Research Article

Abundance and distribution of species in relation to soil properties in sedge-dominated habitats in Uyo Metropolis, Southern Nigeria

Mbong EO*, Osu SR, Uboh DG and Ekpo I

1Department of Environmental biology, Heritage Polytechnic, Ikot Udota-Eket, Nigeria
2Department of Biology, College of Education, Afaha Nsit, Nigeria
3Department of Environmental Biology, Akwa Ibom State Polytechnic, Ikot Osurua, Nigeria
4Department of Botany and Ecological Studies University of Uyo, Uyo, Nigeria

Abstract

A field research was conducted to assess abundance and distribution of species in relation to soil properties in Sedge-dominated Habitats in Uyo Metropolis, Southern Nigeria. Systematic sampling method was used. The result of the study revealed that a total of 12 plant species of which 3 were members of the family Cyperaceae were identified in the habitats studied. The Cyperaceae members found were of the genus Cyperus. Other associated species found were Sida acuta, Scoparia dulcis, Chromolaena odorata, Eleusine indica, Ludwigia decurrens etc. The highest density values obtained in this study is characteristic of Cyperus iria in Habitat 4 (9500 st/ha) while the least density value is characteristic of Plastostoma africanum in Habitat 2 (200 st/ha). Multivariate correlation and regression techniques evidenced that these differences in density of the sedges reflected the functions of various important soil properties such as pH, exchangeable Ca, soil moisture, total nitrogen and available phosphorus. Most specifically, the current result concludes that Cyperus iria showed strong affinity for alkaline soils rich in calcium while Cyperus dfformis and Cyperus rotundus showed strong preference for acid soils. Cyperus dfformis, Cyperus rotundus and Cyperus haspan flourished in soils rich in organic manure while Cyperus iria colonies were found to thrive on soils with limiting levels of phosphorus. This result lends knowledge and practical application in environmental management, weed science and habitat ecology.

Introduction

Cyperaceae is one large family amongst the Monocotyledons comprising up to 104 genera and about 5000 species [1]. Though most members of the Cyperaceae are considered serious weeds, they have a wide cosmopolitan distribution, with a dense concentration in the tropics. Despite this, relevant data on these plants are scanty going through literature and herbarium specimens [2]. The wide occurrence of these species enforces the need to intensify research efforts on the economic values and niche preferences of these individual belonging to taxonomically difficult but highly interesting plant family. Pedology is the scientific study of soil properties. Studies have revealed that most often than not, soil and vegetation is interlocked in a series of intricate relationships which can never be taken for granted. Superficially, it is known that while plants serve as protective coverings for soil and as anchorage against erosion and other physical agents of destruction, it is also major plant nutrient reservoir and home to several beneficial microbes. Hence, from the foregoing it worthy to note that vegetation cover affect the characteristics of soil including pH, nutrient concentrations, texture etc and vice versa. This phenomenon has led to varied impact on vegetation assemblages thus shaping its composition and structure [3,4].

Knowledge of the niche concept theory further applauds this idea that vegetation communities are inevitably mingle in a web of unique connections with incumbent abiotic factors.
in their environment leading to individualistic and communal responses from plants due to these influences [5,6]. In line with the foregoing, several erudite scholars have probed this notion supporting the nexus between the vegetation distribution and its soil environment in diverse natural and created ecosystems. Some of these include: [3], in Fresh water swamp forest [7] in vegetable (Gnetum sp.) farms [8], in mixed oak forest as well as Ogbemudia and Mbong [9], in some dumpsites.

The roles of these omnipresent soil variations govern the dynamics of plant communities both in terms of numeric abundance and floristic attributes [4,10]. These natural interactions may be especially important from micro to ultra-scales especially in this current era of plant resource conservation and in the wake of climate uncertainties. To this end, this study seeks to reveal knowledge on the influence of pedo-ecological properties on four common Cyperaceae plants found in our immediate environment. This may give birth to management clues useful for their conservation in our clime.

Materials and methods

Study area

This research was carried out in Uyo Local Government Area. It is the Capital city of Akwa Ibom State found within the South-South region of Nigeria. Uyo lies between longitude 37°50’E and 37°51’E and latitudes 55°40’N and 54°59’N. The Local Government Area covers a specific area of about 188.035km² with an estimated population of 3,920,208 and experiences an annual precipitation of approximately 1000mm (AKSG 2019).

Uyo is geographically bounded on the East by Uruan Local Government Area, on the west by Abak Local Government Area, Ikono, Ibiono Ibom and Itu Local Government Areas on the North as well as Nsit Ibom, Etinan and Ibesikpo Asutan Local Government Areas on its southern axis. This area is clearly describe in the map below (Figure 1).

Vegetation and soil sampling

Species were sampled in 10m x 10m quadrats, spaced at regular intervals of 20m according to the methods of Ubom (1996) and Greig-Smith [11]. In each quadrat, plants were enumerated and species were properly identified to the species level. Voucher specimens of unknown species were collected for proper identification at the Botany and Ecological Studies Departmental Herbarium, University of Uyo, Akwa Ibom State. Frequency of occurrence and density of the species encountered were estimated according to the methods of Ubom, et al. [3].

Also within each quadrat, two soil samples were obtained at the depths of 0-15 cm respectively which was later bulked to form a composite sample according to Mbong and Ogbemudia [12]. The soil samples were air-dried and preserved for laboratory analysis. Soil pH was determined using Hanna hand held pH meter. Available phosphorus, Exchangeable Ca and Organic matter were determined using standard methods [13].

Statistical analysis

Mean and standard error were computed from triplicate values obtained from the determination of soil physico-
chemical properties. Analysis of variance (ANOVA) and Fisher least significant different (LSD) test were employed to ascertain significant differences between the means of the physicochemical properties of the studied soils. Pearson’s correlation computed through SPSS was employed to ascertain the nature and strength of association existing between soil properties and density values of sedges in the study area according to the methods of Mbong, et al. [10]. In order to probe the influence of soil properties on the distribution of sedges, bivariate regression (logarithmic) was employed. Only sedges with moderate to high significant Carl Pearson association coefficient were adopted for this protocol Ubom [14].

**Result**

The distribution of sedges and associated species found in the study area is shown in Table 1. The table records a total of 12 plants unevenly distributed in four habitats. Habitat 1 recorded up to 5 species of which 1 is a sedge, Habitat 2 records two sedges and two associated species, Habitat 3 has three species of which only includes one sedge and then Habitat 4 which has 8 species (out of which 3 sedges were present). The highest plant density obtained in this study was characteristic of Habitat 4 (9500 stands ha⁻¹ obtained for *Cyperus iria*) while the least density was the characteristic of Habitat 2 (200 stands ha⁻¹ recorded for *Plastostoma africanum*) Table 2.

Table 3 shows the mean physicochemical properties of the soils of sedge dominated habitats in Uyo. The soil pH was highest in Habitat 1 (6.62±0.095) but least in habitat 4 (4.95±0.14). Conversely, soil organic matter was highest in habitat 3 (2.95 ±0.15) but least in habitat 3 (2.52±0.20). Also, available phosphorus was highest in habitat 3 (33.92±3.28) but was least in habitat 1 (19.94±0.13). Also, a higher value of 19.01±0.11 recorded for soil exchangeable Ca in habitat 1 whereas a lower value of 8.85±0.05 was recorded in habitat 3. Soil moisture content was highest in habitat 1 (46.71±2.51) but least in habitat 2 (38.96±6.42).

The correlation matrix (Table 4) revealed high significant correlation coefficients between soil properties and density of sedges in the studied location. The matrix shows that Available phosphorus correlated negatively and significantly with soil exchangeable Ca (-0.979*) whereas on the contrary, soil moisture content correlated positively and significantly with exchangeable Ca (0.971*). Also, *Cyperus iria* correlated positively and significantly with the soil pH (0.985*) while *Cyperus difformis* correlated positively and significantly with *Cyperus rotundus* (0.999**). The regression of soil properties on the individual sedges yielded predictive equations with statistically high levels of accuracy. *Cyperus iria* was sensitive to soil pH, Available phosphorus and Exchangeable Calcium. On the other hand *Cyperus difformis* and rotundus were sensitive to soil pH and organic matter while *Cyperus haspan* exclusively sensitive to soil organic matter (Table 5).

**Discussion**

The vegetation physiognomy of the study area shows a total of four sedges with other associated species. This occurrence agrees with the principles of Mbong et. al. [12], that plant do not grow in isolation and that different species growing together in the same habitat under similar environmental conditions will differ in their tolerance or response to environmental gradient. This justifies the variability recorded in the patchy occurrence and density of the species encountered. This was noted by earlier researchers [15].The numeric gaps as judged from the density values of the Cyperaceae species and other plants underscores the variability in species response to the soil

---

**Table 1:** The geographical coordinates for sedge habitats.

| Habitat | Longitude | Latitude |
|---------|-----------|----------|
| 1       | 7° 56' 31.40" | 4° 59' 25.84" |
| 2       | 7° 56' 32.06" | 4° 59' 25.89" |
| 3       | 7° 56' 31.34" | 4° 59' 26.42" |
| 4       | 7° 56' 31.38" | 4° 59' 28.47" |

---

**Table 2:** Plant distribution in the study area.

| Habitat/Species | Family         | Density(stha⁻¹) |
|-----------------|----------------|-----------------|
| Habitat 1       |                |                 |
| Mitrocarpus villosus | Rubiaceae | 600             |
| Chromolaena odorata | Asteraceae | 400             |
| Sida acuta      | Malvaceae     | 400             |
| Centrosema pubescens | Leguminosae | 300             |
| Cyperus haspan  | Cyperaceae    | 2500            |
| Habitat 2       |                |                 |
| Cyperus haspan  | Cyperaceae    | 4000            |
| Scoparia dulcis | Scoparaceae   | 800             |
| Cyperus iria    | Cyperaceae    | 3000            |
| Plastostoma sp. | Rubiaceae     | 200             |
| Habitat 3       |                |                 |
| Cyperus iria    | Cyperaceae    | 2100            |
| Bidens pilosa   | Asteraceae    | 400             |
| Sida acuta      | Malvaceae     | 400             |
| Habitat 4       |                |                 |
| Cyperus iria    | Cyperaceae    | 9500            |
| Cyperus difformis | Cyperaceae | 3000            |
| Scoparia dulcis | Scoparaceae   | 1500            |
| Cyperus rotundus | Cyperaceae | 4000            |
| Mitrocarpus villosus | Rubiaceae | 1700            |
| Ludwigia decurens | Onagraceae | 3000            |
| Sida acuta      | Malvaceae     | 900             |
| Eleusine indica | Gramineae     | 400             |

---

**Table 3:** Soil Physical and Chemical Properties of Sedge Habitats.

| Habitat | pH          | Organic Matter (%) | Av. P. (mg/kg) | Ex. Ca (cmol/kg) | Soil Moisture (%) |
|---------|-------------|--------------------|---------------|-----------------|------------------|
| Habitat 1 | 6.62±0.095 | 2.54±0.06          | 19.94±0.13    | 19.01±0.11      | 46.71±2.51       |
| Habitat 2 | 6.51±0.10  | 2.87±0.01          | 31.2±1.40     | 9.05±0.15       | 38.96±6.42       |
| Habitat 3 | 5.25±0.01  | 2.52±0.20          | 33.92±3.28    | 8.85±0.05       | 40.13±9.81       |
| Habitat 4 | 4.95±0.14  | 2.95±0.15          | 30.50±1.37    | 11.75±0.15      | 42.77±6.23       |

---

Citation: Mbong ED, Osu SR, Uboh DG, Ekpo I (2020) Abundance and distribution of species in relation to soil properties in sedge-dominated habitats in Uyo Metropolis, Southern Nigeria. Glob J Ecol 5(1): 024-029. DOI: https://dx.doi.org/10.17352/gje.000015
properties such as pH, calcium, organic matter soil moisture regimes and available phosphorus in the four habitats. It is believed that the dominance rate of members of Cyperaceae weeds particularly those Cyperus iria, Cyperus haspan, Cyperus difformis and Cyperus rotundus is related with the fact that these soils have substantial and reasonable moisture content in them. This aligns with the soil moisture values recorded in these results and tangles with Akobundu and Agyakwa [16] opinion that sedges flourish in soils with moderate to high moisture regimes because they have ability to adapt to such situations. This trend may be practically explained in that their seeds are produced in large quantities (litter) giving rise to soil organic matter which on deposition is witnessed continuous decomposition of dead plant materials (litter) giving rise to soil organic matter which on deposition is seen constant associated with the addition of reasonable amounts of organic acids to the soil which explains that high density of this plant were observed in sites with low available phosphorus. In line with this much needed macro nutrient is necessary to maintain its activity and continuous competition for scarce environmental resources.

Table 4: Soil-vegetation correlation matrix of Sedge-dominated Habitats in Uyo.

| Soil property | pH | Org. Matt. | Av. P | Ex. Ca. | Moisture | C. iria | C. haspan | C. difformis | C. rotundus |
|---------------|----|------------|-------|---------|----------|--------|----------|-------------|------------|
| pH            | 1  |            |       |         |          |        |          |             |            |
| Org. Matt.    | -2.22 | 1          |       |         |          |        |          |             |            |
| Av. P         | -6.23 | 3.23       | 1     |         |          |        |          |             |            |
| Ex. Ca        | 0.457 | -3.58      | -9.79’| 1       |          |        |          |             |            |
| Moisture      | 0.233 | -3.29      | -9.05 | 0.971’  | 1        |        |          |             |            |
| C. iria       | 0.985’ | -0.53     | -0.592 | 0.418  | 0.195    | 1      |          |             |            |
| C. haspan     | -3.352 | 0.664    | -2.12 | 0.291   | 0.415    | -0.235 | 1        |             |            |
| C. difformis  | -6.87 | 0.691      | 0.175 | -0.058  | 0.122    | -0.577 | 0.913    | 1           |            |
| C. rotundus   | -6.87 | 0.691      | 0.175 | -0.058  | 0.122    | -0.577 | 0.913    | 0.999**     | 1          |

Note: * = significant at 0.05; **= significant at 0.01; Av. P = available phosphorus; Ex. Ca = exchangeable calcium; Org. matt = organic matter

Agrawal [18] noted that density estimates give information on the degree of competition in within a particular habitat. This is evident in this study in that, there is a visible but short-ranged variation in the numerical strength of species such as Centrosema pubesens, Bidens pilosa, Sida acuta, Plastotoma sp., Chromolaena odorata and Eleusine indica which is an indication of a fierce and continuous competition for scarce environmental resources.

The suitability of correlation analysis in ascertaining the nature and strength of relationships existing between pairs of variables and the role of regression analyses in predicting the influence of associated variables on each other as found in this research is well documented by previous researchers [3,14,19,20]. Currently the high significant correlation coefficient obtained between C. difformis and C rotundus in the matrix cannot be ignored because it hints that both sedges share similar soil nutrient preferences. Also, the matrix indicated that Cyperus iria showed strong affinity for alkaline soils while Cyperus difformis and Cyperus rotundus showed high preference for acidic soils with increased organic matter content. This pattern of relationship exhibited by Cyperus difformis and Cyperus rotundus reflects that habitats dominated by them witnessed continuous decomposition of dead plant materials (litter) giving rise to soil organic matter which on deposition is constantly associated with the addition of reasonable amounts of organic acids to the soil which keeps reducing the amount of calcium in the habitats. This is in tandem with Stevenson [21].

Specifically, Cyperus iria showed negative moderate association with the amounts of available phosphorus in the soil which explains that high density of this plant were observed in sites with low available phosphorus. In line with this trend, the regression model bears a negative slope. This is not unmatched. Here the relationship is understood in that this fast growing sedge persistently keeps drawing reasonable amounts of phosphorus from the soil stock, leaving room for deficits with little or slow compensative replacement since this much needed macro nutrient is necessary to maintain its existing colonies and facilitate the establishment of new ones. On a general note, phosphorus is required by plants for the synthesis of ATP, constitution of plant nucleic structure and in the maintenance of plant health and vigor from seedling stage to maturity [18].

Citation: Mbong EO, Osu SR, Uboh DG, Ekpo I (2020) Abundance and distribution of species in relation to soil properties in sedge-dominated habitats in Uyo Metropolis, Southern Nigeria. Glob J Ecol 5(1): 024-029. DOI: https://dx.doi.org/10.17352/gje.000015
Positive correlates and slope values obtained in the matrix and in the models respectively between sedges (Cyperus difformis, Cyperus rotundus and Cyperus haspan) and soil organic matter reflect that these plants flourished in sites with high organic matter content. The role of organic matter as an essential source of nitrogen in soils can never be undermined (Mbong, 2013). The continuous presence of moisture in the soil facilitates microbial activities enhancing the decay and decomposition of dead plant materials giving rise to a regular supply of nitrogen to the plants in the study area. Nitrogen is not only necessary for plant growth but is also necessary for the synthesis of chlorophyll [22].

Notable are the negative slopes obtained in the regression equation explaining the distribution of C. difformis and C. rotundus in relation to soil pH. This trend summarize that these two sedges thrive on acidic soils. In simple terms, high density of C. difformis and C. rotundus were recorded on sites with low pH. On the contrary, the regression model relating C. iria with soil pH and exchangeable Ca both carry positive slopes which bear evidence that C. iria bloom is favored with an increasing pH. This not novel but in this account it authenticates the fact that increased calcium concentration in these sites foster enhanced values of soil pH and this observation tallies with Gould and Harper [23–26], view that these enhance pH increases the increased calcium concentration in these sites foster enhanced pH and exchangeable Ca both carry positive slopes which bear evidence that C. iria bloom is favored with an increasing pH. Again, the increased pH facilitates microbial decomposition of plant debris giving rise to rapid nitrogen release into the soil.

Conclusion

This research concluded that, the study area is endowed with a total of 13 plant species of which 4 were members of the family Cyperaceae. The Cyperaceae members mostly found were mostly of the genera: Cyperus. Other associated species found were Sida acuta, Scoparia dulcis, Chromolaena odorata, Eleusine indica, Ludwigia decurrens etc. These species are unevenly distributed in the four habitats. The differences in their distribution have been explained as a function of variations in soil properties such as pH, moisture content, organic matter, exchangeable Ca and available phosphorus. The interactions existing between plant species with soil properties thus indicate their importance in this ecosystem. The information obtained from this study could be useful in the management and conservation of lawns and (or) other sedge-dominated habitats.

References

1. Goerghebear P (1998) Cyperaceae. In: Kubitzi K, Huber H, Rudall PJ, Stevens PS, Stu tzel T. eds. The families and genera of vascular plants. Berlin: Springer-Verlag 141-190.
2. Diels L (2007) Vegetation der Erde VII. Die Pflanzengewelt von West-Australien su dilch desWendekreises. Leipzig W. Engellmann. [Translated to English by BJ Grieve, BB Lamont, EO Hellmuth and republished in Conservation Science Western Australia 6: 1-373.
3. Ubom RM, Ogbumudia FO, Benson KO (2012) Soil vegetation relationship in fresh water swamp forest. Scientific Journal of Biological Sciences 1: 43-51. Link: https://bit.ly/2X1RYuG
4. Mbong EO, Ogbumudia FO, Samuel EM (2020) Tree Species Diversity and Dominance in relation to Soil properties in University ofuyo Arboretum. International Journal of Plant Animal and Environmental Sciences 10: 135-142.
5. Medinski TV, Mills AJ, Esler KJ, Schmiedel U, Jürgens N (2010) Do soil properties constrain species richness? Insights from boundary line analysis across several biomes in south western Africa. Journal of Arid Environments 74: 1052-1060. Link: https://bit.ly/2IPBev
6. van der Putten WH, Bardgett RD, Bever JD, Bezemer TM, Casper BB, et al. (2013) Plant-soil feedbacks: The past, the present and future challenges. Journal of Ecology 101: 265-276. Link: https://bit.ly/2BAaK5
7. Mbong EO, Ogbumudia FO, Essang Q (2014) Biometric Edaphological assessments relating the effects of soil properties on the synthesis of essential molecules in Nigerian Gnetum species. International Journal of Research 1: 1968-1976. Link: https://bit.ly/3hik9qw
8. Rodriguez-Loinaz G, Ona ndia M, Amezaga I, Mijangos I, Garbisu C (2008) Relationship between plant Diversity and Soil functional Diversity in Native Mixed Oak Forest. Soil Biology and Biochemistry 40: 49-60. Link: https://bit.ly/39CiaMT
9. Mbong EO, Akpan EE, Osu SR (2014) Soil-plant heavy metal relations and transfer factor index of habitats densely distributed with Citrus reticulata (tangerine). J Res Environ Sci Toxicol 3: 61-65. Link: https://bit.ly/3g1HZNA
10. Beringer J, Chapin FS, Thompson CC, McGuire AD (2005) Surface energy exchanges along a tundra-forest transition and feedbacks to climate. Agricultural and Forest Meteorology 131: 143-161. Link: https://bit.ly/2X4dcht
11. Greig-Smith P (2010) Quantitative Plant Ecology. Blackwell Scientific, Oxford Press.
12. Ogbumudia FO, Mbong EO (2013) Studies on Some Pedological Indices, Nutrient Flux Pattern and Plant Distribution in Metropolitan Dumpsites in Uyo, Akwa Ibom State. Indian J Pharm Biol Res 1: 40-45. Link: https://bit.ly/2X4dcht
13. MAPA (1994) Metodos Oficiales de Analisis de Suelos y Aguas para Riego. In: Ministerio de Agricultura, Pesca y Alimentacion (Ed.), Metodos Oficiales de Analisis 3.
14. Ubom RM (2004) Biometry. Uyo: Abaa Publishers 12-58.
15. Akobundu IO, Agyakwa CW (1998) A handbook of West African Weeds. 2nd ed. Ibadan, Nigeria: IITA 212-231. Link: https://bit.ly/3hH8Dvx
16. Anwana ED, Ila RE, Mbong EO (2019) The distribution of Cyrtosperma Senegalense (Schott) Engl. in a seasonal wetland in Akwa Ibom State. Tropical Western Forest Biology 27: 1-11. Link: https://bit.ly/3kJEMjp
17. Sculthorpe CD (1971) The Biology of Aquatic Vascular Plants, Edward Arnold Ltd. London 601. Link: https://bit.ly/2P1B9GH
18. Verma PS, Agarwal VK (2007) Cell biology, Genetics, molecular Biology, Evolution and Ecology. Schand Company Ltd, New Delhi, 790.
19. Ubom RM (2006) Soil Properties Influencing the abundance and distribution of Isoberlinia Woodlands in Nigeria. International Journal of Soil Science 1: 207-217. Link: https://bit.ly/3hCE6yU
20. Sokal RR, Rohlf FJ (2008) Introduction to biostatistics second edition State University of New York at Stony Brook. Dover Publications, Inc. Mineola, New York 268-270.
21. Stevenson FJ (1991) Organic matter micro-nutrient reaction in the soil. In: Mortuedt JJ, Cox FR, Shuamm LM, Welch RM (eds) micronutrients in agriculture. Madison: SSSA 145-186. Link: https://bit.ly/306GIPC

Citation: Mbong EO, Osu SR, Uboh DG, Ekpo I (2020) Abundance and distribution of species in relation to soil properties in sedge-dominated habitats in Uyo Metropolis, Southern Nigeria. Glob J Ecol 5(1): 024-029. DOI: https://dx.doi.org/10.17352/gje.000015
Citation: Mbong EO, Osu SR, Uboh DG, Ekpo I (2020) Abundance and distribution of species in relation to soil properties in sedge-dominated habitats in Uyo Metropolis, Southern Nigeria. Glob J Ecol 5(1): 024-029. DOI: https://dx.doi.org/10.17352/gje.000015

22. Pandey BP, Sinha SK (2007) Economic Botany. Sixth ed., New Delhi: S Chand and Company Ltd 198-338.

23. Gould WA, Walker MD (1999) Plant community and landscape diversity along a Canadian Arctic river. Journal of Vegetation Science 10: 537-548. Link: https://bit.ly/303kAFW

24. Adepetu JA, Obi OA, Amasan AA (1984) Soil Science Laboratory Manual 2nd ed. Department of Soil Science, University of Ife, Ile-Ife. Nigeria 205.

25. Clarke KR, Warwick RM (2001) Changes in Marine Communities: An Approach to Statistical Analysis and Interpretation. 2nd edition, Primer E: Plymouth 223-256. Link: https://bit.ly/302kZJw

26. Ramlingam RS (2003) Modern Biology for Senior Secondary Schools. Tyndall Publishers, Ibadan 167-198.

Discover a bigger Impact and Visibility of your article publication with Peertechz Publications

Highlight:
- Signatory publisher of ORCID
- Signatory Publisher of DORA (San Francisco Declaration on Research Assessment)
- Articles archived in worlds’ renowned service providers such as Portico, CNKI, AGRISS, TDNet, Base (Bielefeld University Library), CrossRef, Scilit, J-Gate etc.
- Journals indexed in ICMJE, SHERPA/RoMEO, Google Scholar etc.
- OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting)
- Dedicated Editorial Board for every journal
- Accurate and rapid peer-review process
- Increased citations of published articles through promotions
- Reduced timeline for article publication

Submit your articles and experience a new surge in publication services (https://www.peertechz.com/submission).

Copyright: © 2020 Mbong EO, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.