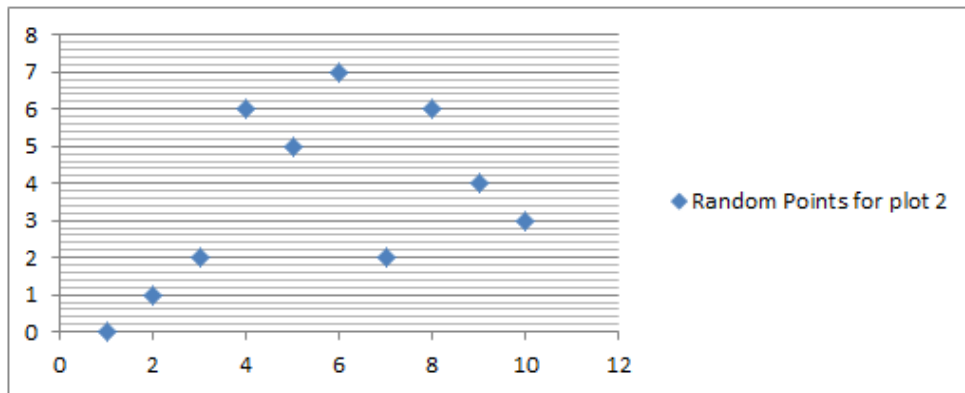


Figure4. Random Points Used for Sampling Plot 2

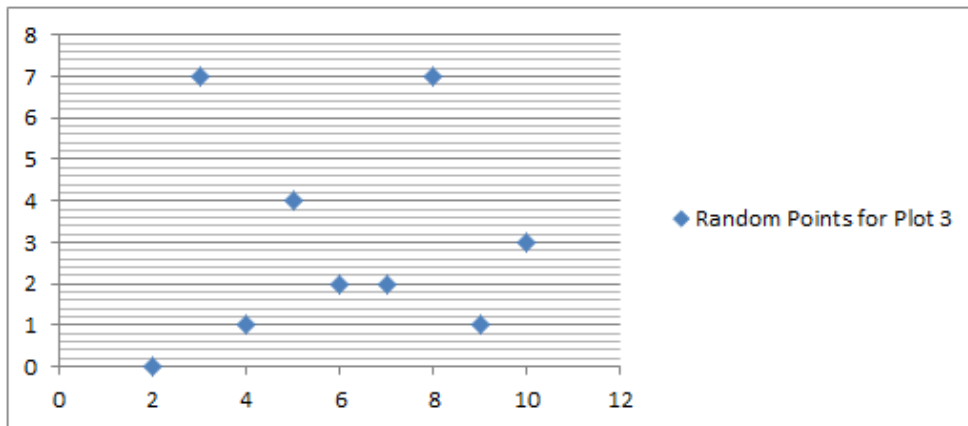


Figure5. Random Points Used for Sampling Plot 3

2.3. Data Analysis

From the records obtained from plots 1, 2, 3, the following calculations were done.

1. Density = $\frac{\text{total number of individual species}}{\text{total area of the plots sampled}}$
2. Relative density = $\frac{\text{density of one species}}{\text{total density of all species}} \times \frac{100}{1}$
3. Frequency = $\frac{\text{number of occurrence of one species}}{\text{number of times sampled}} \times \frac{100}{1}$
4. Relative frequency = $\frac{\text{frequency of one species}}{\text{total frequency of all species}} \times \frac{100}{1}$
5. Importance value = relative density of one species + relative frequency of the same species

Species diversity was calculated using the Shannon - Wiener index and the steps are listed below.

STEP 1:

$$H^I = -\sum(pi) \times (\ln pi)$$

STEP 2:

$$H_{\max} = (\ln S)$$

STEP 3:

$$E = \frac{H^I}{H_{\max}}$$

Where:

Pi = proportion of total sample belonging to the species

S = number of species diversity

H^I = index of species diversity

E = equitability / evenness

NOTE: That the values for species diversity range from 0.1 to 0.99

3. Results and Discussion

Quadrat Size: 1m by 1m

From the table 1, results showed that *Pennisetum purpureum* had the highest density followed by *Bidens pilosa* and *Calapagonium mucunoides*, while *Chloris pilosa*, *Gomphrena celosoides*, *Paspalum scrobiculatum* and *Sida linifolia* were of the lowest and of the same density, followed by *Combretum hispidum*. The table also shows that *Calapagonium mucunoides* and *Pennisetum purpureum* had the highest and the same frequency followed by *Bidens pilosa* while *Paspalum scrobiculatum*, *Sida linifolia*, *Gomphrena celosoides*, *Chromolaena odorata*, *Ipomoea eriocarpa*, *Aspilia africana*, *Eleusine indica*, *Senna obtusifolia*, *Chloris pilosa* had the lowest and the same frequency. The table also showed that *Pennisetum purpureum* had the highest importance value, followed by *Calapagonium mucunoides* while *Sida linifolia*, *Paspalum scrobiculatum*, *Gomphrena celosoides* had the lowest and the same importance value followed by *Ipomoea eriocarpa*.

Table 1. Abundance Values Obtained from Quadrat samples for plot 1

Species	Density (M ⁻²)	Relative Density (%)	Frequency (%)	Relative Frequency (%)	Importance Value
<i>Ageratum conyzoides</i>	2.1	6.29	30	5.26	11.55
<i>Aspiliabussei</i>	3.2	9.58	40	7.02	16.6
<i>Aspilia Africana</i>	0.4	1.2	10	1.75	2.95
<i>Axonopus compressus</i>	0.7	2.1	20	3.51	5.61
<i>Bidens pilosa</i>	4.5	13.47	50	8.77	22.24
<i>Calapagonium mucunoides</i>	4.3	12.87	80	14.04	26.91
<i>Celosia leptoscachya</i>	0.9	2.69	30	5.26	7.95
<i>Chloris pilosa</i>	0.1	0.3	10	1.75	2.05
<i>Chromolaena odorata</i>	0.9	2.69	10	1.75	4.44
<i>Combretum hispidum</i>	0.2	0.6	20	3.51	4.11
<i>Crotalaria retusa</i>	3.2	9.58	20	3.51	13.09
<i>Cyperus esculentus</i>	0.5	1.5	20	3.51	5.01
<i>Eleusine indica</i>	0.4	1.2	10	1.75	2.95
<i>Gomphrena celosoides</i>	0.1	0.3	10	1.75	2.05
<i>Ipomoea eriocarpa</i>	0.3	0.9	10	1.75	2.65
<i>Ipomoea involucrata</i>	1.2	3.59	30	5.26	8.85
<i>Lonchocarpus cyanescens</i>	0.4	1.2	20	3.51	4.71
<i>Paspalum scrobiculatum</i>	0.1	0.3	10	1.75	2.05
<i>Pennisetum purpureum</i>	7.9	23.65	80	14.04	37.69
<i>Senna obtusifolia</i>	0.4	1.2	10	1.75	2.95
<i>Sida acuta</i>	1.5	4.49	40	7.02	11.51
<i>Sida linifolia</i>	0.1	0.3	10	1.75	2.05
TOTAL	33.4		570		

Quadrat Size: 1m by 1m

Table 2. Abundance values obtained from quadrat samples for plot 2

Species	Density (M ²)	RelativeDensity (%)	Frequency(%)	RelativeFrequency (%)	Importance Value
<i>Ageratum conyzoides</i>	6.2	24.92	80	11.76	36.68
<i>Calapagonium mucunoides</i>	3.6	8.96	90	13.24	22.2
<i>Celosia leptoscachya</i>	0.1	0.25	10	1.47	1.72
<i>Chlorispilosa</i>	5.7	14.18	70	10.29	24.47
<i>Combretum hispidum</i>	0.1	0.25	10	1.47	1.72
<i>Cyperus esculentus</i>	0.4	1	10	1.47	2.47
<i>Eleusine indica</i>	2.8	6.97	50	7.35	14.32
<i>Euphorbia hirta</i>	0.3	0.75	10	1.47	2.22
<i>Gomphrenacelosoides</i>	1.1	2.74	20	2.94	5.68
<i>Hiptis lanceolata</i>	0.1	0.25	10	1.47	1.72
<i>Mimosa invisa</i>	0.3	0.75	30	4.41	5.16
<i>Paspalum scrobiculatum</i>	1.4	3.48	50	7.35	10.83
<i>Pennisetum purpureum</i>	4	9.95	90	13.24	23.19
<i>Sida acuta</i>	6.7	16.68	60	8.82	25.5
<i>Sidalinifolia</i>	0.1	0.25	10	1.47	1.72
<i>Sub Ageratum species</i>	7.3	18.16	80	11.76	29.92
TOTAL	40.2		680		

From table 2, the results shows that *Aspiliabussei* has the highest density followed by *Sida acuta*, then *Ageratum conyzoides* while *Sidalinifolia*, *Combretum hispidum*, *Hiptis lanceolata* and *Celosia leptoscachya* had the lowest and same density, followed by *Euphorbia hirta* and *Mimosa invisa* with the same density. The table also shows that *Calapogium mucunoides* and *Pennisetum purpureum* has the highest and the same frequency followed by *Aspiliabussei* and *Ageratum conyzoides* with the same density while *Sidalinifolia*, *Cypruesculentus*, *Comberatum hispidum*, *Euphorbia hirta*, *Hiptis lanceolata* and *Celosia leptoscachya* has the lowest with the same frequency followed by *Gomphrenacelosoides*. The table also showed that *Ageratum conyzoides* have the highest importance value followed by *Aspiliabussei*, then *Sida acuta* while *Sidalinifolia*, *Comberatum hispidum*, *Hiptis lanceolata*, *Celosia leptoschya* has the lowest with the same importance value.

Quadrat Size: 1m by 1m

Table 3. Abundance values obtained from quadrat Samples for plot 3

Species	Density (M ²)	RelativeDensity (%)	Frequency(%)	RelativeFrequency (%)	Importance Value
<i>Ageratum conyzoides</i>	1.8	3.92	40	6.15	10.07
<i>Aspiliabussei</i>	17.7	38.56	100	15.38	53.94
<i>Calapagonium mucunoides</i>	2.5	5.45	90	13.85	19.3
<i>Chlorispilosa</i>	0.7	1.53	10	1.54	3.07
<i>Combretum hispidum</i>	0.2	0.44	20	3.08	3.52
<i>Cyperus esculentus</i>	3.1	6.75	50	7.69	14.44
<i>Eleusine indica</i>	3	6.54	50	7.69	14.23
<i>Fimbristylis littoralis</i>	5.3	11.55	70	10.77	22.32
<i>Hiptis lanceolata</i>	0.1	0.22	10	1.54	1.76
<i>Ipomoea involucrata</i>	0.4	1.84	20	3.08	4.92
<i>Panicum maximum</i>	0.7	1.53	10	1.54	3.07
<i>Paspalum scrobiculatum</i>	5.8	12.64	80	12.31	24.95
<i>Pennisetum purpureum</i>	3.9	8.5	70	10.77	19.27
<i>Polycarpha acorymbosa</i>	0.6	1.31	20	3.08	4.39
<i>Sidalinifolia</i>	0.1	0.22	10	15.38	15.6
TOTAL	45.9		650		

From table 3, results show that *Aspiliabussei* had the highest density followed by *Calapagoniummucunoides*, then *Paspalumscrobiculatum*, while *Sidalinifolia*, *Hiptislanceolata*, *Panicum maximum* and *Chlorispilosa* had the lowest and same density followed by *Combretumhispidum*, *Ipomoea involucrate* and *Polycarphaecorymbosawith* the same density. From the table also, results show that *Aspiliabussei* also had the highest frequency followed by *Paspalumscrobiculatum*, then *Fimbristylislittoralis* while *Hiptislanceolata* had the lowest frequency followed by *Panicum maximum* and *Chlorispilosa* with the same frequency. Results also showed that *Aspiliabussei* had the highest importance value followed by *Paspalumscrobiculatum*, then *Fimbristylislittoralis* while *Sidalinifolia* and *Hiptislanceolata* had the lowest and the same importance value followed by *Combretumhispidum* and *Ipomoea involucrata*

Table 4. Species diversities for all the plots

Plots	Species Diversity
1	0.79
2	0.78
3	0.75

$$\text{Mean} = \frac{0.79+0.78+0.75}{3} = \frac{2.32}{3} = 0.77$$

From the table it was observed that plot 1 has the highest species diversity followed by plot 2 and plot 3. In general the mean value of this species diversity is 0.77 which confirms that the area is highly diverse and the species diversity are highly related. The species diversities are not significantly different from one another, showing how homogenous the three plots were.

4. Conclusions

From the analysis carried out, results obtained show that the species in the different plots vary a lot in terms of density, frequency, relative frequency, relative density and importance value. Having calculated the species diversity using the Shannon wiener index, results show that plot 1 is the most diverse of the three plots followed by plot 2 and then plot 3. But in all the three plots are highly diverse. The result showed *Aspiliabussei* had the highest density across the area. It also had the highest importance value because it was present in most quadrat casted in all the plots. The species with the second highest density and importance value across the area is *Calapagoniummucunoides*. This is followed by *Sidaacuta*, and *Pennisetumpurepureum*. This might be due to their adaptive ability to climatic and edaphic conditions. While species like *Sidalinifolia*, *Gompherenacelosoides*, *Hiptislanceolata*, *Ipomoea involucrata* etc. were low in abundance and are rarely found in the area. This might be due to their inability to adapt to climatic and edaphic conditions. ^[5] in hisphytosociological

study of AbubakarTafawaBelewa University campus, Bauchi observed that *Parkiabiglobosa*, *Sennasiamea* were the most abundant species with high importance value index of 52.64 and 19.67 respectively.

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