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Ecological Survey on Species of Poaceae Family Present in Nnamdi Azikiwe University Campus Awka, Anambra State

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An ecological survey was done on the species of poaceae family present in Nnamdi Azikiwe University Awka campus. Data was collected from eight different zones of the campus which was randomly divided for adequate coverage and proper representation. Species dominance, percentage cover of species, abundance and diversity of poaceae species were recorded. The result of the study showed that a total of 24 poaceae species were identified in the study area; *Eleusine indica* had the highest species abundance across the eight zones, with a total frequency of 36 and a total average cover of 28.59, while *Sporobulus pyramidalis* is the second most abundant with a frequency of 35 and *Pennisetum polystachion* is the third most abundant with a

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frequency of 25. The result went further to show the various distributions of the poaceae species across the different zones. *Eleusine indica* had a relative abundance of 19.4%, followed by *Sporobulus pyramidalis* (16%) and *Pennisetum polystachion* (13.5%). More so, *Andropogon gayanus* had a relative abundance of (8.1%) while *Andropogon tectorum*, *Brachiaria falcifera*, *Dactyloctenium aegyptium* and *Digistaria horizontalis* as well as *Eragrostis tenella*, *Eragrostis tremela*, *Panicum maximum* and *Pennisetum violaccum* all had the lowest relative abundance of 0.5 % each. The result of Shannon Wiener index for species of poaceae family in the study area was 2.59 and this showed that there is high diversity of species of poaceae family in the study area which invariably indicates a great potential for utilization in conservation and ecological purposes.

Keywords: Ecological; poaceae; grass; biodiversity; species; family; abundance; survey.

1. INTRODUCTION

Grasslands are areas where the vegetation is dominated by grasses (Poaceae), however, sedge (Cyperaceae) and rush (Juneaceae) families can also be found. Grasslands occur naturally on continents except Antarctica. Grasslands are one of the world's major ecosystems, covering almost one-third of the Earth's terrestrial surface [1]. The family Poaceae formerly called Graminaeae, forms one of the largest families of flowering plants, grass family of monocotyledons plants, and a division of the order Poales. Grasses comprise a significant group in the flora biota of most campuses. Lawn planting appropriately supplemented with ornamental and non-grasses can provide aesthetic, recreational, and hygienic health benefits [2], asides its functional ecological significance. Apart from the environmental relevance of grasses on the campuses, landscape aesthetics contribute to the cultural ecosystem services, which positively affect the recovery of attention, physiological stress, and emotional stress of humans [3,4]. Poaceae rank among the top five families of flowering plants in terms of the number of species, but they are clearly the most abundant and important family of the earth's flora. They grow in the desert to freshwater and marine habitats and at all habitats but the highest elevations. Plant communities dominated by grasses account for about 24 percent of the Earth's vegetation. It comprises of about 10,000 species and 793 genera [5].

The members of the family occupy a wide and varied ecological range and form an essential component of almost every type of vegetation ranging from major grasslands to the densely canopied evergreen glades. The ecological diversity of the grasses is amply complemented by the great genetic diversity. The grasses contribute to mankind in the form of fodder for cattle, thatching and building materials and medicine etc. Only Asteraceae (compositae), Fabaceae (Leguminosae), Orchidaceae (orchids), and Rubiaceae contain more species than Poaceae [6]. Poaceae are also one of the most ecologically and economically important plant families [7]. Grasslands support diverse invertebrate and vertebrate communities [8], and are important elements in the development and stabilization of soil.

Poaceae live in many other habitats including wetlands, forest and tundra. Grass family being one of the most widely distributed and abundant group of plants on earth are found on every continent and are absent only from central Greenland and much of Antarctica [9,10]. Domestication of poaceae cereal crops such as maize, rice, wheat and barley lies at the foundation of sedentary living and civilization around the world and the poaceae still contains most economically important plant family in modern times providing forage for animals, building materials (bamboos) as well as food. Succession of grasses depends on their morphology and growth processes and also in their physiological diversity.

There is scarcity of information on the distribution, abundance and diversity of plants species in the poaceae family within Nnamdi Azikiwe University, Awka Campus. The university is undergoing rapid development in all areas, hence, vegetation is being cleared within the university and as such, poaceae plant families are being affected/destroyed; as a result of clearing, some species of grasses go into extinction; while some others spring up. The extinction hinders proper documentation of the poaceae family that exists in the university campus, as the species can no longer be found or identified. The aim of this study is to carry out an ecological survey on the species of poaceae family found in the Awka campus of Nnamdi

Azikiwe University by assessing areas the species covers and determining the abundance and diversity of poaceae species in the study area. More so, giving the economic importance of poaceae family in Nigeria, findings of this study will be helpful for future researches and conservation purposes as it will serve as reference to sustainable grass management and habitat restoration.

2. MATERIALS AND METHODS

2.1 Study Area

This research was carried out at Nnamdi Azikiwe University, Awka from June to November. The University sits on a land mass of approximately 4.99km^2 and lies between latitude (7^o00 and 7^o10^1) E and (6^o05 and 6^o15^1) N, along the Enugu-Onitsha expressway in Anambra state Nigeria.

2.2 Data Collection

The institution was randomly divided into Eight (8) zones so as to cover the entire institution, and different grasses were found. Some sites are used mainly for farming; some has been cleared for cultivation and construction while some are left fallow. The study area was divided as follows with their descriptions.

Zone A: This zone is the science village, an area dominated by shrubs, herbs and tall trees. This area has a lot of buildings as a result of rapid construction going on.

Zone B: This area includes Faculty of Management Sciences, Faculty of Law, School Hostels and Faculty of Arts. The small open field is covered by sedges and trees but some species of poaceae were found within the site.

Zone C: This area covers the rare areas of the school which includes: Ifite gate, Unizik Primary school, Unizik High School and Faculty of Social Sciences. It contains Forests, Farmlands and some grass fields. Some parts are swampy and help the growth of the vegetation.

Zone D: This area covers the main university library and the College of Postgraduate studies in Nnamdi Azikiwe University, Awka. It has an open field which was characterized by mostly poaceae families.

Zone E: This site involves the Faculty of Engineering, Faculty of Agriculture and Botany laboratory. Some parts of this area are still in its natural habitat and contain trees, shrubs, herbs and grasses.

Zone F: This site comprise the Administrative blocks, Bank Area and university main gate avenue, which is located after the big Unizik tower beside where banks are built. This area is an open field and it is water-logged and swampy.

Zone G: This site includes the Medical centre, faculty of Environmental Sciences, Afri-hub building and the church buildings. The sites have a small open field which is covered with mainly grasses.

Zone H: This site involves the Faculty of Education, utility building and Works Department. Some of this site has been cleared for cultivation while some parts are still in their natural habitat.

2.3 Sampling Technique

The collection of all the poaceae species was done within the marked zones across Nnamdi Azikiwe University Awka campus. Purposive sampling was used for sampling of each of the zones, where three sample points were selected randomly on a 100m tape; data was collected 10m from the point of sample.

Poaceae species were collected and identified on-site; those which could not be identified on-site were coded and later identified, identification was done using floras and West African weed hand book by Akobundu and Agyakwa [11].

The sites were visited often to identify the conditions in which they exist/existed and it was discovered that most species of poaceae grew more during the rainy season. Sampling was done according to where the species were collected and subsequently, the dominant species in the institution were identified.

2.4 Data Description

The most dominant species in the University: Line Intercept Method was used to identify the most dominant species and average cover of each species was computed. The average percentage (%) cover of each species was calculated using the formula below.

% cover Species A = $\left(\frac{total\ distance\ of\ species\ A}{total\ distance\ of\ line}\right) \times 100$

Abundance of the species: Shannon Wiener index was used to find the species diversity of the species.

Shannon Wiener Index: Shannon Wiener Index is defined and given by the function below:

$H = - \sum (P_i \times Ln\ (P_i))$

Where,

H: Shannon Wiener Index
∑: Summation
P_i: Proportion of total sample represented by species
Ln (P_i): Natural logarithm of total sample represented by species

3. RESULTS

3.1 Analysis of Species Identified

In this study, a total of 24 poaceae species were identified in the study area. The results of the species frequencies of occurrence and average percentage (%) cover for the selected eight (8) zones used in the study area are presented in Table 1.

In Zone A, *Pennisetum polystachion* had the highest frequency of 8 with average % cover of 12.11. This was followed by *Panicum maximum* which had a frequency of 6 and average cover of 7.5%. *Imperata cylindrica* had the lowest frequency of 1 and average cover of 0.03%. In Zone B, *Schizachyrium exile Pilger* had the highest frequency of 11 with average % cover of 13.70. This was followed by *Pennisetum polystachion* with a frequency of 9 but with the highest average cover of 15.93%. *Echinochloa colona* had the lowest frequency of 1 and average cover of 0.77%.

In Zone C, *Sporobulus pyramidalis* had the highest frequency (11) with average % cover of 38.51. This was followed by *Eragrostis ciliaris* (3) and average cover of 5.98%. *Digitaria horizontalis* had the lowest frequency (1) and average cover of 0.17%.

In Zone D, *Andropogon gayanus* had the highest frequency (12) with average % cover of 13.71. This was followed by *Sporobulus pyramidalis* (11) but with highest average cover of 14.39%. *Imperata cylindrica* had the lowest frequency (7) and average cover of 3.57%.*Eleusine indica* had the highest frequency (23) with average % cover of 18.09 in Zone E. This was followed by *Digitaria longifora* having a frequency of 4 and an average cover of 8.94%. *Eragrostis tremula* had the lowest frequency (1) and average cover of 0.03%. In Zone F, *Pennisetum polystachion* and *Oryzea longistaminata* had the highest and same frequency (5) with average % cover of 4.07 and 3.6 respectively. This was followed by *Echinochloa colona* (3) with average cover of 3.13%.*Imperata cylindrica* had the lowest frequency (1) and average cover of 0.4%.

In Zone G, the results revealed that *Eleusine indica* had the highest frequency (7) with high average % cover of 2.93. This was followed by *Digitaria ciliaris* and *Cynodon dactylon* with the same frequency (4) with average cover of 3.27% and 2.77% respectively. *Sporobulus pyramidalis* had the lowest frequency (1) and average cover of 0.67%. In Zone H, the results revealed that *Panicum maximum* had the highest frequency (4) with average % cover of 7.43. This was followed by *Pennisetum polystachion* (3) with highest average cover of 7.81%. *Imperata cylindrical* had the lowest frequency (1) and average cover of 0.4%.

Generally, *Eleusine indica* is more abundant across the eight zones in the area of study, having a total frequency 36 and total average cover of 28.59 while *Sporobulus pyramidalis* is the second most abundant with a frequency of 35 and *Pennisetum polystachion* is the third most abundant with a frequency of 25.

3.1.1 Species identified in the eight (8) selected Zones

Despite the fact that not all the 24 identified species are present in each of the zones, some of the species available in each of the zones exists more abundantly than the others. From the Fig. 1; *Eleusine indica* is predominantly abundant in zone E, although this specie is not present in zones C, D, F, H, but in zones A, B, E and G where they exist, they do so in a fairly leading frequency; *Eleusine indica* make up 19.35% of the entire poaceae family in the study area. *Sporobulus pyramidalis* is also identified in zones A, B, C, D, F, G covers about 18% of the entire poaceae family in the study area and also the second most abundant species in the area of study exist in those zones in little quantities.

Pennisetum polystachion recorded in zones A, B, F, H represents 8.7% of the entire poaceae family in the study area with a frequency of 25 and the most abundant in zone A, second most abundant in zone B, most abundant in zone F and second most abundant in zone H.

Table 1. Frequency and Average Percentage Cover of Species Identified

Area	SPECIE Species	Frequency	Average % cover
Zone A	*Andropogon tectorum*	1	1.23
	Dactyloctenuim aegyptium	1	0.70
	Echinochloa colona	1	0.70
	Eleusine indica	4	2.77
	Imperata cylindrical	1	0.03
	Panicum maximum	6	7.55
	Paspalum scrobiculatum	1	0.50
	Pennisetum polystachion	8	12.11
	Sporobulus pyramidalis	4	4.50
Zone B	*Andropogon gayanus*	1	5.00
	Echinochloa colona	1	0.77
	Eleusine indica	2	4.80
	Pennisetum polystachion	9	15.93
	Schizachyrium exile Pilger	11	13.70
	Sporobulus pyramidalis	3	2.90
Zone C	*Digitaria longiflora*	1	1.22
	Eragrostis ciliaris	3	5.98
	Digitaria horizontalis	1	0.17
	Sporobulus pyramidalis	11	38.51
Zone D	*Andropogon gayanus*	12	13.71
	Imperata cylindrical	7	3.57
	Sporobulus pyramidalis	11	14.39
Zone E	*Digitaria ciliaris*	1	1.53
	Digitaria longifora	4	8.94
	Eleusine indica	23	18.09
	Eragrostis tenella	1	0.82
	Eragrostis tremula	1	0.03
Zone F	*Brachiaria falcifera*	1	2.1
	Echinochloa colona	3	3.13
	Imperata cylindrical	1	0.4
	Oryzea longistaminata	5	3.6
	Pennisetum polystachion	5	4.07
	Pennisetum violaccum	1	2.1
	Sporobulus pyramidalis	1	0.67
Zone G	*Chrysopogon aciculatus*	5	3.03
	Cynodon dactylon	4	2.77
	Digitaria ciliaris	4	3.27
	Eleusine indica	7	2.93
	Eragrostis ciliaris	3	1.83
	Oryzea longistaminata	2	6.87
	Sporobulus pyramidalis	1	0.67
Zone H	*Andropogon gayanus*	1	0.57
	Bambusa vulgaris	2	2.58
	Imperata cylindrical	1	0.4
	Panicum maximum	4	7.43
	Pennisetum polystachion	3	7.81
	Rottboellia cochinchinensis	2	2.99

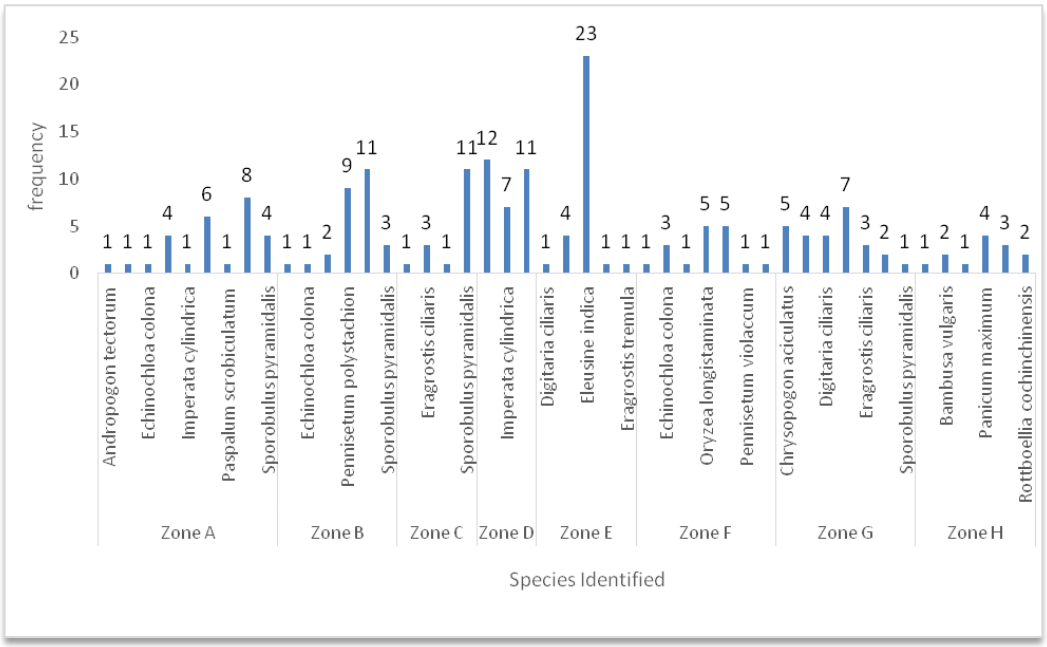

Fig. 1. A chart of species identified at different zones in the study area

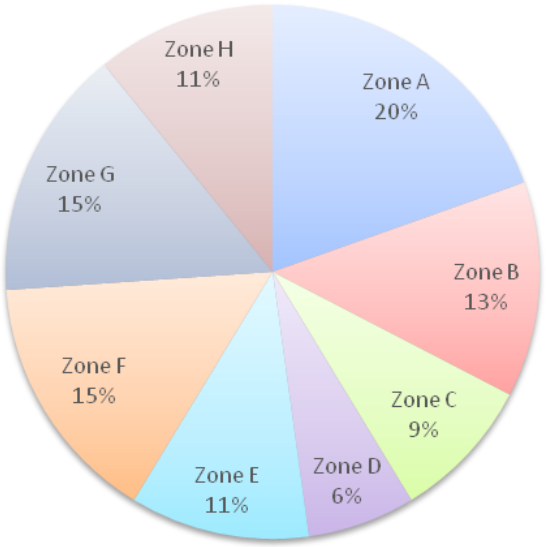

Fig. 2. A chart showing the percentage land coverage of each of the zone in the study area

3.2 Abundance and Diversity of Species in the Poaceae Family

The result of abundance of species in poaceae family was presented in Table 2. The result revealed that out of 24 species were identified. *Eleusine indica* had the highest frequency of 36 with relative abundance 19.4%, followed by *Sporobulus pyramidalis* (16%), *Pennisetum polystachion* (13.5%), *Andropogon gayanus* (8.1%), *Andropogon tectorum*, *Brachiaria falcifera*, *Dactyloctenium aegyptium*, *Digistaria horizontalis*, *Eragrostis tenella*, *Eragrostis tremela*, *Panicum maximum* and *Pennisetum violaccum* has the lowest relative abundance of 0.5 % each. The result of Shannon Wiener index for species in poaceae family in the study area was 2.59 (Equation 1).

$$H' = -\sum(P_i) \times \mathrm{Ln}(P_i)) = -(-2.59034) = 2.59034 \quad (1)$$

Table 2. Species diversity of poaceae found in Nnamdi Azikiwe University, Awka

S/N	Species	Frequency	RA P_i	Ln(P_i)	$P_i \times Ln(P_i)$
1	*Andropogon gayanus*	14	0.075269	-2.58669	-0.1947
2	*Andropogon tectorum*	1	0.005376	-5.22575	-0.0281
3	*Bambusa vulgaris*	2	0.010753	-4.5326	-0.04874
4	*Brachiaria falcifera*	1	0.005376	-5.22575	-0.0281
5	*Chrysopogon aciculatus*	5	0.026882	-3.61631	-0.09721
6	*Cynodon dactylon*	4	0.021505	-3.83945	-0.08257
7	*Dactyloctenuim aegyptium*	1	0.005376	-5.22575	-0.0281
8	*Digitaria ciliaris*	5	0.026882	-3.61631	-0.09721
9	*Digitaria longifora*	5	0.026882	-3.61631	-0.09721
10	*Echinochloa colona*	5	0.026882	-3.61631	-0.09721
11	*Eleusine indica*	36	0.193548	-1.64223	-0.31785
12	*Eragrostis ciliaris*	6	0.032258	-3.43399	-0.11077
13	*Digitaria horizontalis*	1	0.005376	-5.22575	-0.0281
14	*Eragrostis tenella*	1	0.005376	-5.22575	-0.0281
15	*Eragrostis tremula*	1	0.005376	-5.22575	-0.0281
16	*Imperata cylindrical*	10	0.053763	-2.92316	-0.15716
17	*Oryzea longistaminata*	7	0.037634	-3.27984	-0.12343
18	*Panicum maximum*	10	0.053763	-2.92316	-0.15716
19	*Paspalum scrobiculatum*	1	0.005376	-5.22575	-0.0281
20	*Pennisetum polystachion*	25	0.134409	-2.00687	-0.26974
21	*Pennisetum violaccum*	1	0.005376	-5.22575	-0.0281
22	*Rottboellia cochinchinensis*	2	0.010753	-4.5326	-0.04874
23	*Schizachyrium exile Pilger*	11	0.05914	-2.82785	-0.16724
24	*Sporobulus pyramidalis*	31	0.166667	-1.79176	-0.29863
	Total	**186**	**1**		**-2.59034**

4. DISCUSSION

In this study, a total number of 24 species were identified in the eight (8) zones used in the study area. This result is higher than the 22 species of poaceae family reported by Oni and Ndiribe but lower than a total of 81 species of the family Poaceae reported by Sagar et al. [12] in their study on the weeds of the family poaceae to determine species diversity of grasses growing throughout the Bangladesh Agricultural University campus; of course the discrepancy may be as a result of difference in land area used for the studies. This could also be as a result of their ecological flexibility, resilience to disturbance, long distance seed dispersal and capacity to grow in environments with limited soil moisture [13,10].

Generally, *Eleusine indica* is more abundant across the eight zones in the area of study, having a total frequency of 36 while *Sporobulus pyramidalis* is the second most abundant with a frequency of 35 and *Pennisetum polystachion* is the third most abundant with a frequency of 25; this conforms with the findings of Sagar et al. [12] who reported that *Digitaria*, *Eragrostis*, *Brachiaria*, *Panicum*, *Echinochloa* and *Sporobolus* species were most dominant in context to number of species with a total of 29 species. *Eleusine indica* had the highest relative abundance of 19.4% in this study and this agrees with the report of Nodza et al. [14] who reported that *Eleusine indica* had the highest relative frequency (16.26%) and widely distributed in all their studied plots.

This study revealed a composition of species of poaceae family that are similar to the ones reported by Rafay et al. [15], where *Eragrostis* sp. was the most dominant at 18.5 percent, followed by *Cenchrus* and *Aristida* sp. at 14.8 percent each, while *Panicum* sp was at 7.4 percent. There were 24 species of grasses of poaceace family found within the study area and *Pennisetum polystachion, Sporobulus pyramidalis, Andropogon gayanus and Eleusine indica* which are from the subfamily Panicoideae, Sporoboleae, Andropogoneae, and Eragrostideae respectively is more abundant in all the 8 zones of the study area. The result of Shannon Wienner index (2.59) in this study showed that there is high diversity of species of poaceae family in the study area and this is a great potential which is to be utilized for conservative and ecological purposes rather than

attendant clearing and destruction of these plants [16]. The high value for the Shannon Weinner Index may also be indicative of the healthy and thriving plant community in the study area [17]. This agrees with the study of Khan et al. [18] who reported that poaceae is a very diverse grass family with great economic importance. Sanyaolu [19] also recorded large population of poaceae family in disturbed areas within the Lagos state polytechnic Ikorodu campus. According to Sagar et al. [12] a good number of these weeds have various economic, ethnomedicinal and other uses. Many of them are good fodder, soil binder, used as lawn and turf grass and have high medicinal value.

In the area where this study was carried out, there has been very high anthropogenic activities which has consequently mounted pressure on the floral community and may bring about an alteration in the ecological structure and composition of the area and this is detrimental to the well being of the environment [17]. The study also buttressed the fact that there are few groups of plants that contest the importance of grasses from an ecological and evolutionary viewpoint. This relates with the findings of Nodza et al. [14] that sand filling for urbanization was observed to be the major threat facing the herbaceous and grass species growing in their study area which has consequently led to a decrease in the diversity of herbs and grasses within the study area.

5. CONCLUSION

It can be concluded from this study that the species of family poaceae is a dominant plant family in Awka campus of Nnamdi Azikiwe University. It was also observed that clearing of bushes for construction of buildings and roads as well as bush burning for farming are an increasing threat to the existence of these plant species in the study area and as such, could lead to possible decline in the number of species of poaceae in the study area; hence, there should be some level of conservation measures to protect the biodiversity of these grasses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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