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Research Paper

Floristic Diversity of Woody Plants in Forested Wetlands of the Boyo Highlands in Cameroon

Titus Fondo Ambebe*, Nyong Princely Awazi, Georgette Oyang Ekanya
Department of Forestry and Wildlife Technology, College of Technology, The University of Bamenda, Cameroon
**Corresponding Author*

ABSTRACT: *Forested wetlands play a vital ecological and socio-economic role, particularly in biodiversity conservation. This study assessed the floristic diversity status of woody species in forested wetlands at two sites of Fundong Subdivision, Boyo Highlands of Cameroon, which are under two distinct levels of anthropogenic disturbance: Ijim (low disturbance) and Fujua (high disturbance). Data were collected in March 2024 from eight 10 m × 10 m quadrats. Woody species were identified using the PlantNet app and from which Margalef species richness index (d), Shannon-Wiener index (H), Relative Density (RD), and Sørensen similarity index (Cs) were determined. The effect of disturbance on ecological indices was tested with one-way analysis of variance. Ten woody species from ten families were recorded encompassing a total of 283 individual stems which were mainly used for timber and medicine. Unlike d whose increase from the site of high disturbance to that of low disturbance was not statistically significant ($p = 0.267$), the similar trend for H was significant ($p = 0.056$) indicating greater ecological balance in the low disturbance site. Value of Sørensen index (0.625) indicated somewhat moderate overlap between the sites. Across sites, six species were found to be abundant, with Sida acuta and Blumea balsamifera ranked at the top of the category. Human activities such as logging, farming, and grazing significantly influenced woody species diversity in the forested wetlands. Promotion of sustainable harvesting, reinforcement of traditional ecological knowledge, and prioritization of community-based wetland management could potentially maintain the floristic diversity of the Boyo Highlands.*

KEYWORDS: *Boyo Highlands, Disturbance, Ecological Indices, Floristic Diversity, Wetlands, Woody Plants*

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I. INTRODUCTION

Forested wetlands in Africa represent some of the most ecologically rich yet understudied ecosystems on the continent (Thamaga et al., 2022). These landscapes exist at the interface of terrestrial and aquatic realms, offering a unique blend of biodiversity and ecosystem functionality. Despite their undeniable ecological significance, particularly in Central and West Africa, forested wetlands have largely remained on the periphery of scientific inquiry. This neglect has left critical knowledge gaps, especially in the face of escalating threats from anthropogenic pressures such as urbanization, agriculture, and climate change (Awazi et al., 2024a). Cameroon, situated in the heart of Central Africa, exemplifies both the ecological wealth and conservation challenges facing forested wetlands (Ajonina et al., 2025). Forested wetlands function as ecological powerhouses. They provide an array of ecosystem services, including water purification, flood regulation, groundwater recharge, and carbon sequestration (Tanyi and Kometa, 2015). In addition, they serve as habitats for a wide range of flora and fauna, many of which are endemic or threatened. As noted by Mandishona and Knight (2022), wetlands are biodiversity hotspots that support species not typically found in other ecosystems, owing to their fluctuating water levels and complex hydrological regimes. In Africa, where many rural communities are heavily dependent on natural resources, these ecosystems also offer direct benefits such as food, medicine, and building materials (Dube et al., 2023).

Despite these values, forested wetlands are underrepresented in ecological research across Africa. According to Mitchell (2013), less than 10% of wetland studies conducted on the continent focus specifically on forested wetlands. Most research is skewed toward more accessible or economically significant ecosystems like savannahs or lowland rainforests. This pattern is especially pronounced in Central and West Africa, regions with

high ecological potential but limited scientific infrastructure and funding. As noted by Mumuni et al. (2025), these regions are particularly susceptible to habitat loss due to rapid demographic expansion and land-use change, yet are among the least understood in terms of wetland biodiversity. Cameroon is often referred to as "Africa in miniature" due to its remarkable ecological diversity. The country hosts over 9,000 plant species, placing it among the top countries in tropical Africa in terms of plant species richness per degree square (Murphy et al., 2023). Its varied landscapes, ranging from coastal mangroves to montane forests create a mosaic of habitats that support a multitude of life forms. However, research in Cameroon has largely concentrated on lowland rainforests and savannah ecosystems, with forested wetlands receiving limited attention. This neglect is particularly concerning given the mounting threats these ecosystems face. Urban sprawl, logging, agriculture, and infrastructure development are encroaching upon these sensitive areas (Chebo, 2009; Enomah et al., 2024). Despite being critical reservoirs of biodiversity and cultural knowledge, forested wetlands are often drained or converted with minimal ecological assessment.

The Northwest Region of Cameroon offers a distinctive ecological context within the national landscape. Situated within the Cameroon Highlands, this region is characterized by montane forests and high-altitude wetlands, ecosystems that are both ecologically significant and environmentally fragile (Asongwe et al., 2022; Awazi et al., 2024b). One of the crown jewels of this area is the Kilum-Ijim Forest, the largest remaining Afromontane forest in West Africa. According to Awazi (2024b; 2025), this forest is recognized for its high endemism and biological diversity, supporting numerous species of conservation concern. Equally important is the Kimbi-Fungom National Park which encompasses a range of ecosystems from lowland rainforests to gallery forests and woodland savannas. These diverse ecological zones make the park a key biodiversity reservoir and a vital corridor for species migration. However, the adjacent forested wetlands, particularly those in the Boyo Division and around Fundong, remain insufficiently studied. These areas are increasingly threatened by agricultural expansion and urban encroachment, leading to habitat fragmentation and degradation.

In Fundong, an ethnobotanical survey recorded 82 tree species, many of which are used for medicinal, nutritional, and ritualistic purposes (Focho et al., 2009). These findings highlight the intertwined relationship between local communities and their forested environments. Traditional knowledge systems contribute significantly to biodiversity conservation and resource management, often preserving species and practices overlooked by formal conservation mechanisms. However, these systems are under threat from modernization, population growth, and land-use changes that erode both ecological and cultural landscapes. As Dingha et al. (2025) argue, local use of forest resources in wetlands can be sustainable if integrated with conservation planning, but this requires detailed understanding of both species diversity and community practices (data currently lacking for forested wetlands in the Boyo Highlands). The floristic composition and ecological functions of forested wetlands in montane regions like Boyo are poorly documented. While there have been broader assessments of Cameroon's forest diversity, few studies have focused on the unique ecological features of high-altitude wetlands and their associated plant communities. This gap hampers effective conservation and sustainable resource management. Given the ongoing threats to these ecosystems, there is an urgent need for systematic ecological surveys and long-term monitoring programs. Such research would not only document species diversity but also evaluate ecosystem health and resilience. As indicated by the Ramsar Convention, wetland inventories are a critical first step toward sustainable management, yet remain incomplete for much of Africa (Rebelo et al., 2018). In addition, interdisciplinary approaches that combine ecological, ethnobotanical, and socio-economic perspectives are essential. These would provide a holistic understanding of how local communities interact with forested wetlands, what pressures they exert, and how traditional knowledge can be harnessed for conservation.

Forested wetlands in Africa, and particularly in Cameroon's montane regions, represent a frontier of ecological knowledge and conservation opportunity. These ecosystems, exemplified by the wetlands of the Boyo Highlands, offer invaluable ecosystem services and harbor a wealth of biodiversity. However, their future is imperiled by land-use changes, unsustainable resource extraction, and a critical lack of scientific attention. Focused studies, such as the one proposed to assess the floristic diversity of forested wetlands in the Boyo Division, are vital for addressing these gaps.

II. MATERIALS AND METHODS

Study area

Fundong Subdivision is the capital of Boyo Division in the North West region of Cameroon, with a population of about 20,000 inhabitants. It is located within the grassland savannah area of the mountainous western highland region of Cameroon. It is surrounded by Wum sub divisions to the west and to the east by Noni sub divisions while to the north it is bounded by Fungom sub division and to the south by Njinikom sub division. It is situated about 80 km from Bamenda and covers a land surface area of about 519 square kilometers with 34 villages and numerous quarters. The population of Fundong is mostly rural with farming as primary occupation. Fundong is mainly populated by Kom people. The area is characterized by temperatures ranging

from 15 ℃ to 38 ℃ and an average annual rainfall of 2400 mm. There are two seasons with the rainy season beginning in mid-March and ending in mid-October to give way for the dry season that runs from mid-October to March.

Research sites

This study was carried out in two areas which differed in level of anthropogenic disturbance; that is, in Fujua being the highly disturbed area and Ijim a lowly disturbed area of forest wetlands in Fundong. The high level of disturbance in Fujua can be attributed to human activities such as farming, gardening, fishing, logging and cattle grazing. On the other hand, the low level of disturbance in Ijim was attributed to little human interference resulting from cattle grazers trans-humance and the collection of non-timber forests products from the forest by the riparian communities.

Data collection

Eight (08) quadrats were established in two wetlands sites of 10m x 10m each and mapped out; they were separated from each other at equal distances of 25 m. Woody plant species were identified with the help of an identification plant app known as PlantNet which had been carefully pre-tested to ascertain accuracy of results. This app was used to identify the woody flora found in the two sites under study, and a count of the number of individual species was done in all 8 quadrats and recorded into data collection sheets. The data collection was done in March 2024.

Margalef index, Shannon-Wiener index, Relative Density, and Sørensen index were comuted from the data following the models of Margalef (1958), Shannon and Wiener (1949), and Sørensen (1948).

i. Margalef index (*d*)

This index determines the species richness and evenness or dominance.

$$d = \frac{S-1}{lnN}$$

Where S = total number of species; N = total number of individuals in the site; In = natural logarithm (Margalef, 1958).

ii. Shannon-Wiener index (*H*)

The Shannon-Wiener index was used to examine how diverse the woody species in the wetlands are.

$$H = -\Sigma\, Pi \ln Pi$$

Where $Pi = \frac{RD}{100}$; In = natural logarithm. Values ≤ 1.5 means low diversity, values found in the range of 1.5 ≤X≤2.5 means medium diversity, values ≥ 2.5 means high diversity (Shannon and Wiener, 1949).

iii. Relative Density (*RD*)

It was used to determine the abundance of specific species in the two wetland-disturbance categories (Mueller-Dombois and Ellenberge, 1974).

$$RD = \frac{Ns}{Nt} \times 100$$

Where Ns = number of individuals of species; NT = total number of individuals of all species. The floristic diversity status of the individual species was determined from their relative densities (RD) as described by Ambebe et al. (2021): abundant ($RD \geq 5.00$); frequent ($4.00 \leq RD \leq 4.99$); occasional ($3.00 \leq RD \leq 3.99$); rare ($1.00 \leq RD \leq 2.99$); endangered ($0.00 < RD \leq 1.00$).

iv. Sørensen similarity coefficient (*C*s)

*C*s indicates the degree of similarity between the two levels of disturbance.

$$Cs = \frac{2a}{(2a+b+c)} \times 100$$

Information on human interaction with wetlands and local uses of the species encountered was elicited by interview aided with a guide.

Data analysis

To analyze data that were collected from all the sources outlined above for this study, statistical techniques were applied which were both descriptive and inferential. The effect of disturbance level on number of stems and biodiversity indices were tested with one-way analysis of variance (ANOVA), at a significant level of 0.1. The analysis was performed in MS Excel 2016.

III. RESULTS

Classification and uses of woody plants in forested wetlands in Fundong Subdivision

According to the inventory carried out in the two levels of disturbance, some ten woody species belonging to diverse families were identified. Half of the number of species was trees and the other half shrubs. They offer a range of uses that are integral to the livelihoods of the local population. Medicinal value was the

most common use, with six species some of which included *Sida acuta, Blumea balsamifer*a, and *Solandra grandiflora*. Timber and fuelwood uses were also notable, particularly from species like *Alsophila glaucifolia, Eucalyptus robusta,* and *Tectona grandis*. Additionally, species like *Brillantaisia owariensis* and *Solandra grandiflora* were multipurpose, being used for both food and medicine (Table 1).

Table 1: List and economic value of woody flora in the study area

Family	**Scientific name**	**Common/Local name**	**Habit**	**Uses**
Cyatheaceae	*Alsophila glaucifolia*	Egwie	Tree	Timber
Ranunculaceae	*Ranunculus fluitans*	River water crowfoot	Tree	Timber, shade
Malvaceae	*Sida acuta*	Sheum	Shrub	Medicine
Asteraceae	*Blumea balsamifera*	Ngai camphor	Shrub	Medicine
Combretaceae	*Terminalia catappa*	Tropical almond	Tree	Fuel, medicine
Acanthaceae	*Brillantaisia owariensis*	Giant blue African salvia	Shrub	Medicine, food
Lamiaceae	*Tectona grandis*	Teak tree	Tree	Furniture, shade
Myrtaceae	*Eucalyptus robusta*	Swamp messmate	Tree	Fuel, timber
Euphorbiaceae	*Ricinus communis*	Castor-oil-plant	Shrub	Medicine
Solanaceae	*Solandra grandiflora*	Awouvus	Shrub	Medicine, food

Overall, a total of 283 stems were encountered in the study area. The two levels of disturbance varied in number of individuals per species. The portion with a low level of disturbance had 165 individual woody species, *Sida acuta* being the most abundant with a total of 57 individual trees. *Eucalyptus robusta, Ricinus communis,* and *Solandra grandiflora* were completely absent at this site. The highly disturbed site had 118 individual woody species, with *Blumea balsamifera* being the most abundant represented by a total of 54 individual trees (Table 2). However, the difference in number of individuals per species was not statistically insignificant between the two disturbance levels ($p = 0.188$).

Table 2: Total count of woody flora within the study area

Tree species	**Low**	**High**	**Total**
Alsophila glaucifolia	14	-	14
Ranunculus fluitans	4	-	4
Sida acuta	57	17	74
Blumea balsamifera	31	54	85
Terminalia catappa	24	-	24
Brillantaisia owariensis	26	-	26
Tectona grandis	9	-	9
Eucalyptus robusta	-	19	19
Ricinus communis	-	10	10
Solandra grandiflora	-	18	18
N	**165**	**118**	**283**

Floristic diversity of forested wetlands sites in Fundong Subdivision under low and high levels of disturbance

Although higher in absolute value in the lowly disturbed than highly disturbed site, the ANOVA did not detect as significant the difference in Margalef index between the wetland fragments ($p = 0.267$). In contrast, the Shannon-Wiener index was markedly affected by level of disturbance ($p = 0.056$), declining from the site of low to that of high disturbance (Table 3). The sites showed a Sørensen similarity index (Cs) of 62.5%.

Table 3: Relative Density (*RD*), Relative Abundance (P_i), Margalef index (*d*), and Shannon-Wiener index (*H*) of woody species in wetlands in Fundong Subdivision under two levels of anthropogenic disturbance

Disturbance	Tree species	*RD*	P_i	*D*	*H*
Low	*Alsophila glaucifolia*	8.484848	0.084848	2.546051	0.209312
	Ranunculus fluitans	2.424242	0.024242	0.58755	0.090173
	Sida acuta	34.54545	0.345455	10.96761	0.367182
	Blumea balsamifera	18.78788	0.187879	5.875503	0.314125
	Terminalia catappa	14.54545	0.145455	4.504553	0.280421
	Brillantaisia owariensis	15.75758	0.157576	4.896253	0.291176
	Tectona grandis	5.454545	0.054545	1.566801	0.158658
High	*Eucalyptus robusta*	16.10169	0.161017	3.773043	0.294057
	Ricinus communis	8.474576	0.084746	1.886522	0.209161
	Sida acuta	14.40678	0.144068	3.353816	0.279127
	Blumea balsamifera	45.76271	0.457627	11.10952	0.357727
	Solandra grandiflora	15.25424	0.152542	3.56343	0.286827

Floristic diversity status of woody plants in wetlands in Fundong Subdivision

Of the 10 woody species identified in the research area, 6 were classified as abundant comprising of *Sida acuta, Blumea balsamifera, Terminalia catappa, Brillantaisia owariensis, Eucalyptus robusta* and *Solandra grandiflora* while 02 (*Tectona grandis* and *Ricinus communis*) were occasional. Of the remaining 02, *Alsophila glaucifolia* was found to be frequent and *Ranunculus fluitans* fell in the rare category (Table 4).

Table 4: Relative density (RD) and floristic diversity status of woody plants in wetlands in Fundong Subdivision

Tree species	*RD*	Status
Alsophila glaucifolia	4.946996	Frequent
Ranunculus fluitans	1.413428	Rare
Sida acuta	26.14841	Abundant
Blumea balsamifera	30.03534	Abundant
Terminalia catappa	8.480565	Abundant
Brillantaisia owariensis	9.187279	Abundant
Tectona grandis	3.180212	Occasional
Eucalyptus robusta	6.713781	Abundant
Ricinus communis	3.533569	Occasional
Solandra grandiflora	6.360424	Abundant

IV. DISCUSSION

This study has brought out the importance, abundance and diversity of woody tree species of forested wetlands in Fundong. The local populations of Kom have been known to depend highly on forest resources including those wetlands. These forests and their trees in return provide the communities with economic, social, ornamental and environmental benefits. The results of this study indicate that there are diverse and abundant wetlands woody species in Fundong that are of varied relevance to the local populations. They are used for timber, fuel wood, food, utility poles, shade, fodder, ornamentals and medicine. This could also be seen in the document by Focho et al (2009) where 49% of tree species were being recorded in Fundong Central and were said to be useful in the lives of the local populations for food, construction materials, fuel wood, handicrafts and overwhelmingly medicine. Despite the myriad of benefits the forested wetlands in Fundong offer to the local communities, the ecosystem is being threatened by anthropogenic activities especially logging which is very rampant.

The findings clearly show that the less disturbed site was more diverse in terms of species than the highly disturbed site. The high representation of disturbance could be attributed to high anthropogenic activities

going on there. The findings of the study is in accord with the works of Ibrahim et al., (2019) and Ambebe et al. (2021) in which substantial declines in species richness of disturbed forest patches was marked by anthropogenic activity which did not only reduce the floral cover but also resulted in the modification of micro-climatic conditions. Also, this study is in line with Tanwie et al. (2024) who recorded low abundances of the individual species which were attributed to the fact that the wetlands of Bamenda III were disturbed as evident from the Margalef index and the disturbances were typically human induced. In a nutshell, the wetland ecosystems have increasingly come under pressure from population growth, housing and other infrastructural developments in the Fundong community. There was an insignificant difference between the two disturbance levels, with the results of the Margalef index indicating that the forested wetlands of Fundong were disturbed. The Shannon Weiner index indicated that, the highly disturbed site was of low diversity while the lowly disturbed site was of moderate diversity. If ongoing increases in anthropogenic activities remain uncontrolled, species diversity and richness will decline even further. According to the Sørensen similarity index, the two wetlands were similar in composition.

V. CONCLUSION

This study explored the floristic diversity status of forested wetlands in the Fundong Subdivision of the Boyo Highlands, Cameroon, focusing on two sites with varying levels of anthropogenic disturbance: Ijim (low disturbance) and Fujua (high disturbance). The study successfully identified and compared the woody flora composition, abundance, and diversity in these ecologically significant sites. A total of 283 woody individual species across 10 distinct families were recorded. The findings revealed that the Ijim site, characterized by minimal human interference, exhibited greater floristic diversity and a tendency for superiority in species richness than the highly disturbed Fujua site. Although species richness and abundance did not differ significantly between the two sites, the level of disturbance clearly impacted species evenness and ecological balance. Dominant species such as *Sida acuta* and *Blumea balsamifera* were recorded across both sites, but a number of species, including Eucalyptus robusta and Ricinus communis, were absent from the low disturbance site, indicating the selective pressure of anthropogenic activities. Additionally, the Sørensen similarity index suggested moderate overlap in species composition between the two sites, reflecting the influence of environmental gradients and human activity. Interview findings further supported this, highlighting traditional ecological knowledge, customary practices, and the perception of biodiversity changes among local communities. These insights underline the essential role local knowledge plays in the sustainable management of forested wetlands. The study underscores that increased human activity significantly influences biodiversity patterns in forested wetlands, often reducing floristic diversity and altering ecosystem functions. The protection and sustainable management of these wetlands are therefore critical for maintaining ecological stability and supporting livelihoods in the region.

Based on the findings of this study, different policy recommendations emerge with the most prominent being the strengthening of community-based management, promoting sustainable livelihood alternatives, enforcing zoning and land-use regulations, integrating customary laws into formal legislation, instituting environmental education and awareness, monitoring and research, and institutional collaboration.

- Empower and support local communities, particularly in Ijim, to lead conservation efforts through inclusive community-based forest wetland management frameworks. This can harness indigenous knowledge and traditional practices that promote sustainable resource use.
- To reduce pressure on wetlands, alternative income-generating activities such as agroforestry, beekeeping, and ecotourism should be introduced. These alternatives can lessen dependence on farming, logging, and grazing in sensitive areas.
- Develop and enforce land-use planning policies that clearly demarcate conservation zones and regulate agricultural, fishing, and grazing activities in wetlands. Buffer zones should be established to limit human encroachment in core biodiversity areas.
- Customary land and forest practices that align with conservation should be recognized and incorporated into municipal and national environmental governance to ensure culturally appropriate management approaches.
- Conduct awareness campaigns in schools and communities to highlight the ecological importance of wetlands and the long-term consequences of biodiversity loss. Education can shift behavior and foster stewardship among the younger generation.
- Establish long-term biodiversity monitoring programs using tools like quadrat sampling and participatory ecological assessments. Regular monitoring will help in assessing the effectiveness of conservation measures and guiding adaptive management.
- Strengthen collaboration between government agencies, NGOs, and research institutions to support data sharing, policy implementation, and funding for conservation initiatives in the Fundong Subdivision and beyond.

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