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Abundance and Distribution of Sedges in Relation to Soil Properties in Sedge-Dominated Habitats in Uyo Metropolis, South-South Nigeria

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Abstract

A field research was conducted to assess soil nutrient variation and plant distribution in four sedge-dominated habitats. 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 decurens* etc. The highest density values obtained in this study is characteristic of *Cyperus* iria in Habitat D (9500 st/ha) while the least density value is characteristic of *Plastostoma africanum* in Habitat 2 (200 st/ha). Multivariate correlation analysis evidenced that these differences in density of the sedges reflected the functions of variations important soil properties such as pH, exchangeable Ca, soil moisture, total nitrogen and available phosphorus.

Most specifically, the current result concludes that while *Cyperus iria* showed strong affinity for soil acid soils rich in available phosphorus which had moderate soil moisture regimes, *Cyperus haspan* indicated it preference for alkaline soils. This result lends knowledge and practical application in environmental management, weed science and habitat ecology.

Keywords: Sedges; Cyperaceae; correlation; Density; Habitat

Introduction

Pedology is the study of soil properties. Scientific studies have revealed that most often than not, Soil and vegetation are entangled in a web of important relationships which can never be taken for granted.

It is know that while plants serve as protective coverings for soil, anchorage against erosion and other physical agents of destruction as well as source of important nutrient through litter decomposition, soil also functions as a medium for plant anchorage, 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. This phenomenon has varied impact on vegetation thus shaping its composition and structure (Ubom, et. al,).

Cyperaceae is one of the largest family in 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 on herbarium specimens [2].

Against this background, it is believed that the wide occurrence of these species points to the need to increase research on economic values and ecological niche of members of this taxonomically difficult but highly interesting family.

To this end, this study seeks to reveal knowledge on the habitat ecology of some common Cyperaceae species found in our immediate environment as 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 are of about 188.035 km2 with an estimated population of 3,920,208 and experiences an annual precipitation of approximately 1000 mm (AKSG).

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 1: specific coordinates for sedge habitats.

Uyo is geographically bounded on the East by Uruan Local Government Area, Abak Local Government Area in the West, Ibiono Ibom Local Government Area in the North and Ibesikpo Asutan Local Government Area by the South. The specific coordinates for sedge habitats are shown in Table 1.

Vegetation and soil sampling

Species were sampled in 10 m × 10 m quadrats, spaced at regular intervals of 20 m according to the methods of Knight, [3]. 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 Hebarium, University of Uyo, Akwa Ibom State.

Frequency of occurence and density of the plant species encountered were estimated according to the methods of Ubom, [4].

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, [5].

The soil samples were air- dried and preserved for laboratory analysis. Soil pH was determined using Hanna hand held pH meter.

Available phosphorus was determined using Bray No. 1 method while Exchangeable Ca was determined using Flame photometry [6] Organic matter was determined using the Walkey-Black method [7].

Statistical analysis

Mean and standard error were computed from three replicates 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 strength of relationships existing between soil properties and density of sedges according to the methods of Ubom [8].

Results

The distribution of sedges and associated species found in the study area is shown in Table 2. The table records a total of 12 plants unevenly distributed in four habitats.

Habitat A recorded up to 5 species of which 1 is a sedge, Habitat B has one sedge and one associated species, Habitat C has three species of which only includes one sedge and then Habitat D which has 8 species (out of which 3 sedges were present).

The highest density obtained in this study was characteristic of Habitat D (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 3 shows the means of the physicochemical properties of the sedge dominated habitats. The habitats were weakly acidic with a pH ranging between 4.95 ± 0.14 up to 6.62 ± 0.095 in the four habitats. Organic matter content of the habitat sediments ranged between 2.95 ± 0.15 in habitat D, 2.87 ± 0.01 in habitat B, 2.54 ± 0.06 in habitat A and 2.52 ± 0.20 in habitat C.

Habitat/Species	Family	Density(stha-1)
Habitat A		
Mitrocarpus villosus	Rubiaceae	600
Chromolaena odorata	Asteraceae	400
Sida acuta	Malvaceae	400
Centrosema pubescens	Leguminosae	300
Cyperus haspan	Cyperaceae	2500
Habitat B		
Cyperushaspan	Cyperaceae	4000
Scoparia dulcis	Scoparaceae	800
Cyperus iria	Cyperaceae	3000
Plastostoma sp.	Rubiaceae	200
Habitat C		
Cyperus iria	Cyperaceae	2100
Bidens pilosa	Asteraceae	400
Sida acuta	Malvaceae	400
Habitat D		
Cyperusiria	Cyperaceae	9500
Cyperusdifformis	Cyperaceae	3000
Scoparia dulcis	Scoparaceae	1500
Cyperusrotundus	Cyperaceae	4000
Mitrocarpus villosus	Rubiaceae	1700
Ludwigia decurens	Onagraceae	3000
Sida acuta	Malvaceae	900
Eleusine indica	Gramineae	400

Table 2: Plant distribution in study area.

	Habitat A	Habitat B	Habitat C	Habitat D
pH	6.62 ± 0.095	6.51 ± 0.10	5.25 ± 0.01	4.95 ± 0.14
Organic Matter (%)	2.54 ± 0.06	2.87 ± 0.01	2.52 ± 0.20	2.95 ± 0.15
Av. P. (mg/kg)	19.94 ± 0.13	31.2 ± 1.40	33.92 ± 3.28	30.50 ± 1.37
Ex. Ca (cmol/kg)	19.01 ± 0.11	9.05 ± 0.15	8.85 ± 0.05	11.75 ± 0.15
Soil Moisture (%)	46.71 ± 2.51	38.96 ± 6.42	40.13 ± 9 . 81	42.77 ± 6.23

Table 3: Physical and Chemical properties of sedge habitats.

Available phosphorus was highest in habitat C (33.92 ± 3.28) but was least in habitat A (19.94 ± 0.13). The most abundant cation in the habitats was calcium and its values were 19.01 ± 0.11, 9.05 ± 0.15, 8.85

± 0.05 and 7.75 ± 0.15 in habitats A, B, C and D. soil moisture content ranged between 38.96 ± 6.42 in Habitat B and 46.71 ± 2.51 in Habitat A.

The correlation matrix (Table 4) revealed high signifcant correlation coefficients between soil and density of sedges in the studied location.

The matrix shows that Available phosphorus correlated negatively and significantly with soil exchangeable Ca (-0.979*) where as on the contrary, soil moisture content correlated positively and significantly with exchangeable Ca (0.971*).

Also, *Cyperus haspan* correlated positively and significantly with the soil pH (0.985*) while *Cyperus difformis* and *Cyperus rotundus* correlated positively and significantly with *Cyperus rotundus* (0.999**).

	pH	Organic Matter	Available P	Exchangeble Ca	Soil Moisture	*C. iria*	*C. haspan*	*C. difformis*	*C. rotundus*
pH	1								
Organic Matter	-0.222	1							
Available P	-0.623	0.323	1						
Exchangeble Ca	0.457	-0.358	-.979*	1					
Soil Moisture	0.233	-0.329	-0.905	.971*	1				
C. iria	-0.662	0.638	0.929	-0.907	-0.814	1			
C. haspan	.985*	-0.053	-0.592	0.418	0.195	-0.574	1		
C. difformis	-0.687	0.691	0.175	-0.058	0.122	0.471	-0.577	1	
C. rotundus	-0.687	0.691	0.175	-0.058	0.122	0.471	-0.577	0.999**	1
Note: * = significant at 0.05; **= significant at 0.01.									

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

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. [5], 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 occurence and density of the species encountered. This was noted by earlier researchers [8].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 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 tangles with Akobundu and Agyakwa [9] 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 and are being spread almost evenly by wind, rain splashes or slow water current across the nutrient-rich muddy substrate.

On the other hand, the low density noted for *Plastostoma africanum, Sida acuta, Centrosema pubesens* etc may be linked with their poor adaptability to the existing environmental conditions inherent in the habitat or ineffective reproductive strategies. This idea aligns with the views of Sculthorpe [10] opined that efficient reproductive strategies and good dispersal capabilities are the two factors that could explain dominance and rarity in natural ecosystems.

The density values noted for *Ludwigia decurrens* compares with those of the Cyperaceae species in this study. This is justified in that it can be interpreted to mean that these species may share similar environmental and nutrient requirements and this phenomenon is suggestive of a considerable level of competition in these habitats. Agreeing with this, Verma and Agrawal [11] 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* whichis an indication of a fierce and continuous competition for scarce environmental resources.

The suitability and use of correlation analysis in ascertaining the nature and strength of relationships existing between pairs of variables as is found in this research is well documented by previous researchers [4-13]. Currently, the matrix indicated that *Cyperus haspan* showed strong affinity for alkaline soils while *Cyperus iria, Cyperus difformis* and *Cyperus rotundus* showed high preference for slightly acidic soils with increased organic matter content. This pattern of relationship exhibited by the sedges reflects that the decomposition of plant litter to form soil organic matter in the habitat 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 agrees with Stevenson [14-17]. Specifically, *Cyperus iria* showed strong affinity for soil available phosphorus, low exchangeable calcium and moderate soil moisture regimes.

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 decurens* 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 the ecosystem. The information obtained from this study could be useful in the management and conservation of lawns and (or) other sedge- dominated habitats.

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