



## DISTRIBUTION AND ABUNDANCE OF ANGIOSPERM FLORA IN MONKIN FOREST, ZING LOCAL GOVERNMENT AREA, TARABA STATE, NIGERIA

<sup>1\*</sup> Bako, R.S., <sup>2</sup> Chimbekujwo, B.I., <sup>1</sup> Jatau, D.J.

<sup>1</sup>Department of Biological Sciences, Taraba State University, Jalingo-Nigeria.

<sup>2</sup>Department of Plant Science, Modibbo Adama University, Yola-Nigeria.

### ARTICLE INFO

#### Article history:

Received 15 August 2025

Received in revised form 25 August 2025

Accepted 28 August 2025

#### Keywords:

Angiosperm, flora, Monkin Forest, species diversity, invasive species, anthropogenic activities, conservation .

### ABSTRACT

This study evaluates the distribution, abundance, and conservation status of angiosperm flora in Monkin Forest, Zing Local Government Area, Taraba State, Nigeria, a savanna ecosystem facing significant anthropogenic pressures. Systematic sampling using the point-centered quadrat (PCQ) method along five 500-meter transects was employed to document 22 angiosperm species across 10 plant families. The Fabaceae family dominated, with *Pterocarpus erinaceus* (African rosewood, Madobiya) exhibiting the highest abundance (N=82) and Importance Value Index (IVI: 57.14). Other notable species included *Eucalyptus globulus* (N=31), *Balanites aegyptiaca* (N=23), and *Azadirachta indica* (N=22), while species like *Psidium guajava* (N=2) and *Tectona grandis* (N=3) showed low abundance, indicating potential conservation concerns. The Shannon–Wiener Diversity Index ( $H' = 2.58$ ) and Species Richness ( $S = 22$ ) suggest moderate species diversity compared to other West African forests. Invasive species, including *Eucalyptus globulus*, *Azadirachta indica*, and *Leucaena leucocephala*, were identified as threats due to their high water consumption and allelopathic effects, which suppress native flora. The anthropogenic activities revealed that farming (33.3%), grazing (27.8%), logging (22.2%), and hunting (16.7%) were the common activities which lead to habitat degradation, with 55.6% of respondents reporting reduced plant diversity, particularly affecting local species (60.0%). Conservation awareness was high (66.7%), but 44.4% of respondents considered existing measures inadequate.

### 1. Introduction

Biodiversity underpins the health and resilience of ecosystems, providing vital services such as carbon storage, soil stabilization, and habitat support that are essential for human well-being and environmental sustainability (Watson *et al.*, 2019). Within tropical and savanna environments, angiosperms, or flowering represent the most diverse and ecologically significant group of terrestrial flora, contributing to primary productivity, nutrient cycling, and the sustenance of diverse animal communities (Benton *et al.*, 2022). West Africa, recognized as a global biodiversity hotspot, boasts a rich array of angiosperm species, yet faces growing threats from deforestation, agricultural expansion, and invasive species (Mittermeier *et al.*, 2020). Nigeria, situated within this region, encompasses a variety of ecological zones from rainforests to savannas, each supporting distinctive plant communities (Igu & Ezenwenyi, 2023). However, rapid urbanization, unsustainable land-use practices, and insufficient conservation efforts have led to notable biodiversity declines, particularly in understudied areas like Monkin Forest in Taraba State (Ayeni *et al.*, 2023).

Monkin Forest, located in Zing Local Government Area of Taraba State, Nigeria, is part of a transitional savanna ecosystem marked by seasonal rainfall and a mosaic of wooded grasslands and shrublands. Despite its ecological importance as a habitat for native and introduced plant species that sustain local livelihoods through timber, fuelwood, and non-timber forest products (Soladoye *et al.*, 2010), it remains poorly documented. Limited systematic studies on its angiosperm flora reveal significant knowledge gaps that hinder effective conservation planning (Oke & Odebiyi, 2019). Anthropogenic pressures such as farming, grazing, logging, and hunting threaten the forest's ecological integrity, emphasizing the need for comprehensive floristic assessments. Floristic research not only provides baseline data essential for monitoring biodiversity changes but also informs conservation policies, especially in regions with limited previous studies (Houngnon *et al.*, 2021).

This article aims to fill existing gaps by presenting a detailed inventory of the angiosperm species in Monkin Forest,

\* Corresponding author. Tel.: +2348103187386

E-mail address: bakosamr@gmail.com

evaluating their distribution, abundance, and conservation status. Additionally, it assesses the impacts of invasive species and human activities on the forest's biodiversity, integrating ecological surveys with local community perspectives to support sustainable management strategies.

## 2. Materials and Methods

The research was conducted in Monkin Forest, situated within Zing Local Government Area of Taraba State, Nigeria (coordinates: 8°50'N, 11°42'E). Covering approximately 50 square kilometers, the forest lies within the Guinea Savanna ecological zone and exhibits a tropical climate characterized by distinct wet (May–October) and dry (November–April) seasons. The area receives an average annual rainfall of 1,200–1,500 mm. The vegetation comprises a mosaic of wooded grasslands, shrublands, and scattered tree stands, supported by predominantly ferruginous soils that facilitate diverse plant growth. The region experiences significant anthropogenic pressures—including farming, grazing, logging, and hunting—exacerbated by growing population pressures and economic reliance on forest resources. The selection of this study site was based on its ecological importance coupled with the paucity of comprehensive floristic data.

A systematic sampling methodology was employed to ensure representative coverage across the heterogeneous landscape of Monkin Forest. The point-centered quadrat (PCQ) approach, as outlined by Kent and Coker (1992), was adopted due to its efficiency in assessing species distribution within complex ecosystems. Five linear transects, each extending 500 meters along a north-south axis, were established to capture variability in vegetation structure and topography. These transects were spaced at 200-meter intervals to maintain spatial independence and minimize overlap. Within each transect, five 10 m × 10 m quadrats (totaling 25 quadrats) were systematically positioned at 100-meter intervals, following standard protocols for savanna vegetation sampling (Sutherland, 2006). Sampling was conducted during the late wet season (October 2024) and early dry season (January 2025) to account for seasonal variations in plant phenology and detectability.

Within each quadrat, all vascular plants—including trees, shrubs, and herbs—were recorded, focusing on angiosperms. Identification was carried out through detailed field surveys by a team of botanists and trained assistants. Species were identified *in situ* using taxonomic keys from Hutchinson and Dalziel (1954–1972) and Mabberley's *Plant-book* (2017). For specimens requiring further verification, voucher samples were collected following protocols by Jessy (1975) and Maden (2004), pressed, dried, and deposited at the Herbarium of the Department of Biological Sciences, Taraba State University, Jalingo. These were used to supplement morphological identification.

For each species within a quadrat, the following parameters were recorded: (1) frequency—the number of quadrats where the species occurred; (2) density—the number of individuals per unit area; and (3) basal area measured at 1.3 meters height for woody species using a diameter tape. These metrics facilitated the calculation of the Importance Value Index (IVI) as per Curtis and McIntosh (1951), where IVI equals the sum of Relative Frequency, Relative Density, and Relative Basal Area. Species richness (*S*) was determined by tallying the total number of species across all quadrats, while evenness (*E*) was calculated using the Shannon–Wiener diversity index:

$$H = -\sum_{i=1}^S p_i * \ln p_i \quad (1)$$

Where;  $p_i$  is the proportion of individuals of the (*i*)-th species. Species Richness (*S*) was determined as the total number of species recorded across all quadrats. Evenness (*E*) was calculated as:

$$E = \frac{H}{\ln S} \quad (2)$$

Data were collected in triplicate for each quadrat to ensure accuracy, and mean values were used for analysis. Exotic and invasive plant species were identified based on their known ecological impacts, dominance, and literature records (Borokini *et al.*, 2023). Criteria for classification included high abundance, rapid growth, and documented ecological disruption, such as allelopathy or resource competition. Field observations, coupled with consultations with local communities, facilitated the mapping of invasive species distribution within the transects, enabling assessment of invasion patterns. A structured questionnaire was administered to 18 purposively selected respondents including local farmers, hunters, loggers, civil servants, and community leaders to gather qualitative data on human activities affecting the forest. The questionnaire covered demographic details, types and frequency of activities (farming, grazing, logging, hunting), perceived ecological impacts, and conservation awareness. Interviews were conducted in local languages (Hausa and Mumuye) with translation support to ensure clarity. Responses were recorded verbatim, translated into English, and analyzed thematically. Field observations and photographic documentation (see Appendix II) supplemented questionnaire data, capturing visible signs of anthropogenic disturbance such as deforestation, trail formation, and agricultural encroachment. Quantitative ecological data including species abundance, distribution, IVI, Shannon–Wiener diversity, species richness, and evenness were

analyzed using descriptive statistics in Microsoft Excel and R (version 4.2.3). Distribution patterns were visualized through spatial mapping using QGIS (version 3.22). Ecological indices were computed following standard formulas and protocols. Invasive species distribution was mapped to identify invasion hotspots. Qualitative data from questionnaires were coded and analyzed thematically to elucidate local perceptions and socio-economic drivers of anthropogenic impacts. Differences in species diversity across transects were tested statistically using one-way ANOVA, with significance set at  $p < 0.05$ .

### 3. Results

#### 3.1 Species Composition

The study identified 22 angiosperm species across 10 plant families (Table 1). The Fabaceae family was the most dominant, with species such as *Pterocarpus erinaceus* (N = 82, IVI: 57.14), *Senna occidentalis*, *Senna siamea*, *Crotalaria juncea*, and *Leucaena leucocephala*. Other notable families included Myrtaceae (*Eucalyptus globulus*, *Psidium guajava*), Meliaceae (*Azadirachta indica*), and Combretaceae (*Combretum micranthum*).

Table 1: Checklist of Angiosperm Species in Monkin Forest

Family	Scientific Name	Common Name	Local Name	Conservation Status
Fabaceae	<i>Pterocarpus erinaceus</i>	African rosewood	Madobiya	Near Threatened (NT)
Ebenaceae	<i>Diospyros mespiliformis</i>	Ebony	Kanya	Near Threatened (NT)
Combretaceae	<i>Combretum micranthum</i>	Combretum	Not recorded	Not Evaluated
Fabaceae	<i>Piliostigma thonningii</i>	Camel's Foot Tree	Kargoo, Kalgoo	Not Evaluated
Sapotaceae	<i>Vitellaria paradoxa</i>	Shea butter	Kadanya	Least Concern (LC)
Fabaceae	<i>Senna occidentalis</i>	Antbush	Sanga-sanga	Least Concern (LC)
Meliaceae	<i>Azadirachta indica</i>	Neem tree	Dogo yaro	Least Concern (LC)
Myrtaceae	<i>Eucalyptus globulus</i>	Eucalyptus	Zeti	Least Concern (LC)
Fabaceae	<i>Senna siamea</i>	Yellow cassia	Malga, Marga	Least Concern (LC)
Lamiaceae	<i>Tectona grandis</i>	Teak	Daji	Near Threatened (NT)
Myrtaceae	<i>Psidium guajava</i>	Guava	Gwaiva	Least Concern (LC)
Fabaceae	<i>Crotalaria juncea</i>	Brown hemp	Not recorded	Least Concern (LC)

Source: Field Survey, 2025

#### 3.2 Distribution and Abundance

*Pterocarpus erinaceus* was the most abundant species, followed by *Eucalyptus globulus* (N = 31), *Balanites aegyptiaca* (N = 23), and *Azadirachta indica* (N = 22). Species with low abundance included *Psidium guajava* (N = 2), *Tectona grandis* (N = 3), *Adansonia digitata* (N = 3), and *Tamarindus indica* (N = 3). The Shannon–Wiener Diversity Index ( $H' = 2.58$ ) and Species Richness (S = 22) indicate moderate diversity.

#### 3.3 Invasive/Exotic Species

Exotic species included *Eucalyptus globulus*, *Azadirachta indica*, and *Leucaena leucocephala*. *Eucalyptus globulus* exhibited high water consumption, while *Azadirachta indica* and *Leucaena leucocephala* showed allelopathic effects, potentially suppressing native species.

#### 3.4 Anthropogenic Activities

##### 3.4.1 Demographic Profile

Respondents were predominantly male (72.2%) and aged 25–40 years (38.9%). Occupations included farming (27.8%), civil service (22.2%), hunting (16.7%), logging (16.7%), and community leadership (16.7%) (Table 2).

Table 2: Demographic Data of Respondents

Variable	Frequency	Percentage (%)
<b>Age Group</b>		
25–40 years	7	38.9
41–50 years	6	33.3
Above 50 years	5	27.8
<b>Gender</b>		
Male	13	72.2
Female	5	27.8
<b>Occupation</b>		
Farmer	5	27.8
Hunter	3	16.7
Timber logger	3	16.7
Civil servant	4	22.2
Community leader	3	16.7
<b>Duration of Residence</b>		
5–10 years	6	33.3
10–15 years	5	27.8
16–20 years	4	22.2
Above 20 years	3	16.7

Source: Field Survey, 2025

### 3.4.2 Types of Activities

Farming was the most prevalent activity (33.3%), followed by grazing (27.8%), logging (22.2%), and hunting (16.7%). Subsistence farming (55.6%) dominated over commercial farming (44.4%) (Table 3).

Table 3: Types of Anthropogenic Activities

Variable	Frequency	Percentage (%)
<b>Common Activities</b>		
Farming	6	33.3
Logging	4	22.2
Hunting	3	16.7
Grazing	5	27.8
<b>Frequency of Activities</b>		
Daily	5	27.8
Weekly	6	33.3
Monthly	4	22.2
Seasonally	3	16.7
<b>Purpose of Farming</b>		
Subsistence	10	55.6
Commercial	8	44.4

Source: Field Survey, 2025

### 3.4.3 Perceived Impacts

Farming and logging were rated as having moderate to high impacts (27.8% and 33.3%, respectively). Grazing and hunting had varied impacts, with 27.8% and 22.2% rating them as moderate, respectively (Table 4). A majority (55.6%) reported reduced plant diversity, with local species (60.0%) being most affected (Table 5).

Table 4: Impact of Anthropogenic Activities

Activities	No Impact (1)	Low Impact (2)	Moderate Impact (3)	High Impact (4)	Very High Impact (5)
Farming	2 (11.1%)	4 (22.2%)	5 (27.8%)	4 (22.2%)	3 (16.7%)
Logging	1 (5.6%)	3 (16.7%)	6 (33.3%)	5 (27.8%)	3 (16.7%)
Hunting	4 (22.2%)	5 (27.8%)	4 (22.2%)	3 (16.7%)	2 (11.1%)
Grazing	3 (16.7%)	2 (11.1%)	5 (27.8%)	4 (22.2%)	4 (22.2%)

Source: Field Survey, 2025

Table 5: Changes Due to Anthropogenic Activities

Item	Frequency	Percentage (%)
<b>Reduction in Plant Diversity</b>		
Yes	10	55.6
No	5	27.8
Not sure	3	16.7
<b>Types of Plants Affected</b>		
Local species	6	60.0
Exotic species	3	30.0
Both	1	10.0

Source: Field Survey, 2025

### 3.4.4 Conservation Awareness

A majority (66.7%) were aware of conservation efforts, primarily led by government agencies (41.7%). However, 44.4% believed the forest was inadequately protected. Suggested mitigation strategies included stricter laws (33.3%), awareness campaigns (27.8%), community involvement (22.2%), and reforestation (16.7%) (Table 6).

Table 6: Conservation Awareness and Practices

Variable	Frequency	Percentage (%)
<b>Awareness of Conservation Efforts</b>		
Yes	12	66.7
No	4	22.2
<b>Leadership of Efforts</b>		
Government agencies	5	41.7
Local community	3	25.0
NGOs	2	16.7
Religious organizations	2	16.7
<b>Adequacy of Protection</b>		
Yes	7	38.9
No	8	44.4
Not sure	3	16.7
<b>Mitigation Suggestions</b>		
Awareness campaigns	5	27.8
Stricter laws and enforcement	6	33.3
Community involvement	4	22.2
Reforestation programs	3	16.7

Source: Field Survey, 2025

## 4. Discussion

### 4.1 Species Diversity and Dominance

The identification of 22 angiosperm species across 10 families indicates moderate diversity in Monkin Forest, with a Shannon–Wiener Diversity Index ( $H' = 2.58$ ). This is lower compared to studies carried out by Patel and Punjani (2021), who reported 471 species in Gujarat, India, while Hounnon *et al.* (2021), documented 185 species in Benin. The dominance of *Pterocarpus erinaceus* (Fabaceae) aligns with findings by Biaou *et al.*, (2023) and Asigbaase *et al.*, (2024), where Fabaceae was prevalent in Nigerian ecosystems. The low abundance of

### 4.2 Invasive Species

Exotic species such as *Eucalyptus globulus*, *Azadirachta indica*, and *Leucaena leucocephala* pose threats to native biodiversity. *Eucalyptus globulus*'s high water consumption and allelopathy mirror findings by Borokini *et al.* (2023), who noted invasive species' ecological impacts in Nigeria. These species' dominance may suppress native flora, necessitating management strategies like selective removal.

### 4.3 Anthropogenic Impacts

Significantly impacted Monkin Forest, with 55.6% of respondents reporting reduced plant diversity. This agrees with the report of Chukwuma *et al.* (2021) and Olowokudejo *et al.* (2018), who linked habitat degradation to agricultural expansion and urbanization. The prevalence of subsistence farming (55.6%) reflects local dependence on forest resources, highlighting the need for sustainable practices.

### 4.4 Conservation Awareness

The high conservation awareness (66.7%) is promising, but inadequate protection (44.4%) suggests enforcement gaps. Respondents recommended stricter laws, community involvement, and reforestation. Similar observations were reported by Soladoye *et al.* (2013), emphasizing multi-stakeholder conservation approaches.

## 5. Conclusion

Monkin Forest hosts a moderately diverse angiosperm flora, with 22 species across 10 families. *Pterocarpus erinaceus* dominates, while low-abundance species and invasive exotics threaten biodiversity. Anthropogenic activities, particularly farming and logging, drive habitat degradation, necessitating urgent conservation measures. Enhanced enforcement, community engagement, and long-term monitoring are critical for sustainable forest management.

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