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Species Richness and Evenness of Weeds found in selected Hospital Dumpsites in Port Harcourt

Chuku, O.S.[1], Amadi, N.[2] and Chukwuemeka, T.C.[3]
[1,2,3] Department of Plant Science and Biotechnology.
Email: *solomon.chuku@ust.edu.ng, noble.amadi1@ust.edu.ng*

Abstract

Species diversity is crucial for ecosystem stability, resilience and function, as diverse ecosystems are generally better at withstanding environmental changes and supporting a wide range of ecosystem services. The aim of this study was to examine the specie richness and specie evenness of weeds found in hospital dumpsites in Port Harcourt. The hospital dumpsites used for this study were; Station 1(University of Port Harcourt Teaching Hospital dump site), Station 2 (Rivers State University Medical Centre dump site), and Station 3 (Uniport, Choba as control). The research involved analysing species count, diversity indices, and statistical comparisons to understand the distribution and abundance of plant species in each station. The result showed that station 3 emerged as the most diverse (4626 species) , with the highest specie richness, evenness and the lowest dominance , indicating a well-balanced and resilient ecosystem. In contrast, station 1 exhibited the lowest species diversity (225 species), suggesting significant ecological stress likely due to environmental degradation or anthropogenic activities. Station 2 displayed intermediate species diversity as compared to the other two stations (2483 species), indicating a transitional ecosystem with moderate biodiversity. Statistical analysis confirmed significant differences in diversity between the stations, particularly highlighting the superior ecological condition of station 3 as compared to stations 1 and 2. The findings emphasize the need for targeted conservation efforts, including the protection of station 3, restoration of station 1 and careful management of station 2 to enhance and preserve biodiversity.

Keywords: Species diversity, hospital dumpsites, diversity indices, and statistical comparisons

Introduction

Species richness refers to the number of different species present in a particular area or ecosystem. It is a key component of biodiversity and is often used as a measure to assess the health and complexity of ecosystems (Chao & Chiu 2016). High species richness indicates a diverse ecosystem with many different kinds of organisms, which can contribute to greater resilience and stability. Wilson, Peet, Dengler and Pärtel, (2012), defined species richness as the count, or total number, of unique species within a given biological community, ecosystem, biome, or other defined area. While species richness does not consider the population sizes of individual species in the area or how even the distribution of each species is, it is an important, simple, component of biodiversity. Species richness is often used to compare the biodiversity of different biological communities, compare the number of species within a particular taxonomic grouping at different locations, and monitor changes in a particular biological community over time (Nielsen, Van, Maruthaveeran & Bosch, 2014). In general, species richness increases with proximity to the Equator and decreases from the Equator to the poles. This pattern occurs across a range of scales.

Species evenness is a measure of the relative abundance of the different species within a given area. Species evenness describes the commonness or rarity of a species; it requires knowing the abundance of each species relative to those of the other species within the community (Mulder, *et al.,* 2014). Abundance values can be difficult to obtain. Area-based counts, distance methods, and mark–recapture studies are the three general categories of methods for estimating abundance. Species evenness is highest when all species in a sample have the same abundance. Specie evenness quantifies the relative distribution of individuals among species within the community (Wilsey & Potvin, 2020). High species evenness indicates that each species in the community has a similar abundance, while low species evenness means that a few species dominate the community in terms of abundance.

The study of weed species richness and evenness in hospital dump sites is a critical area of research in urban ecology and environmental science. Hospital dump sites, often overlooked in environmental studies, can serve as unique ecosystems where various plant species, particularly weeds, thrive. These sites are characterized by disturbed soils, high levels of organic waste, and varying microclimatic conditions, all of which contribute to the establishment and proliferation of diverse weed communities.

Materials and Methods

Study Area

The sampling area, was two sampling sites and one control site which is; University of Port Harcourt Teaching Hospital Dump Site (4.89626°N, 6. 93070˚E), Rivers State University Medical Centre Dump Site (4. 796499˚N, 6. 976584) and then for the control site, University of Port Harcourt Choba (4. 89853˚N, 6. 91663˚E). These geographical co-ordinates is located in Niger Delta area. This areas experiences two distinct seasons. The dry season and rainy season which span from November to March and April to October respectively. The climatic condition of the area is characterized by a temperature range of 36˚C to 45˚C.

Sampling Method

A systematic sampling method was adopted, a transect line was laid across a mapped out area of 20m by 20m and a quadrant of 1m by 1m was placed on the marked point. Sampling was done at 1m interval all the way down the line given a total of 10 quadrat at each site. The dominant plant species were characterized (station 1, station 2, station 3) by counting and identifying using handbook of West African Weed (IITA) to obtain phytosociological data.

Vegetation Analysis

Parameters such as specie composition, specie richness, specie population, species diversity and specie evenness were observed and calculated.

Determination of Specie Composition and Type

Plant species within the sample plot were observed, photographed, collected and taken to plant herbarium for identification.

Specie Richness

Specie richness data were collected on the sample site (Station 1, station 2, station 3). Specie richness data was obtained by taxonomical identification of the different species found in different stations by physical count. Specie richness was determined by using margalef index is expressed as $\frac{s-1}{natural\ log_n}$ while the specie diversity was obtained by using the method of Mehinicks which is mathematically expressed as $\frac{S}{\sqrt{n}}$ (S – Specie richness, n – number of species)

Data Analysis

The data generated was subjected to ecological statistical analysis using PAST 4.03 while further validation of significant difference between stations were estimated using Hutchinson.

Results

Specie Count across Three Stations

The table below represent the specie count from three different locations in Port Harcourt. The locations is Station 1 (University of Port Harcourt Teaching Hospital (UPTH)), Station 2 (Rivers State University Medical Centre (RSU)) and control. A total of 16 species was recorded. Some species, like *Panicum maximum, Eleusine indica,* and *Kyllinga erecta*, have particularly high counts in Station 2 and Station 3 compared to Station 1. Station 1 (UPTH) generally has lower count across most species. For example, *Panicum maximum* has only 17 individuals here, while it has 357 and 662 individuals in Stations 2 and 3, respectively. Station 2 (RSU) often has significantly higher counts, e.g., *Eleusine indica* with 322 individuals. Station 3 (Control) shows even higher numbers for many species, e.g., *Panicum maximum* and *Kyllinga erecta*.

Specie Count across Three Stations

S/N	SPECIES	STATION 1	STATION 2	STATION 3
1	*Luffa aegyptiaca*	24	23	34
2	*Commelina erecta*	39	56	33
3	*Alternanthera sessillis*	28	33	345
4	*Panicum maximum*	17	357	662
5	*Eleusine indica*	3	322	324
6	*Spilanthes filicaulis*	17	77	300
7	*Ipomoea sp*	15	89	218
8	*Chromolena sp*	34	0	22
9	*Cyperus difformis*	-	190	113
10	*Tridax procumbens*	34	256	131
11	*Kyllinga erecta*	-	229	567
12	*Kyllinga difformis*	3	342	332
13	*Azadriacta indica*	2	15	213
14	*Nelsonia canescens*	-	38	432
15	*Portulaca oleracea*	5	100	566
16	*Euphorbia hirta*	4	356	334

Species Diversity across Stations

The table below presents diversity indices such as Taxa_S, Dominance_D, Simpson_1-D, Shannon_H, Evenness_e^H/S, and others for each station.Station 1 has the lowest richness with 13 species, while Station 3 has the highest with 16 species.Station 2 is intermediate with 15 species.Station 1 has 225 individuals; Station 2 has 2483 individuals and Station 3 has 4626 individuals. Station 1 shows the highest dominance (0.1197), while Station 3 has the lowest (0.0901), indicating a more evenly distributed species composition in Station 3.Station 3 has the highest Shannon index (2.524), reflecting the greatest species diversity.Station 1 has the lowest (2.257), indicating lower diversity.Station 3 shows the highest evenness (0.78), meaning individuals are more evenly spread across species.Station 1 has a lower evenness score (0.7351), suggesting some species are more dominant than others.

Species Diversity

	STATION 1	STATION 2	STATION 3
Taxa_S	13	15	16
Individuals	225	2483	4626
Dominance_D	0.1197	0.1069	0.0901
Simpson_1-D	0.8803	0.8931	0.9099
Shannon_H	2.257	2.384	2.524
Evenness_e^H/S	0.7351	0.7229	0.78
Brillouin	2.149	2.366	2.513
Menhinick	0.8667	0.301	0.2352
Margalef	2.216	1.791	1.777
Equitability_J	0.88	0.8802	0.9104
Fisher_alpha	3.002	2.123	2.075
Berger-Parker	0.1733	0.1438	0.1431

The information above is represented on a graph as shown in figure 1 below

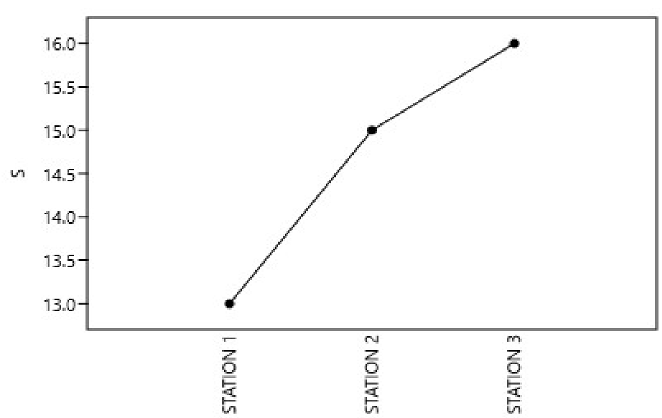

Figure 1: Graph of Specie Diversity

Shannon Index

The table below shows the results from Hutcheson t-tests comparing the Shannon index between stations.The t-value of 1.9171 and a p-value of 0.056339 suggest that the difference in diversity between Station 1 and Station 3 is significant at $p < 0.001$.The t-value of 8.3815 and an extremely low p-value (6.9201E-17) indicate a highly significant difference between Station 2 and Station 3.

Shannon index between stations 1 and 3

	STATION 1		STATION 3
D:	0.11968	D:	0.10692
Variance:	4.146E-05	Variance:	2.8811E-06
t:	1.9171,	df: 257.25,	p(same): 0.056339

Hutcheson t test provides method of calculating t to test for significant difference between stations Conclusion t (1.9171) > 0.11. Therefore, the diversity of plant species in station 1 is significantly at $p < 0.001$ as compared to station 3.

Shannon index between stations 2 and 3

	STATION 2		STATION 3
Simpson index			
D:	0.10692	D:	0.090096
Variance:	2.8811E-06	Variance:	1.1472E-06
t:	8.3815		
df:	4473.4		
p(same):	6.9201E-17		

Hutcheson t test provides method of calculating t to test for significant difference between stations Conclusion t (8.381) > 0.106. Therefore, the diversity of plant species in station 2 is significantly at $p < 0.001$ as compared to station 3.

Discussion

Magurran, (2004) gave a report about specie evenness as being one of the simples and most commonly used metrics for assessing biodiversity in the plant community. However, anthropogenic activities such as dumping of wastes improperly and undesignated areas inadvertently alter that normal composition of specie richness and evenness in any plant community by altering their normal germination and subsequent growth (Smith *et al.,* 2006). In furtherance to that, the garbage accumulation and local population exposure create discomforts and affect the population health (Maiti, 2004; Ouedraogo, 2010).

In general, A total of 16 different weed species were identified from the three study stations which includes native species like *Eleusine indica, panicum maximum, chromolena spp, cyperms difformis, kyllinga erecta, kyllinga difformis, Azadiracta Indica* which were all found in significant amount in the study locations, their abundance might be as a result of their hyperaccumative and phytoremediative capabilities (Shuhe *et al.,* 2007).

Station 1 (UPTH hospital site) had a total of 225 plant species while station 2 (Rivers State University medical centre) has a total of 2, 483 plant while the station 3 (Uniport, Choba) being the control site recorded the highest number of weed species in all the species recorded with a total of 4, 626 weed species. This is in line with the report of Dedeke and Akinolade (2014) who reported an increased number of seed emergence in control when compared to polluted or contaminated sites. It was observed that the control site recorded the highest abundance of native weed species as compared to the station 1 and 2 respectively.

Station 1 recorded the least number of plant species which might have been as a result of the regular disposal of Hospital wastes at very large quantities owing to the regular inflow of patients in the University of Port Harcourt Teaching Hospital.

This high volume of patients gives rise to the utilization of a high volume of hospital equipment's, facilities and materials for the regular treatments of patients.

Station 2 was significantly higher in terms of plant species as compared to that of Station 1 which might have been as a result of some specific factors which includes, the environmental factors, limited or low medical supplies and low disposal rate. In addition, station one was identified as a Federal hospital and as such had higher influx of both patients and medical supplies as compared to that of station 1 which was a state owned Hospital situated in the university campus, solely for staff and students of the university.

Station 3 which served as the control had obviously larger numbers of species as compared to that of stations 1 and 2. This might be as a result of the fact that station 3 is an unpolluted or uncontaminated site which is therefore a safe haven for plant of weed species as it poses little or no threat to the native biodiversity. Hospital dumpsites releases heavy metals from their medical supplies and other hazardous chemicals and it adversely affects native vegetation which leads to bioaccumulation and biomagnification along the food chain.

The identified weed species are very common and native to this part of this world and they are commonly known for their hyperaccumulative potentials as previous and recent researches has proved to be true. Many of these weed species have shown heavy metal tolerance and phytoaccumulation abilities (Messon, 2013) for cadmium, lead, zinc, iron etc. Prasad (2001) for cadmium, zinc, lead, capper and iron; Abe, (2001) for cadmium, etc.

The highest number of weed species collected in the 3 station recorded highest in station 3 (control site) at 4,626 plant species which might be as a result of the fact that the land is unpolluted and undisturbed. This is in accordance with (Li, Y. 2017), where he observed that an abandoned and undisturbed land had higher specie richness and evenness as compared to a farmland, polluted area or contaminated area.

Shannon index is related to the weighted geometric mean of the proportional abundance of the types.

The results from Shannon index shows a significant difference amongst the three stations. There was a progression from station 1 up to station 3 which might be as a result of the low amount of wastes observed in station 2 and the unpolluted or control site in station 3. This agrees with the report of (Li *et al.,* 2017).

Conclusion

This study provides a comprehensive analysis of plant species diversity across three different stations, revealing significant variations in ecological health and stability. The results show that Station 3 consistently supports the highest species richness, diversity, and evenness, indicating that it is the most balanced and resilient ecosystem among the three. The high species counts and favourable diversity indices suggest that Station 3 enjoys optimal environmental conditions, likely with minimal human disturbance, making it a benchmark for ecological health in the region.Station 1, on the other hand, exhibits the lowest species richness, higher dominance, and lower evenness, indicating significant ecological stress. The low diversity and high dominance by a few species suggest that Station 1 is experiencing adverse conditions, such as soil degradation, pollution, or high levels of human activities. These factors contribute to an imbalanced ecosystem where only a few species can thrive, reducing overall biodiversity and ecosystem stability.Station 2 appears to be an intermediate ecosystem, with diversity and species richness that are higher than Station 1 but lower than Station 3. This station might be experiencing moderate levels of disturbance or suboptimal environmental conditions, leading to its transitional status. While it is not as ecologically stressed as Station 1, it also does not achieve the high biodiversity seen in Station 3.Statistical analyses further confirm these observations, with significant differences in diversity between the stations, particularly between Stations 2 and 3, and between Stations 1 and 3. These results highlight the importance of environmental conditions in shaping plant species diversity and underscore the need for targeted conservation efforts.Station 3 represents an ecologically robust environment that should be preserved and possibly used as a model for restoration efforts in the other stations.

References

Abe, T., (2001). Plant response to heavy metal" *Molecular Mechanisms and Applications*.

Chao, A., & Chiu, C. H. (2016). Species richness: estimation and comparison. *Wiley StatsRef: statistics reference online*, *1*, 26.

Dedeke, G. A., & Akinolade A. O. (2014). "Impact of Industrial Pollution on plant diversity and seed germination.

Li, Y., (2017). Biodiversity and Ecosystem Services in changing environments.

Magurran, A.E. (2004). Measuring Biological Diversity. Blackwell Publishing, Oxford, 256.

Maiti S. K., (2004). "*Environmental Health and Population Control*".

Messon, J. N., (2013). "*Phytoremediation of heavy metal polluted soils and wetland*.

Mulder, C. P., BazeleyW. E., Dimitrakopoulos, P. G., Hector, A., SchererL. M., & Schmid, B. (2014). Species evenness and productivity in experimental plant communities. *Oikos*, *107*(1), 50-63.

Nielsen, A. B., Van Den Bosch, M., Maruthaveeran, S., & van den Bosch, C. K. (2014). Species richness in urban parks and its drivers: A review of empirical evidence. *Urban ecosystems*, *17*, 305-327.

Ouedraogo, A., (2010). *Urban Ecology and Health in Developing Countries*.

Prasad, M. N. V. (2001). "*Heavy Metal Stress in Plants*: from biomolecules to ecosystem.

Shuhe L., (2007) "*Phytoremediation of heavy metal-contaminated soils and ground water*".

Smith, R. E., Smith T. M., & Smith R. L., (2006). Environmental science: *A Study of Interrelationships.*

Stromberg, J. C. (2023). *Bringing Home the Wild: A Riparian Garden in a Southwest City*. University of Arizona Press.

Uetz, G. W., McClintock, W. J., Miller, D., Smith, E. I., & Cook, K. K. (2016). Limb regeneration and subsequent asymmetry in a male secondary sexual character influences sexual selection in wolf spiders. *Behavioral Ecology and Sociobiology*, *38*, 253-257.

Waide, R. B., Willig, M. R., Steiner, C. F., Mittelbach, G., Gough, L., Dodson, S. I., ... & Parmenter, R. (2019). The relationship between productivity and species richness. *Annual review of Ecology and Systematics*, *30*(1), 257-300.

Wilsey, B. J., & Potvin, C. (2020). Biodiversity and ecosystem functioning: importance of species evenness in an old field. *Ecology*, *81*(4), 887-892.

Wilson, J. B., Peet, R. K., Dengler, J., & Pärtel, M. (2012).Plant species richness: the world records. *Journal of vegetation Science*, *23*(4), 796-802.

Zimdahl, R. L., & Basinger, N. T. (2024). *Fundamentals of weed science*. Elsevier.

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