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Research Article

Grass Species Diversity and Abundance at Rennajj Fish Farm, Jos South, Nigeria and Surrounding Environment

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ABSTRACT

Vegetation management is key to ecosystem conservation. This research work examined grass species diversity and abundance, together with the effects of management and habitat types on grass diversity and abundance at Rennajj Fish Farm and surrounding environments. Thirty (31) points were randomly selected and marked with the aid of a Global Positioning System (GPS) unit. They were classified as managed and unmanaged, consisting of sixteen (16) points within the managed area and fifteen (15) around the surrounding environments. At each point, plots of $20m^2$ were measured, and within the plot, 4 random $1m^2$ sub-quadrats were selected, where grass species were identified and recorded. Data analysis was carried out using the R statistical Software. A total of twenty (23) grass species, belonging to six (6) families and twenty (20) genera were recorded. Grass species diversity differed by the study sites and habitat types ($P < 0.001$), respectively. The unmanaged environments had higher grass diversity compared to the managed Rennajj Fish Farm. Grasslands had the highest grass species diversity while woodland had the least. Mean grass abundance was significantly different by family ($P < 0.001$). The family Rubiaceae was the most abundant while, Polygonaceae was the least.

Keywords: Grass diversity, Abundance, Management, Rubiaceae, Polygonaceae

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INTRODUCTION

The vegetation diversity of an ecosystem is important because, they occupy the bottom of the food chain and trophic level (Duffy, 2002). A plethora of factors determine vegetation diversity and distribution (Bai *et al.*, 2001; Krause and Culmsee, 2013). Grasses are graminoids, that is, monocot angiosperms with narrow leaves growing from the base (Cope and Gray, 2009). Grasses are one of the earliest vegetation to colonize a place in cases of primary and secondary succession after a disturbance (Kalliola *et al.*, 1991; Wiegleb and Felinks, 2001). In Nigeria, quite several studies have examined plant vegetation structure and diversity (Adeyemi *et al*, 2015; Abiem *et al.*, 2018; Salami and Jibo, 2019; Etuk *et al.,* 2020). This study assessed grass diversity and abundance at Rennajj Fish Farm and surrounding environments, to ascertain the effects of management and habitat types on grass diversity and abundance.

METHODOLOGY

Study Area

The study was carried out in Jos South Local Government Area (LGA), Plateau State, Nigeria, at Rennajj Fish Farm, Rayfield, Jos 9°48'47.78'N 8°54'40.58'E and surrounding environments around the farm (Figure 1). The fish farm is an abandoned mining site that had collected water over time and is managed by Eden Creation Care Initiative, which is a faith-based, non-profit, conservation organization based in Jos, Nigeria, that helps communities protect areas important for their biodiversity, through educational programs and scientific research. The study area consists of different habitat types such as abandoned mining ponds that are wet and dry, woodlands, and grasslands. Farmlands, reclaimed land, and human settlements occur exclusively in the surrounding environments.

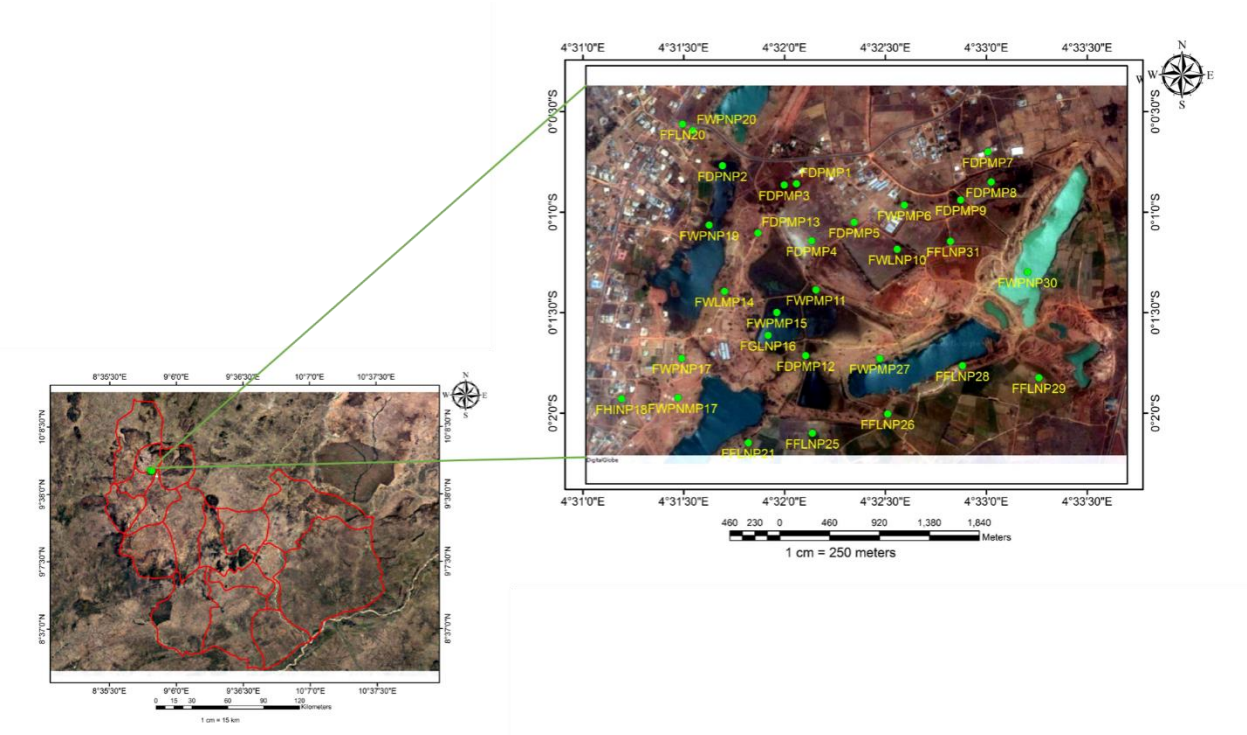

Figure 1: Map of Plateau State showing Rennajj Fish Farm and Surrounding Environment, Jos South Local Government Area

Data Collection

Grass data was collected using the quadrat method at a total of thirty-one (31) randomly selected points, marked with the aid of a Global Positioning System (GPS) unit. Sixteen (16) points were located within the managed fish farm and fifteen (15) located at the unmanaged surrounding environments. Points were at least a 100 m apart. At each point, a 20m^2 plot was marked out with the aid of a measuring tape. Within the 20 m^2 plot, four (4) 1 m^2 sub-quadrats were randomly selected from which grass species were inventoried. Grass species were identified using Flora of West Tropical Africa (Hutchinson and Dalziel, 1954) and by comparing plant specimen with photographs and illustrations (Akobundu and Agyakwa, 1987). Samples of grasses were taken to the herbarium of the A. P Leventist Ornithological Research Institute, University of Jos Conservatory for further authentication and validation. Family classification of grass species was based on APG III (2009) and (Yang and Ayodele, 2012).

Data Analysis

Grass species diversity index was calculated using the Shannon - wiener diversity index.

$$\text{Shannon} - \text{Weiner diversity index (H`)} = \sum_{n,=N}^{S} \text{pi ln (pi)}$$

Equation 1. Shannon wiener diversity index

Statistical analysis was carried out using the R Commander statistical software version 2.15 (Team, 2012). The distribution of the data was determined. Species diversity was normally distributed, while abundance was Poisson, thus Linear Model (LM) and Generalized Linear Models (GLM) were used to examine differences between the response variables and predictors. In cases where the mean difference was significant between groups, a Tukey (HSD) post hoc test was used to assess pairwise comparison within the group. Graphs were plotted using the means and the standard error values obtained from the models.

RESULTS

Grass Species Diversity

A total of twenty-three (23) Grass species belonging to five (5) Families and twenty (20) Genera were recorded (Table 1).

Grass species diversity differed significantly by sites and habitat types (Table 2).

The response variable is Grass Species Diversity Index. Significant differences are highlighted in bold. Adjusted R^2 = 0.75
The unmanaged surrounding environment had higher grass species diversity compared to the managed fish farm (Figure 2).

Grasslands had the highest diversity while woodland had the least (Figure 3).

Grass abundance differed significantly by family, and marginally by sites, but not by habitat types (Table 3). The response variable is Grass Abundance. Significant differences are highlighted in bold. PseudoR^2 = 0.11
The family Rubiaceae had the highest abundance while the family Polygonaceae had the least (Figure 4).

Table 1: List of Grass Species Recorded at the Study Area

Species	Family
Brachiaria spp	Poaceae
Clotalaria retusa	Papilionaceae
Cyperus haspan	Cyperaceae
Cyperus iria	Cyperaceae
Digitaria horizontalis	Poaceae
Echinochloa crus-pavonis	Poaceae
Eleusine indica	Poaceae
Eragrostis atrovirens	Poaceae
Eragrostis tremula	Poaceae
Fimbristylis littoralis	Cyperaceae
Hyparrhenia involucrata	Poaceae
Kyllinga erecta	Cyperaceae
Leersia hexandra	Poaceae
Mariscus longibracteatus	Cyperaceae
Panicum subalbidum	Poaceae
Paspalum scrobiculatum	Poaceae
Polygonum pensylvanicum	Polygonaceae
Pycreus lanceolatus	Cyperaceae
Schoenoplectus senegalensis	Cyperaceae
Seteria barbata	Poaceae
Seteria pallide-fusca	Poaceae
Spermacoce verticillata	Rubiaceae
Sporobolus pyramidalis	Poaceae

Table 2: Grass species diversity by sites and habitat types

Variables	df	Sum Sq	Mean Sq	F value	Pr (>F)
Site	1	11.86	11.86	568.98	**< 0.001**
Habitat	7	7.50	1.072	51.40	**< 0.001**

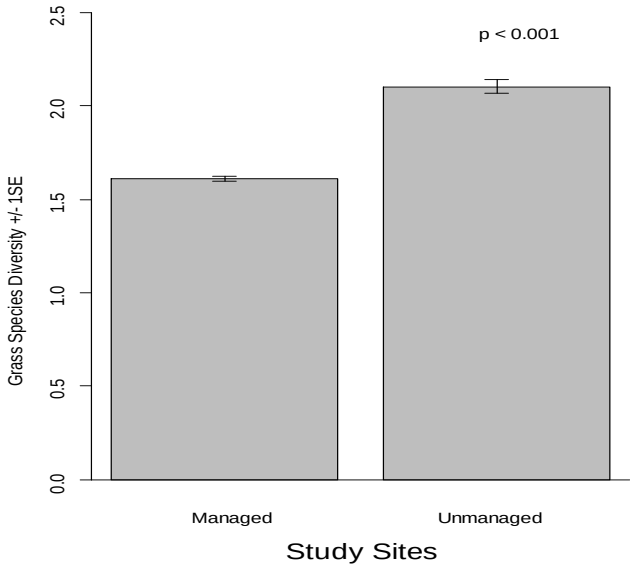

Figure 2: Grass species diversity of managed and unmanaged study sites

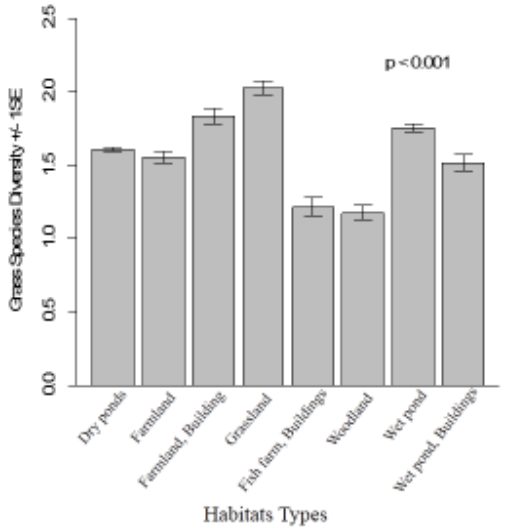

Figure 3: Grass species diversity across habitat types Grass abundance

Table 3: Grass abundance by family, sites, and habitat types

Variables	df	Deviance	F value	Pr (>F)
Site	1	3197.80	568.98	0.09
Habitat	7	3227.10	51.40	0.58
Family	4	3479.70	7.32	**< 0.001**

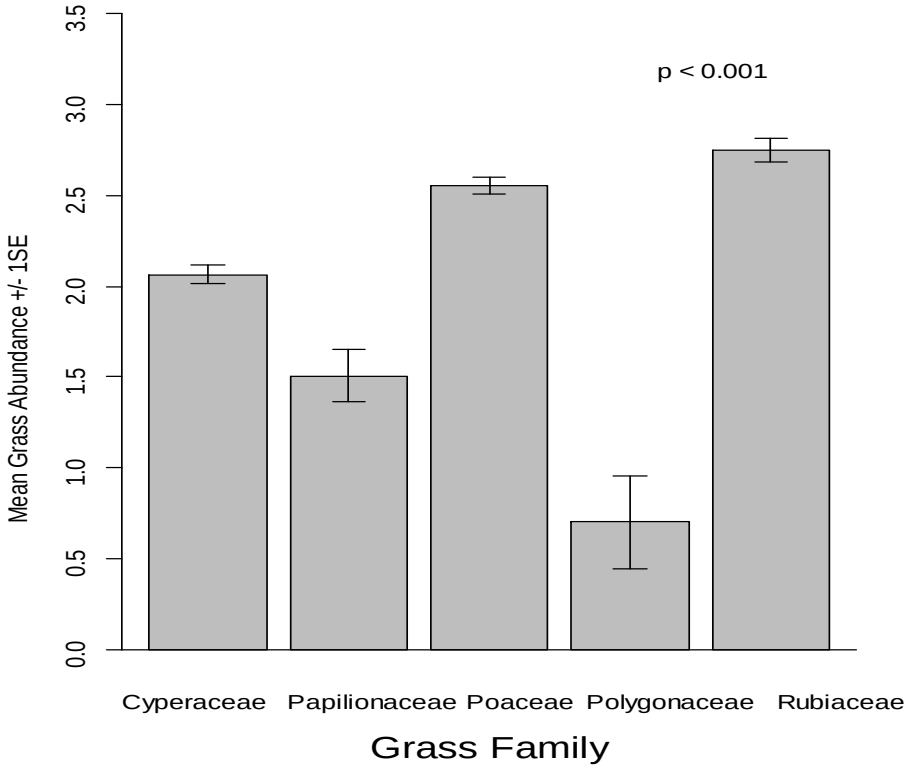

Figure 4: Grass abundance by family

DISCUSSION

The grass species observed during the study have also been recorded in previous studies in Nigeria (Mohammed *et al.*, 2015; Nodza *et al.*, 2021). Higher grass species diversity recorded in the unmanaged surrounding environments could be associated with the presence of higher level of habitat heterogeneity at the unmanaged surrounding environments (Lundholm, 2009; Gastauer *et al.*, 2021). Also, the highest grass species diversity recorded in the grasslands may be due to habitat heterogeneity, micro-topography and Jazen-Connell effects (Petermann and Buzhdygan, 2021). The lower diversity at the woodland could be a result of lower vegetation growth under tree canopies due to limited penetration of sunrays (Ford and Newbould, 1971; Packham *et al.*, 1992). The highest abundance of the family Rubiaceae recorded, had also been reported in similar studies (Kenfack *et al.*, 2007; Djaha *et al.*, 2008; Fonge *et al.*, 2011; Janfa *et al.*, 2021). This may be an indication of dominance by the family Rubiaceae (Fonge *et al.*, 2013) and may also account for their high representation in the International Union for the Conservation of Nature (IUCN) Red list of Threatened Plant Species in Nigeria (Borokini, 2014). Conversely, Azila *et al.* (2020) reported that the family Poaceae was the most dominant in grassland vegetation. The Lowest abundance of the

family Polygonaceae observed in the study, aligns with the findings from previous studies (Mohammed *et al.*, 2015; Nodza *et al.*, 2021).

CONCLUSION

The study recorded twenty-three (23) grass species belonging to five (5) families and twenty (20) genera. Grass species diversity differed by study sites and habitat types. The unmanaged surrounding environments had higher grass species diversity compared to the managed fish farm. Grassland habitats had the highest grass diversity while the woodland had the least. The family Rubiaceae had the highest grass abundance whereas the family Polygonaceae had the least.

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