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Relationship between Vegetation Height and Species Richness of Birds in Some Wetlands of Sinnar State, Sudan

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ABSTRACT

Objectives of this study were to: identify the relationship between vegetation height and birds' species at various wetlands of Sinnar State; This study was conducted in Sinnar state, central Sudan (Latitudes 05° - 12° to 05° -14° N and longitudes 32.9° - 35.4° E), covering 12 wetlands (mayas) during the wet and the dry season duration 2011 - 2013; the wetlands are Ronga, Allahmaana, Gladeem, Elban, Rahad Kobri 45, Lawni, Kinnaf Tura 5, Rigaba, Shamiya, Wad elggack, Homrani and Sinnar Dam reservoir. The study focused on abundance of herbaceous vegetation, Parameters of herbaceous vegetation were determined at 50-m intervals along line transects; these parameters were plant counts and vegetation height in a 1-m circular quadrat. Birds were counted twice a day (morning and evening) in all wetlands with the help of telescopes and binoculars, and species utilizing each site of the wetlands are identified. Excel programme was used for data analysis. Vegetation height is negatively correlated with birds' species richness in wet seasons of 2011 - 2012 and 2012 - 2013, positively correlated in the dry season when herbaceous vegetation is tall, but negatively correlated when it is short.

1. Introduction

Biodiversity is central to ecosystem functioning worldwide ^[1]. understanding and quantifying the factors driving biodiversity have received increased attention to support management and conservation efforts ^[2]. Although numerous factors can affect biodiversity, vegetation structure is frequently identified as an important driver at the local scale.

Many studies mention the importance of vegetation structure and vegetation composition with association to species richness of birds, but are mainly concentrated in forest. ^[3]. In fact, avian community composition and diversity has not received enough attention in Sudan.

A few studies have, however, been conducted to look at avian diversity mainly in Sinnar state.

Sudan's climate varied from arid to humid and other special region this variation contributed to enrich the diversity of plant species, flowering plants recorded in Sudan, are about 3112 ^[4].

One of the unique land that hosted vast diversity of vegetation cover are wetland. Sudan's wetlands categorized under 13 th types. Wetland is an area of transition between a land-based and water-based ecosystem.

Types of wetlands include marshes, swamps, bogs, and fens. Though there are many different types of wetlands, they have three physical characteristics in common:

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(1) Water: Wetlands are saturated or covered with shallow water for at least some period during the year. However, because of tides, rainfall, snowmelt, and drought, the presence of water does not necessarily indicate a wetland.

(2) Hydric Soil: Hydric soil is formed under saturated conditions, often has limited or no oxygen, and may include an upper layer of decaying plant matter that decomposes slowly or not at all;

(3) Hydrophytes: Wetlands provide habitat for hydrophytes, or “water-loving” (aquatic) plants, that are adapted to living in saturated soil all or part of the year [5].

Aquatic plants (or aquatic macrophytes) live in wet habitats. occur in permanently wet places, but others known as helophytes are more amphibious and may tolerate seasonal drying. As is true of all organisms, the distribution and abundance of aquatic plants are influenced by variations of environmental factors. This fact can be used to identify species and communities that are reliable indicators of important changes in their ecosystem, including ones that may serve as gauges of ecological integrity [6-8].

Study sites revealed that mid elevation zone forest had higher bird’s species diversity (BSD), bird species richness (BSR) and plant species diversity (PSD) than other forests, which is understandable that variety of plant species or plant species diversity provide food, good shelter and roosting sites to the bird communities [9].

Some studies indicate positive correlation between plant species diversity (PSD), foliage high density (FHD) and bird species diversity (BSD) and have shown the variety of plant species supports more bird species in tropical area as compare to temperate habitats [10-11].

seem significant role to determining BSD and BSR in the study areas.

Aquatic Plant Classification

Wetlands plants are usually categorized as:

Emergent - rooted in soil, but plant parts extend above the water;

Submergent - the entire plant lives underwater;

Floating - leaves float on the surface, while roots hang down into the water or are planted in the soil; or

Riparian - found along the edges of wetlands or other water bodies. USDA Taxonomy for Plants. [12].

The objectives of this study is to: identify the relationship between vegetation highest and birds’ species at various wetlands of Sinnar State.

2. Materials and methods

Study Area

Twelve wetlands (mayas, according to Ramsar classification)) were studied during the dry season and the wet season; these were Ronga, Allahmaana, Gladeem, Elban, Rahad Kobri 45, Lawni, Kinnaf Tura 5, Rigaba, Shamiya, Wad elggack, Homrani and Sinnar Dam reservoir. Locations and detailed descriptions of these wetlands.

Table. 1. Name and location of wetlands of (study area) in Sinnar state

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No	Name	Coordination
1	Gladeema	N 13.341833 E33.742517
2	Ronga	N13.288818 E 33.89012
3	Allah maana	N13.259289 E33.0926969
4	Kinaf Tura 5	N 12.617379 E34.03792
5	Shamiyia	N 12.62132 E34.14017
6	Rigaba	N 12.60163 E34.16600
7	Rahad Kobri 45	N 12.61711 E34.04314
8	Elban	N 13.08110 E33.58585
9	Wad elggack	N 13.02699 E33.95849
10	Lawni	N124922.1 E 34 0121.7
11	Homrani	N 13.304017 E33.8746
12	Sinnar Dam reservoir	N33.68661 E13.465216

The two parameters measured were Total count of birds was conducted twice a day (morning and evening) in all wetlands with the help of telescopes and binoculars, and bird species utilizing each wetland were identified, and the vegetation height of plant species were determined. Two line transects were selected randomly across the wetland and these transects were traversed by two observers. Vegetation attributes were determined at 50-m intervals along line transects; plant species were counted in a 1-m circular quadrat, and simultaneously, vegetation height was measured with the help of a tape.

3. Result

Species richness (number of bird species) relationship with vegetation height was consistent in the wetlands during the wet seasons, inconsistent during the dry seasons. There were negative relationships between vegetation height and species richness in wet seasons of 2011 - 2012 (Figure 1, and 2012 - 2013 (Figure 2). Apparently, the situation is different during the dry season when most of the areas surrounding wetlands were devoid of vegetation cover. Most bird species preferred relatively taller vegetation cover as indicated by 2011- 2012 dry season when vegetation height ranged 11.67 - 35.75 cm compared to 7.79 - 27.78 cm in 2012 - 2013 dry season; the relationship was positive in the former season (Figure 3), negative in the latter season (Figure 4).

Table 2. Vegetation heights and Average of plant species at some wetlands of Sinnar state

Wetland	Vegetation height, cm				Average
	Wet season		Dry season		
	2011 - 20112	2012 - 2013	2011 - 2012	2012 - 2013	
Gladema	12.68	11.88	19.47	7.79	11.79
Ronga	9.58	-	13.64	12.0	11.74
Alla Maana	8.25	19.88	13.64	9.0	12.69
Kinaf Tura	15.30	22.18	15.46	-	17.65
Shamiya Khalil	23.45	20.33	22.9	18.8	21.37
Rigaba	22.5	24.00	35.75	26.4	27.16
Rahad Turda 5	16.69	24.70	19.5	15.0	18.97
Elban	24.06	18.00	21.83	27.78	22.92
Wadegack	11.33	14.33	13.25	9.0	12.00
Lawni	13.69	12.33	11.67	12.60	12.57
Homrani	14.15	16.53	19.22	10.78	15.17
Sinnar Dam	14.05	16.27	13.67	14.11	14.53
Average	15.34	17.65	18.63	15.00	
Minimum	8.25	11.00	11.67	7.79	
Maximum	24.06	24.70	35.75	27.78	

Birds’ Species: Abundance and richness of birds

Seasonal abundance of birds is summarized in Table 3.

Species richness and the total number of birds counted during the wet and dry seasons are presented in Table 3 and figure 1. More population numbers of birds were distributed along the riverine ecosystem in 2011 - 2012 compared with 2012 - 2013 (figure 3). There was a decrease in the number of birds (-12.7 %) during the wet seasons, an increase (+34.4 %) during the dry seasons across of the 12 wetlands (Table 3). Richness in Rahad 45 was highest (40 species) followed by Sinnar dam (39 species) and Gladema (37 species). The remaining wetlands supported species richness varying between 33 and 29. Both species richness and the proportion of birds utilizing the wetland were used to judge the importance of the wetlands. In this context, Rahad 45 was the most important wetland; it supported the highest species richness and the highest proportion ((57.4%) of birds utilizing it, followed by Gladema (10.3 %).

Table 3. Seasonal abundance and species richness of birds in wetlands of Sinnar state

Wetlands	Richness	Wet season		Dry season		Total and (%)
		2011-2012	2012-2013	2011-2012	2012-2013	
Gladema	37	553	728	385	4723	6389 (10.3)
Ronga	30	924	3	405	1533	2865 (4.6)

Alla maana	30	184	73	72	36	365 (0.6)
Kinnaf turaa 5	30	2595	22	1319	0	3936 (6.3)
Shamiya Khalil	32	307	197	138	166	808 (1.3)
Rigaba	32	1052	17	461	202	1732 (2.8)
Rahad 45	40	12786	17992	2745	2173	35696 (57.4)
Elban	29	1167	436	585	327	2515 (4.0)
Wad elg-gack	30	2243	110	0	138	2491(4.0)
Lawni	32	338	228	808	654	2028 (3.3)
Homrani	33	235	28	383	222	865 (1.4)
Sinnar Dam	39	684	312	784	687	2467 (4.0)
Total		23068	20146	8085	10861	62160
		-12.7 %		+34.4 %		

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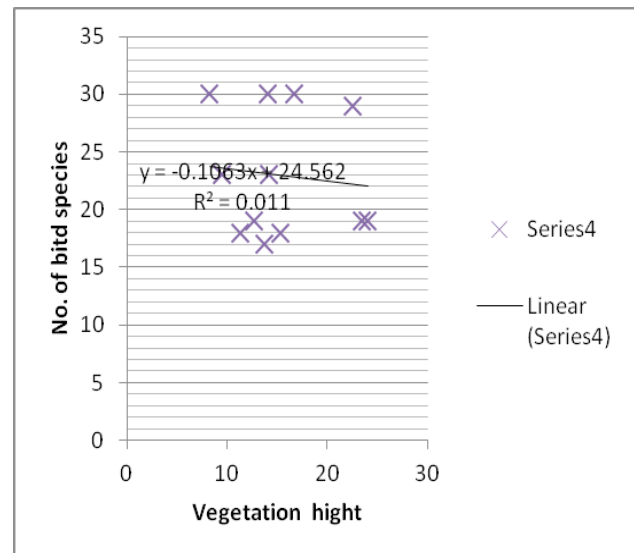


Figure 1. Relationship between vegetation height and bird’s species richness in 2011 - 2012 wet seasons, Sinnar wetlands

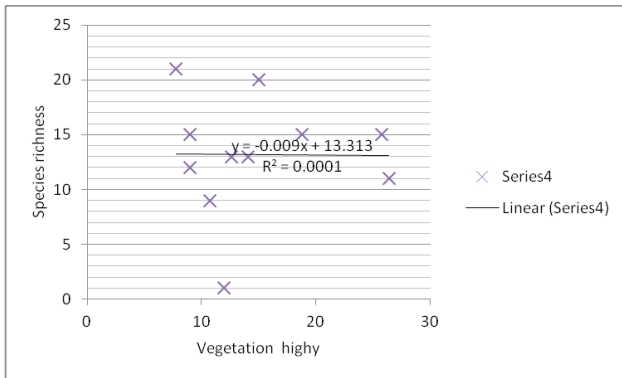


Figure 2. Relationship between vegetation height and birds' species richness in 2012 - 2013 wet seasons, Sinar wetlands

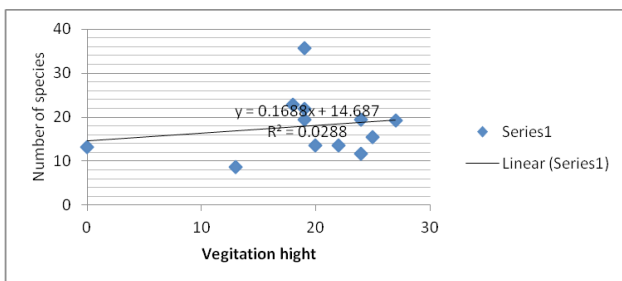


Figure 3. Relationship between vegetation height and birds richness in 2011 - 2012 dry seasons, Sinar wetlands

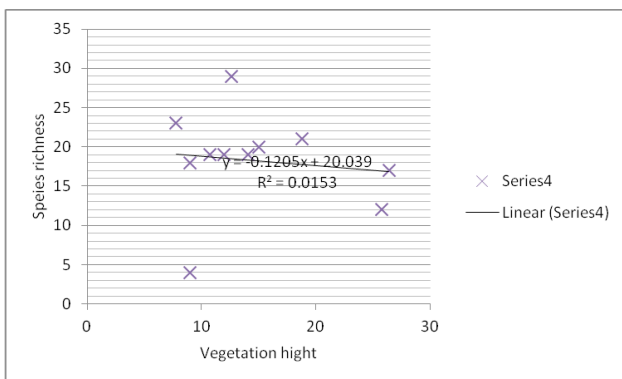


Figure 4. Relationship between birds' richness and the vegetatin hight in 2012 - 2013 dry season, Sinar wetlands

4. Discussion

In ecology, species richness refers to number of species^[13]. Species richness in wetlands of Sinar fluctuates widely. This fluctuation is more or less related to seasonal changes in the abundance of plant and bird's species. Which may have affected by the amount of rain fall and hence the size of wetlands.

The height of vegetation cover is correlated positively or negatively with species richness. Strong correlation between these two variables is not expected as values of

the parameters measured cannot be controlled under field conditions, but the trend of the relationship (positive or negative) is the parameter used to judge the relationship. The relationship is negative in wet seasons suggests that vegetation height in most of the wetlands distract many bird species from utilizing the wetlands during the wet season because tall grasses discourage feeding process, hide enemies. In most wetlands, taller vegetation grows at their edges, especially when xeric conditions prevail, which act as an interface between bare areas surrounding the wetlands and shorter vegetation preferred by waders inside these wetlands^[14]. The reverse is, to some extent, true during the dry season.^[15] revealed that there is a positive relationship between percentage ground cover and birds recorded.

Grazing can positively or negatively affect water birds. Trampling negatively affect bird's nests^[16], and removal of vegetation biomass and structure degrade bird's habitat value. Vegetation removal can, however, have beneficial effects on birds that rely on larger areas of open water. Previous study's findings are: (a) increased frequency of grazing on an annual basis correlate significantly with decrease of bird's abundance and shrub height in Rivierine ecosystem; (b) bird abundance increased with the increased taller shrub height; and (c) bird species richness decreased with the increased grazing.

Since there are no such studies in Sudan and Africa about the relationship between birds, vegetation covers and the complicated factors surrounding bird's habitat like human activities, disturbance, amount of rain fall and others that judging the correlation, such studies are highly needed in the future for the purpose of birds and plant conservation, put in consideration the global climate change.

5. Conclusion

The herbaceous vegetation height in the wetlands and the surrounding these wetlands are a function of birds' richness. Tall vegetation's distract water birds in the wet season; attract them during the dry season.

Recommendations

- (1) Training on wetlands evaluation and management, using modern techniques and programs.
- (2) Plans need to be developed by governmental departments for monitoring biodiversity regularly.
- (3) More studies on wetlands are needed to identify, evaluate bird's species and the ecological status of their habitat, through national and regional programs.
- (4) Encourage coordinated international agreement and

seek for national and international partnership.

(5) Support the development of flyway-scale site networks, especially where they are least developed, to include the widest possible range of available habitat for migratory birds.

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