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Importance Value Index (IVI) of Tree Species and Diversity of Baturiya Hadejia Wetland National Park, Jigawa State, Nigeria

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ABSTRACT

Tree species inventory and diversity studies help to understand the species composition and determine the information for forest conservation. This research evaluates the importance value index (IVI) of tree species and diversity at Baturiya Hadejia Wetland National Park. Three Plots of 100 x 100m^2 were systematically laid in three habitats (Swampy, Fadama and Wetland). Importance value Index (IVI) was determined. *Acacia sieberana* had the highest value of (39.8%), followed by *Adonsonia digitata* (35.4%) and *Anogeissus leiocarpus* (34.6%), the least recorded stem/ha was *Aristolochis albida, Calostropis procera, Celosia argentea* and *Eragrostis gangetica* with (11.2%). A total of 958 stem/ha belonging to 83 species were distributed to 63 genera and 36 families were enumerated. *Acacia sieberana* had the dominant stems/ha of (0.31%), and *Hyphaene thebaica* (0.21%), *Ziziphus mauritiania* (0.19%), *Balanite aegyptiaca* (0.17%), and *Piliotigma recticulatum* (0.16%) which recorded as Co dominant stems/ha. Species with stem/ha of 1 were recorded the least with (0.01%). Shanon weiner diversity index was computed with 3.32, richness 2.70 and evenness 0.75. Out of 36 families, *Fabaceae* had the highest of 18.07% stems/ha followed by *Moraceae* 9.64% stems/ha and families with least stem/ha were recorded 1.21%, the similarities index of biodiversity summary was also recorded 12% respectively. However, study suggest conservation strategies to protect woody species against anthropogenic pressures, rather than following a strict protectionist approach in the management of the Park.

KEYWORDS: *Diversity, IVI, Tree species, Family, Similarity index and Baturiya Wetland*

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The National Park, being a tropical rainforest ecosystem consist of broad leaved evergreen trees and many species of shrubs, herbs, climbers, lianas, and epiphytes naturally arranged in a multi-storey structure (Ajayi & Obi, 2016). Baturiya Hadejia Wetland National Park support farmers, herdsmen and fishermen who depend on the wetland for their livelihoods (NCF, 2003). Based on the natural annual flooding, the wetland performs a number of economic and ecological functions which are critical to local, national, and international communities. (Kabir, 2006). The Importance Value Index (IVI) shows the complete or overall picture of ecological importance of the species in a community, (Ripu & Shiv, 2004). They play important role in protecting soil and water resources and provide a vast array of products and services for the population (Thomas, 2006). The importance value index (IVI) of tree species was determined as the sum of relative frequency, relative density, and relative dominance (Curtis & McIntosh, 1950) as cited by Mohd *et al*, (2017) and Narayan, (2015). Each of these values is expressed as percent, and ranges from 0 to 100. Nowadays due to the massive degraded peat swamp forest, preserving the forest remnants is important, especially in conservation or reserve areas. Consequently, it is necessary to study the vegetation in order to elucidate the characteristics and regeneration processes of the

remaining vegetative in the forest areas. (Mohd *et al*, 2017). Tree species composition as an ecosystem, is a habitat for biodiversity representing the very foundation of human existence as it produces goods and services for the most fundamental human needs. For instance, forest trees provide resources like food, traditional medicine, energy, timber, shade, clear air, fresh water, food, fuel wood and habitats for other organisms. It also provides recreational, psychological, emotional and spiritual fulfillment (FAO, 2016). Globally, 52% of the total forests are in tropical regions and they are known to be the most important areas in terms of biodiversity. Local communities living nearby depend on these trees for their livelihoods. The rapid increase in human population near forest ecosystem has increased threats of degradation and fragmentation to this ecosystem, (David, 2014).

Biodiversity is the relationship between species and their pattern of richness (Young & Swiacki, 2006). Globally it has been affected through a series of activities which may broadly be categorized into two. Those that produce direct effects such as hunting, fishing, and over grazing and those that produce indirect effects through destruction (bush burning, road construction) and modification of the environment (WWF, 2014)

In Nigeria, population growth coupled with urbanization, agriculture and industrialization have put more pressures on the dwindling forest resources which increases demand on renewable natural resources and often resulted to over exploitation and clearance of forests. According to Oyebo (2006) about 350, 000 to 400,000 ha of forests are being lost per annum through over exploitation (mainly as food, fuel, fodder, illegal logging, overgrazing etc.) and non-replacement of the natural vegetation. Tree species inventory and diversity studies help to understand the species composition diversity status of forests which also determine the information for forest conservation. Prior to forest management operations, biodiversity inventories also give the researcher hint on the nature and distribution of diversity resources of the region being managed, (Sivakumar, *et al,* 2014).

Materials and Methods

Baturiya Hadejia- Wetlands is a wide expanse of flood plain wetlands situated in the Northwestern Nigeria, the location lies in the sudano-sahelian zone, which is the zone between the Sudano Savanna in the south and the Sahel in the North. The wetland is found in Yobe State, located in the Northern part of Nigeria, which include the Nguru Lake (Saka *et al,* 2020). Baturiya which is a section of the Hadejia Nguru Wetlands National park, is located on the Latitude 12°20'0" N to 12°40'0" N and Longitude 10°10'0" E to 10°30'0" E in the south east (where the reserve is located) mean annual rainfall range between 600mm to 850mm, (Ramsar, 2008). The vegetation of the study area is of Sudano- sahelian type, comprising of varieties of *Acacia spp, Adansonia spp, Tamarindus spp, Mitrogynus spp, Diospirus spp Faidhebia spp Ficus spp* and *Hyphaene spp* e.t.c and the vegetational cover varies being dense with taller trees, (Jigawa State Ministry of Agriculture and Natural Resources Policy – JSMARP, (2016)

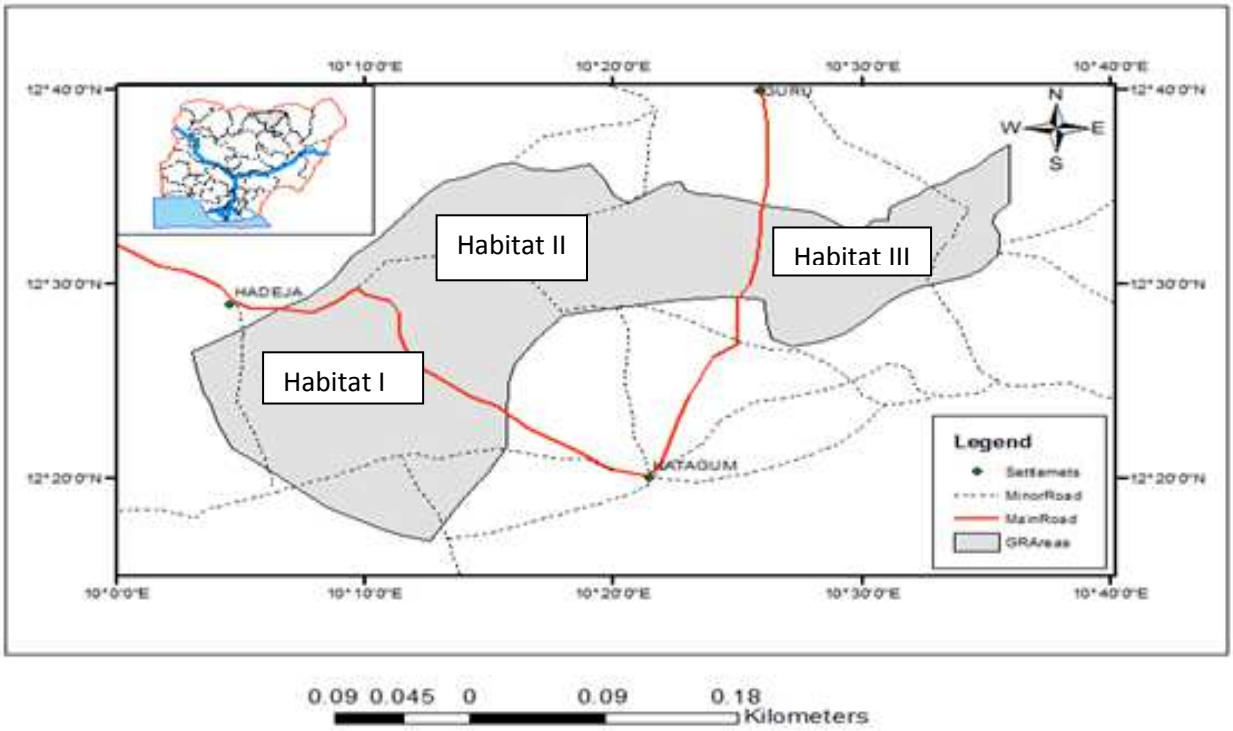

Figure 01: Baturiya Hadejia Wetland Game Reserve National Park Map

Sampling Techniques

Reconnaissance survey was made in the study area, general features of the area were assessed and different site in the area was identified for selection of sample plots. Systematic sampling method was adopted for this study, in which the study area was stratified according to existing habitats (Uplands, Fadama and Swamp) in the park.

Plots of 100 x 100m^2 from each habitat were made. All tree species was enumerated by direct counting and consolidated check list of all the trees species in the sample plots was made. Plant entries include species and family of every living stems/ha encountered on the plots within the period of the research. Specie with dbh ≥ 15cm were enumerated as matured trees, (Akinyemi *et al.,* 2001). For finding IVI, the percentage values of relative frequency, relative density and relative dominance were added together, and this value is called Importance Value Index or IVI of a species as cited by Mohd, (2017).

Data Analysis

The IVI of the species was estimated by the use of the following formula as described by (Ripu& Shiv, 2004)$\mathbf{IVI} = \frac{RF+RD+RDo}{3}$

Species diversity were computed using Shannon Wiener's diversity index as described by Charles (1989). The Shannon's index is computed as; $H^1 = -\sum PilnPini$

Species richness R is given as $\mathbf{d} = \frac{N}{\sqrt{S}}$

Evenness is calculated using Shannon Evenness index (*E'*) *E'*= *H'*/*H'*max

Results

The result of Importance Value Index (IVI) for stems/ha in the study area was computed based on relative frequency (RF), relative density (RD) and relative dominant (RDo) and recorded that *Acacia sieberana* had the heighest stems/ha of 39.8%, followed by *Adonsonia digitata* 35.4% and *Anogeissus leiocarpus* 34.6%, and *Aristolochis albida, Calostropis procera, Celosia argentea* and *Eragrostis gangetica* were recorded with 11.2% as indicated in figure 2. Diameter at breast hieght (Dbh) and basal area were also determined.

Tree species diversity and distributions shows a total of 958 stems/ha belonging to 83 species which were distributed to 63 genera and 36 families. Thus, *Acacia sieberana* had the dominant stems/ha of (0.31%). The Co dominant stems/ha was *Hyphaene thebaica* (0.21%), *Ziziphus mauritiania* (0.19%), *Balanite aegyptiaca* (0.17%), *Piliostigma recticulatum* (0.16%) and species recorded with 1 stems/ha in Figure 3 had the least percentage of (0.01%). Shannon wiener diversity was computed with the average of 3.32, richness of 2.70 and evenness of 0.75 respectively.

Family recorded with highest stems/ha was *Fabaceae* with relative frequency of 18.1% (15 species) followed by *Moraceae* with 9.6%, (8 species), *Rubiaceae* with 6.0% (5 species), *Combretaceae* and *Leguminosae* of 4.8% (4 species) each, *Amaranthaceae,Anacardiaceae, Arecaceae* and *Rhamnaceae* with 3.6% (3 species) each. *Burseraceae*, *Capparaceae, Dioscoreaceae, Euphorbiaceae, Loganiaceae, Meliaceae, Poaceae* and *Verbenaceae* with 2.4% (2 species) each. The least recorded family was *Annonaceae,Apocynaceae, Aristolochiaceae, Caesalpinioideae,Cannabaceae Celastraceae, Chrysobalanaceae, Cochlospermaceae, Cycadaceae, Ebenaceae Malvaceae, Mimosoideae, Myrtaceae, Oleaceae, Polygalceae, Sapotaceae, Sterculiaceae, Ulmaceae* and *Zygophyllaceae* of 1.2% (1 specie) each as shown in Table: 01 and similarities index of biodiversity was also recorded of 12% in table 02 respectively.

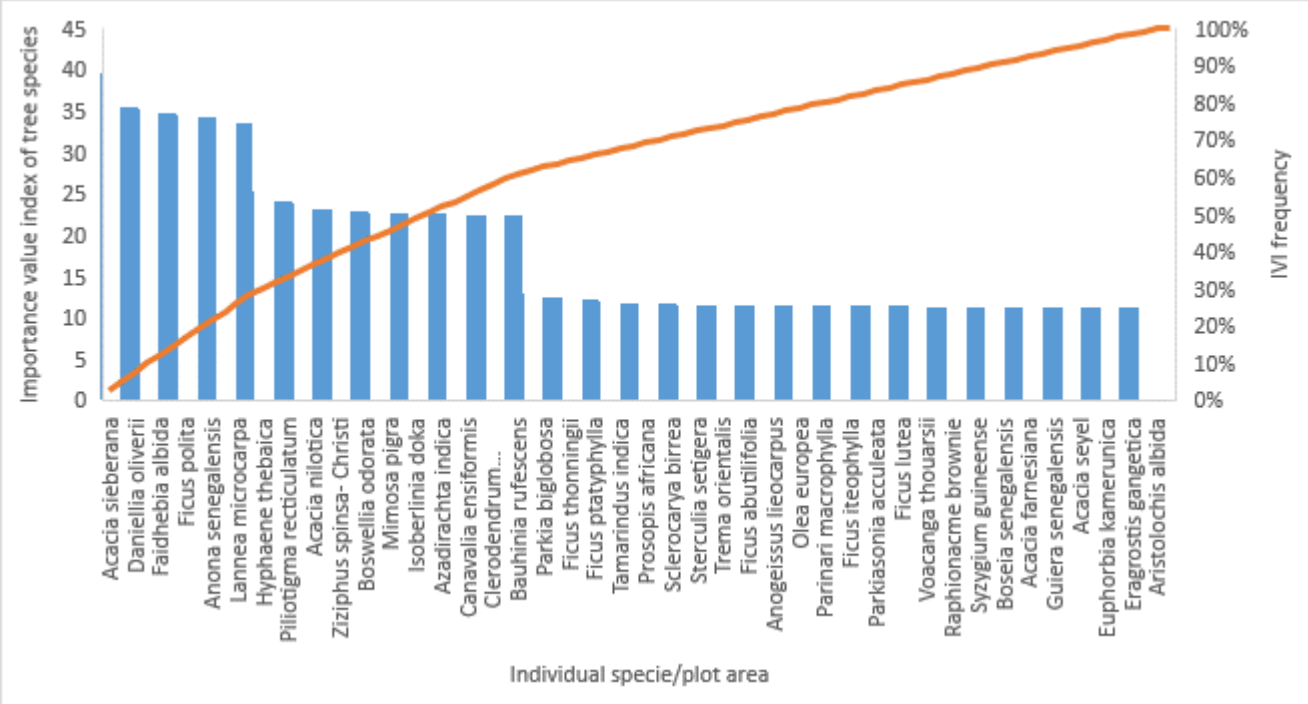

Figure 2: Importance value index (IVI) of tree species in the study area.

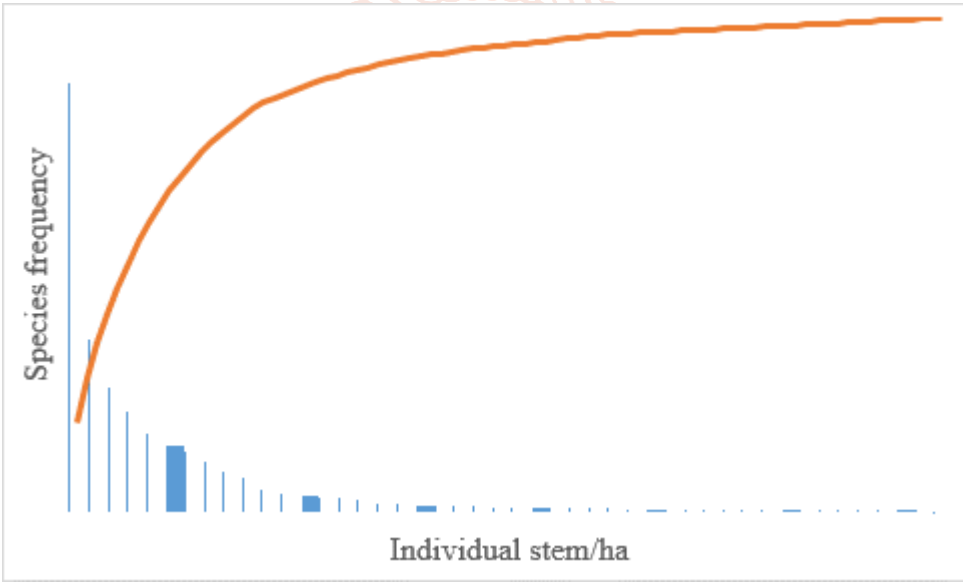

Figure 3: Tree species diversity Index, distribution and abundances in the study area.

Table 01: Families diversity and relative frequency of sampled habitats

S/No	Family	N/ha	Relative Frequency
1	Amaranthaceae	3	3.614
2	Anacardiaceae	3	3.614
3	Annonaceae	1	1.205
4	Apocynaceae	1	1.205
5	Arecaceae	3	3.614
6	Aristolochiaceae	1	1.205
7	Burseraceae	2	2.410
8	Caesalpinioideae	1	1.205
9	Cannabaceae	1	1.205
10	Capparaceae	2	2.410
11	Celastraceae	1	1.205

12	Chrysobalanaceae	1	1.205
13	Cochlospermaceae	1	1.205
14	Combretaceae	4	4.819
15	Cycadaceae	1	1.205
16	Dioscoreaceae	2	2.410
17	Ebenaceae	1	1.205
18	Euphorbiaceae	2	2.410
19	Fabaceae	15	18.072
20	Leguminosae	4	4.819
21	Loganiaceae	2	2.410
22	Malvaceae	1	1.205
23	Meliaceae	2	2.410
24	Mimosoideae	1	1.205
25	Moraceae	8	9.639
26	Myrtaceae	1	1.205
27	Oleaceae	1	1.205
28	Poaceae	2	2.410
29	Polygalceae	1	1.205
30	Rhamnaceae	3	3.614
31	Rubiaceae	5	6.024
32	Sapotaceae	1	1.205
33	Sterculiaceae	1	1.205
34	Ulmaceae	1	1.205
35	Verbenaceae	2	2.410
36	Zygophyllaceae	1	1.205
TOTAL		83	100

Source: Field Survey, (2021)

Table: 2 Summary of the Biodiversity indices of the study area

S/N	Variables	Values
1	Number of Species	83
2	Number of Families	36
3	Number of Genera	63
4	Number of Stem/ha	958
5	Mean Dbh	31.1
6 7	Dominant Dbh Basal Area	28.61 28.160
8	Shannon Weiner (H)	3.32
9	Species Richness (R)	2.69
10	Evenness (E)	0.75
11	Similarity Index	12%

Source: Field Survey, (2021)

Discussion

The finding of importance value index (IVI) indicated that the dominant stands based on species relative frequency (RF), species relative density (RD) and species relative dominant (RDo) *Acacia sieberana* had the heighest stands with 39.8%, followed by *Adonsonia digitata* (35.4%) and *Anogeissus leiocarpus* (34.6%). Those with least recorded IVI were *Aristolochis albida, Calostropis procera, Celosia argentea* and *Eragrostis gangetica* (11.2%) each as presented in Figure 2 respectively**.** The finding also indicated that *Acacia sieberana* had the highest RD of 18.1% followed by *Hyphaene thebaica* (8.7%), the species with plot density of 1 in IVI were recorded with the least RD of 0.1% respectively. In RDo *Adonsonia digitata* had the highest value (5.9%) followed by *Parkia biglobosa* (3.5%), *Vitex doniana* and *Ficus thonningii*(3.4%) each. The specie recorded with least RD_O was *Aristolochis albida* with 0.35% respectively. Abubakar, (2015), reported similar results at Illo-Kaoje Forest Reserve, Kebbi State, Nigeria with *Daniellia oliveri* recorded the highest RD and RDo of 13.38% and 20.24%, followed by *Anogeissus leiocarpus* (10.74) and (16.42%) while the least RD and RDo were recorded by *Annona senegalensis* (0.52) and (0.21%) and *Nauclea diderrichii* (0.53) and (0.56%) respectively. Mohd *et al*. (2017) also reported a similar result on his research in the Analysis of importance value index of unlogged and logged peat swamp forest in Nenasi Forest Reserve, Peninsular Malaysia, which were recorded the IVI of 71.21, 51.13 and 42.49 and in logged peat swamp forest the dominant species are *Shorea platycarpa*, followed by *Pometia pinnata*, and *Xylopia fusca*. The Summary of the Biodiversity indices of the study area were also recorded with the similarities index of 12% respectively.

Tree species diversity indices provide useful information about the composition and status of every vegetation. Ultimately, it helps to understand the community structure of a natural forest. A total of 958 stems/ha belonging to 83 species which were distributed to 63 genera and 36 families were recorded. Of this, *Acacia sieberana* had the dominant species of (0.31%), followed by *Hyphaene thebaica* (0.21%), *Zizphus mauritiania* (0.19%), *Balanite aegyptiaca* (0.17%), *Piliotigma recticulatum* (0.16%) as the Co dominant species while species with plots frequency of 1 in Shannon diversity index were recorded the least (0.01%) as presented in Figure 3 respectively. This could be attributed to the fact that the species relationship and their pattern of richness are abundance in the study area as cited by (Young & Swiacki, 2006). This finding is similar to the findings of (Ihenyen *et al*, 2010) in Ehor Forest Reserve in Edo State (Forest zone) of Southern Nigeria, where 2062 trees were identified belonging to 99 species distributed into 87 genera and 36 families.

Family recorded with highest representative trees is *Fabaceae* with relative frequency of 18.1% (15 species) followed by *Moraceae* with 9.6%, (8 species), *Rubiaceae* with 6.0% (5 species), *Combretaceae* and *Leguminosae* with 4.8% (4 species) each and *Amaranthaceae,Anacardiaceae, Arecaceae* and *Rhamnaceae* 3.6% (3 species) each and *Burseraceae,Capparaceae, Dioscoreaceae, Euphorbiaceae, Loganiaceae, Meliaceae, Poaceae* and *Verbenaceae* with 2.4% (2 species) each. The least represented family is *Annonaceae, Apocynaceae, Aristolochiaceae, Caesalpinioideae, Cannabaceae,Celastraceae, Chrysobalanaceae, Cochlospermaceae, Cycadaceae, Ebenaceae Malvaceae, Mimosoideae, Myrtaceae, Oleaceae, Polygalceae, Sapotaceae, Sterculiaceae, Ulmaceae* and *Zygophyllaceae* with 1.2% (1 specie) each in plot frequency as shown in Table 1. This finding could be attributed as a result of anthropogenic activities or due to the fact that the family of *Fabaceae* is the most common family found in the tropics and can be found in all the habitats within the regime as cited by Hadiza (2015). This finding is also far from what Muazu, (2010) found in Kuyambana Forest Reserve, Zamfara State, Nigeria. He reported the dominance of *Caesalpinaceae*, *Mimosaceae* and *Combretaceae* families comparatively.

The Shanon wiener's diversity index were computed with the average of 3.32, richness of 2.70 and evenness of 0.75 respectively. However, this finding is similar to (Arif *et al,* 2018) on Diversity of trees in a community managed forest, the case of Komolchori VCF, Khagrachari, Bangladesh. This is also close to what (Bello *et al,* 2013) found in species distribution at Kogo forest reserve of North-Western Nigeria he reported the Shannon diversity indices of 2.63, but higher than what Dikko (2012) found at Dabagi, who recorded H' value of 1.45 which is very low. This shows that generally many families are represented in the wetland. These differences may be due to the attribute of climate variability between savanna and forest ecological zones of Nigeria as cited by (Ogie-Odia *et al*, 2010)

Conclusion

Evaluation on the importance value index of tree species and diversity revealed that among the abundant tree species studied for IVI *Acacia sieberana* was numerically higher, followed by *Adansonia digitata*,where the least stem/ha was recorded in *Aristolochis albida, Celosia argentea* and *Eragrostis gangetia* respectively. Meanwhile, the

findings obtained in tree species diversity shows that *Acacia sieberana* was higher in composition and abundance than *Hyphaena thebaica, Ziziphus Mauritania, Balanite aegyptiaca* and *Piliostigma reticulatum* whichwererecorded as Co-dominant, while other tree species evaluated like *Celosia argentia, Ficus iteophylla, Mangifera indica, Parinari macrophylla* etc were recorded as the least stem/ha in the study area. Hence, conservation strategies to protect woody species against anthropogenic pressures should be adapted, instead of the present strict protectionist approach measure in the management of the park.

Conflict of Interests

The authors have not declared any conflict of interest.

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