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ORIGINAL RESEARCH ARTICLE

Preliminary Checklist of Macrophytes and Conservation Needs in Ganjuwa Bauchi State, Nigeria

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ABSTRACT

Macrophytes in Ganjuwa LGA play a critical role in maintaining the healthy and stability of freshwater ecosystems, and maintain ecosystem properties and function. The study was conducted in Ganjuwa LGA of Bauchi State to document and compile voucher specimens of macrophytes. Swamps and lakes are the primary aquatic ecosystems used for study. A richness of 49 macrophytes belonging to 21 families was recorded and collected using the quadrat sampling method. A 1m² square was used at an interval of 10m² between each quadrat sampling. These findings contribute to checklists and *in-situ* photographs of rare plant taxa, including *Ranalisma humile: Ammannia senegalensis, Pontederia natans,* and other macrophytes. Notably, *Aeschynomene fluitans* (the giant water-sensitive plant) was reported from one of the study locations, marking the first documentation of Aeschynomene fluitans in West Africa. However, ongoing habitat degradation, deforestation, infrastructure developments, urbanization, and poor agricultural practice continues to threatens freshwater aquatic ecosystems and their plants diversity. Conservation measures are particularly needed on roadways with swamps that are increasingly impacted by human activities.

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INTRODUCTION

As producers, macrophytes contribute to maintaining key functions and related biodiversity in freshwater ecosystems, and to meet the needs of human societies (Bornette & Puijalon, 2009; Kutama *et al.,* 2015). According to Sugimani & Sanjeet (2018), aquatic vascular plants (macrophytes) are an essential component of ecosystems and play a vital role in ecosystem services. As producers, Rejmankova (2011) notes that aquatic plants provide habitat for algae and other microphytes (Mpopetsi *et al.,* 2025). Aquatic vascular plants, comprising both macrophytes and helophytes, are integral components of freshwater ecosystems and contribute to ecological balance by providing habitat and food to aquatic fauna, stabilizing sediments, and enhancing water quality, while supporting nutrient cycling and regulating climate (Odoligic *et al.*, 2020). They provide multiple benefits for humans (Sidinei, 2021). Despite their ecosystem services and ecological significance, aquatic plant communities are increasingly threatened by anthropogenic pressures such as habitat destruction, infrastructural developments, pollution, urban expansion, and unsustainable agricultural practices (FGN, 2015).

In many parts of Sub-Saharan Africa, including Nigeria, aquatic plants are poorly documented, and their ecosystems are underexplored —a critical gap, given the IUCN Data Deficient (DD) status for some Nigerian aquatic flora (Smith et al., 2009).

Bauchi State is located in north-eastern Nigeria, (Sudan Savanna vegetation Zone) BSOD, (2008), encompasses diverse wetland habitats such as marshes, rivers, lakes, and seasonal swamps that support a variety of aquatic flora. Despite Bauchi's wetland richness, no checklists exist for Ganjuwa LGA. However, the growing fact of infrastructural developments, land-use changes, and environmental degradation poses a significant risk to those fragile ecosystems. The Ganjuwa LGA area, in particular, is experiencing rapid environmental changes,

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yet there is limited baseline information on its aquatic ecosystem's plant diversity.

Previous studies on aquatic vascular plants in Nigeria have left many species of macrophytes undocumented, as they reported macrophytes in Nigeria. This research aims to fills the knowledge gap by regarding a detailed checklist of available macrophytes in Ganjuwa LGA which could serve as a foundational resource for further botanical, ecological, and ethnobotanical studies through these objectives including (i) collections and to prepare of voucher specimens of macrophytes (ii) document checklist of macrophytes , (iii) provide photo-guide of some macrophytes from study locations.

MATERIALS AND METHODS

List of acronyms and their meanings

BSOD: Bauchi State Official Diary

DD: Data Deficient

DD format: Decimal degree format

NE: Not Evaluated

FGN: Federal Government of Nigeria

GPS: Global Positioning System

IUCN: International Union of Conservation of Nature

LGA: Local Government Area

JSTORE: Journal Storage

POWO: Plants of the world online

Study Area

The study was conducted in Ganjuwa LGA, which covers an area of 5,440 km². Some locations with freshwater aquatic ecosystems were selected for the study, includes Gubi Lake and many swamps, including seasonal swamps along road sides.

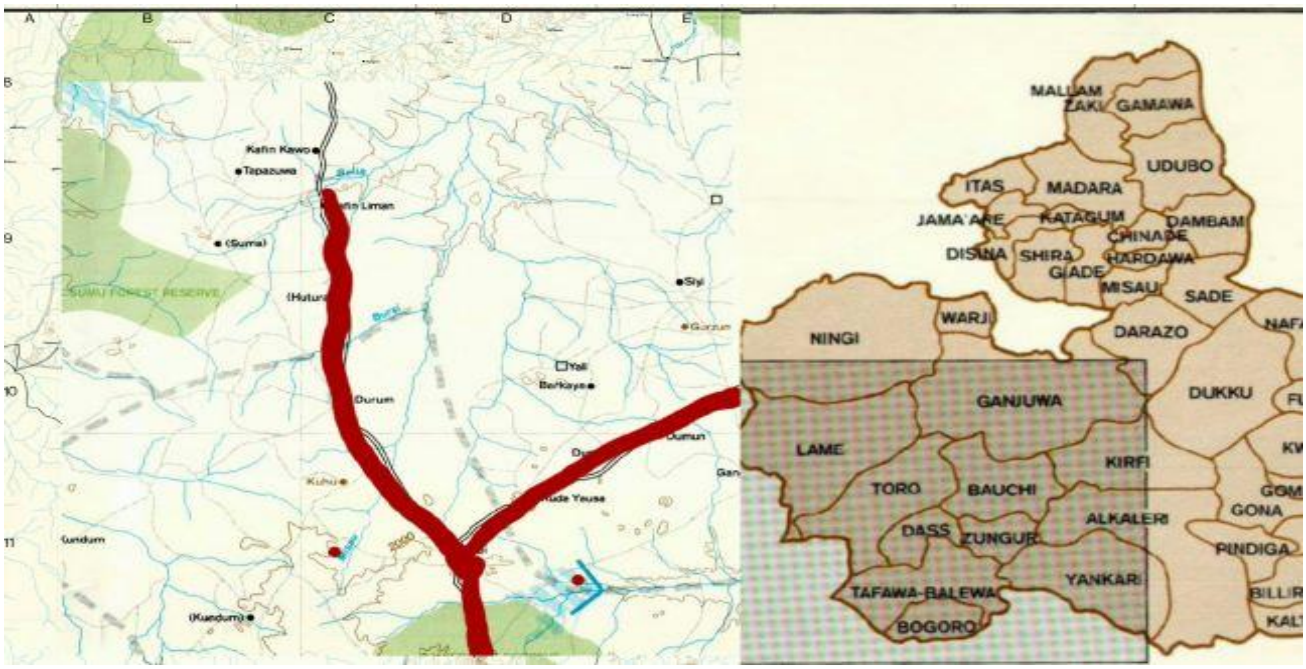

Figure 1. Map of Bauchi State and Ganjuwa LGA showing some study locations in red color.

Data Collection and Sampling Method

Field surveys were carried out throughout the season. For sampling methods, 1m² quadrats were employed for data recording at a 10-meter interval between each quadrat for some aquatic fresh ecosystems with an area cover of more than 10m². However, 1 m² quadrat sampling was used for swamps with an area cover of less than 10 m². GPS coordinates were recorded for each sampling site from all study locations of aquatic ecosystems that were covered.

voucher specimen compilation

Available voucher specimens were compiled from the study locations using plant-collecting techniques. Locally made Long fronds/rakes were used for collecting macrophytes, which are known to be important for some aquatic ecosystems. The departments of water are unknown. Voucher specimens were deposited at the ATBU herbarium.

Specimens identification and authentication

Taxonomic identification keys were constructed to assign collected macrophytes specimens, and were identified with the help of a book, including Flora of West Tropical Africa by Hutchinson and Dalziel (1972). Some collected macrophyte specimens were identified using available illustrations and relevant literature. Some collected specimens of macrophytes were verified and compared with available herbarium specimens from the local herbarium (Abubakar Tafawa Balewa University, Bauchi) and authenticated by curators and experts in plant taxonomist, while some collected specimens of macrophytes were verified by comparing with journal storage (JSTORE) online specimens and plants of the world online (POWO).

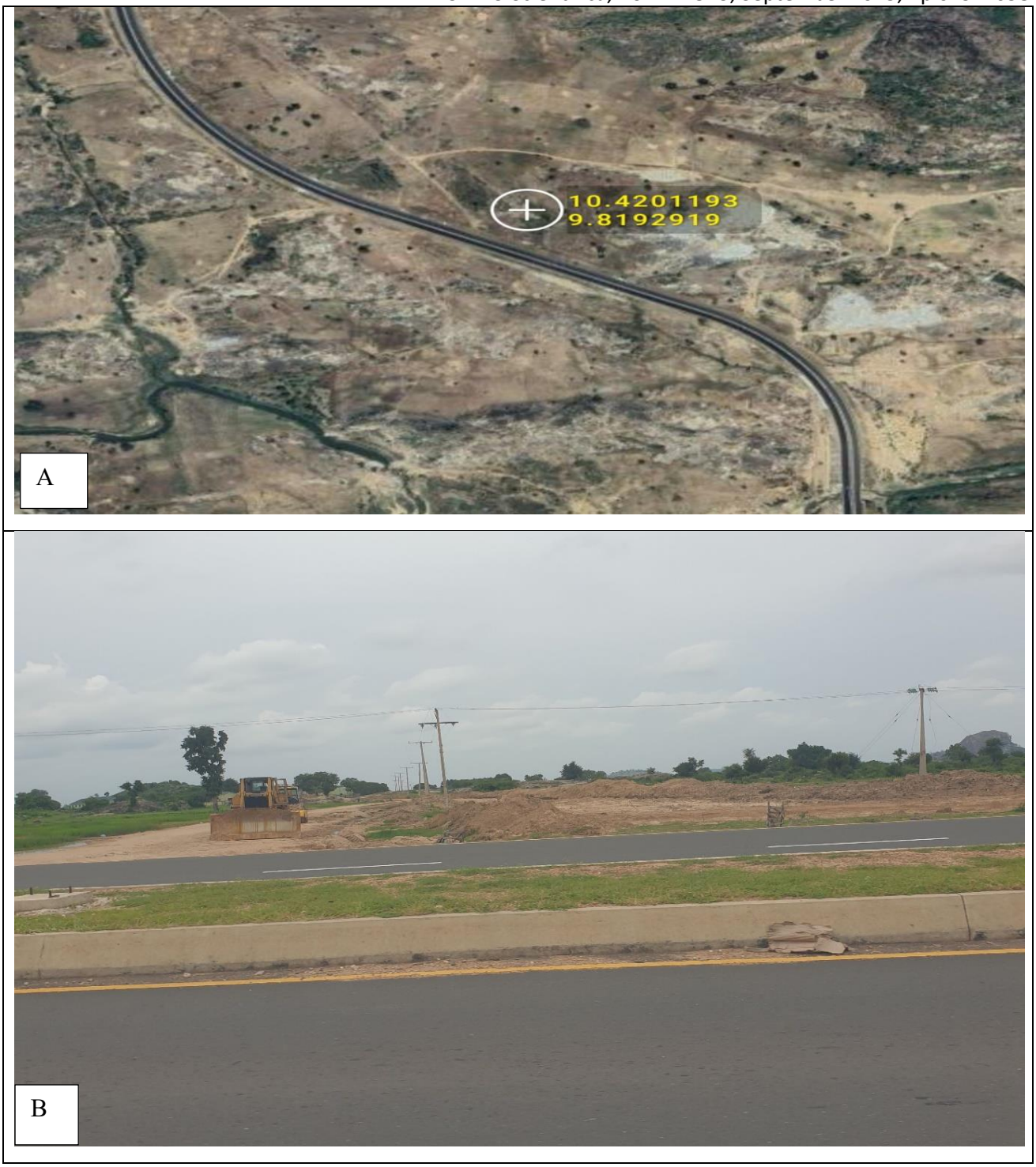

Figure 2: How infrastructural development threatens freshwater aquatic ecosystems (Swamps) and their plant diversity. A. Satellite imagery evidence. (recent dualization of road Bauchi to Kano Road in Ganjuwa L.G.A). B. recent project with bulldozer along roadside (N10.425652, E 9.8150031). Photos A & B: Musa, Umar. (2025).

Table 1: Richness of macrophytes per family documented in Ganjuwa LGA in freshwater aquatic ecosystems

Family	Species richness	Family	Species richness	Family	Species richness
Alismataceae	4	Gentianaceae	1	Nymphaeaceae	3
Araceae	3	Hydrocharitaceae	2	Onagraceae	2
Asteraceae	2	Lentibulariaceae	2	Poaceae	3
Boraginaceae	1	Lythraceae	3	Pontederiaceae	2
Convolvulaceae	2	Malvaceae	1	Polygonaceae	1
Cyperaceae	9	Marantaceae	1	Verbenaceae	2
Fabaceae	3	Marsileaceae	1	Typhaceae	1
Total					**49**

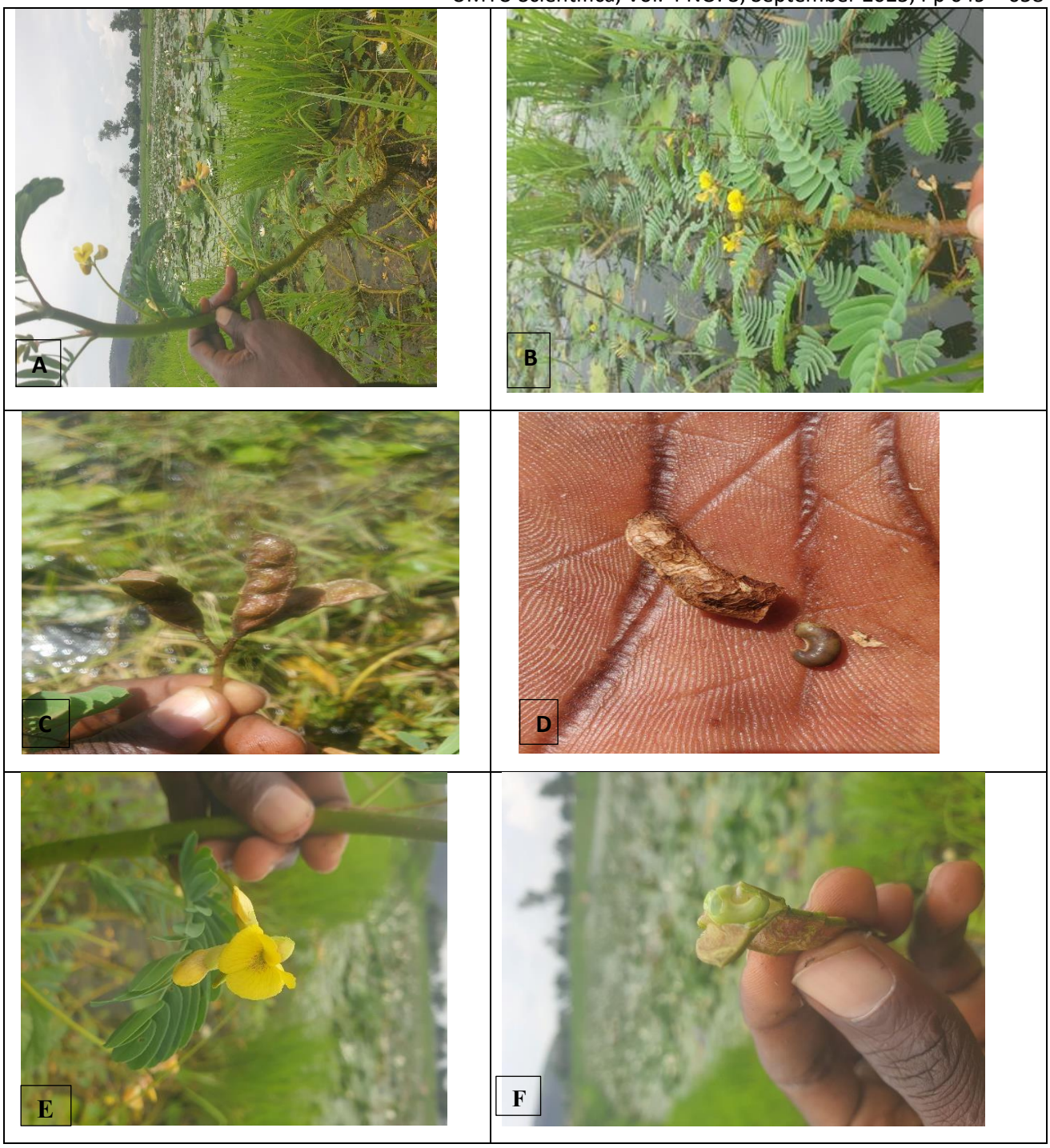

Figure 3: *Aeschynomene fluitans* Peter. A. in a swamp ecosystem, B. floating on the surface of water, C. dry legume pods, D. dry fruit (legume pod) and dry seed, E. Flowering, F. fresh fruit and exposed fresh seed. Photos A-F: Musa Umar, 2024 & 2025.

RESULTS AND DISCUSSION

Richness of 49 macrophytes belonging to 20 families was recorded from different locations in some locations with freshwater aquatic ecosystems in Ganjuwa LGA of Bauchi State. In Table 1, 8 families were represented by 1 species, while more than one species represented 13 families. The family Cyperaceae has the highest number of species recorded, with a richness of 9 species.

Some Sampling locations, including lakes and marshes with an area of more than 10m^2 more than one sampling done, while some swamps along the roadside with an area of less than 10m^2 one sampling done

Table 2 is a list of macrophytes documented in Ganjuwa lake and swamps with their current IUCN status global 2025. The IUCN did not evaluate some macrophytes, while 30 macrophytes have an IUCN status of Least Concern (LC).

Discussion

From the results obtained from various freshwater aquatic ecosystems along roadsides, including seasonal swamps and Lake Gubi in Ganjuwa Local Government Area of Bauchi State, 49 species of macrophytes from 20 families were documented as floating or free-floating, emergent, and submerged. Another studies on checklist of aquatic

macrophytes was conducted by Adesina *et al.,* 2011 on Jebba lake, Nigeria, were they documented a richness of 46 Aquatic macrophytes belonging to 22 families, from their finding, richness of aquatic macrophytes they reported is less than the finding reported in Ganjuwa LGA within selected study locations, this is because more than one type freshwater aquatic ecosystems was involve including swamps and lake.

Table 2: List of macrophytes documented in Ganjuwa LGA in freshwater aquatic ecosystems

Family	Species	IUCN Status global 2025
Alismataceae	*Butomopsis latifolia* (D.Don) Kunth	LC
	Limnophyton obtusifolium (L.) Miq.	LC
	Ranalisma humile (Rich. Ex Kunth) Hutch	LC
	Sigittaria guayanensis Kunth	NE
Araceae	*Lemna aequinoctialis* Welw	LC
	Pistia stratiotes L	LC
	Wolffia arrhiza (L) Horkel ex Wimm	LC
Asteraceae	*Eclipta prostrata* (L.) L	LC
	Grangea maderaspatana (L.) Poir.	LC
Boraginaceae	*Euploca spp*	-
Convolvulaceae	*Ipomea aquatica* Forssk	LC
	Ipomea asarifolia (Desr.) Roem. & Schult.	NE
	Ipomoea carnea Jacq.	NE
Cyperaceae	*Cyperus albescence* (Steud.) Larridon & Govaerts	NE
	Cyperus articulatus L.	LC
	Cyperus lanceolatus Poir.	LC
	Cyperus reduncus Hochst. ex Boeckeler	LC
	Cyperus tenuispica Steud.	LC
	Eleocharis acutangulata (Roxb.) Schult.	LC
	Fuirena umbellata Rottb.	LC
	Schoenoplectiella senegalensis (Steud.) Lye	LC
	Scleria spp	-
Leguminosea	*Aeshynomene fluitans* Peter	NE
	Aeschinomene sensivita Sw.	NE
	Neptunia oleracea Lour.	LC
Gentianaceae	*Exacum oldenlendoides* (S.Moore) Klack.	NE
Hydrocharitaceae	*Ottelia ulvifolia* (Planch.) Walp.	LC
	Vallisneria spiralis L.	LC
Lentibulariaceae	*Utricularia gibba* L.	LC
	Utricularia stellaris L.f.	VU
Lythraceae	*Ammannia senegalensis* Lam.	LC
	Rotala stagnina Hiern	LC
	Trapa natans L.	LC
Malvaceae	*Melochia corchorifolia* L.	NE
Marsileaceae	*Marsilea minuta* L	LC
Nymphaeaceae	*Nymphaea lotus* L.	LC
	Nymphaea micrantha Guill. & Perr.	NE
	Nymphoides senegalensis (G.Don) Tippery	NE
Onagraceae	*Ludwidia adscendens* (L.) H.Hara	LC
	Ludwigia erecta (L.) H.Hara	NE
Poaceae	*Oryza barthii* A.Chev.	LC
	Panicum paucinode Stapf	NE
	Sacciolepis africana C.E.Hubb. & Snowden	LC
Pontederiaceae	*Heteranthera callifolia* Rchb. Ex Kunth	LC
	Pontederia natans P.Beauv.	LC
Polygonaceae	*Persicaria senegalensis* (Meisn.) Sojak	LC
Verbenaceae	*Stachytarpheta spp*	-
	Phyla nodiflora (L.) Greene	NE
Typhaceae	*Typha domingensis* Pers	LC

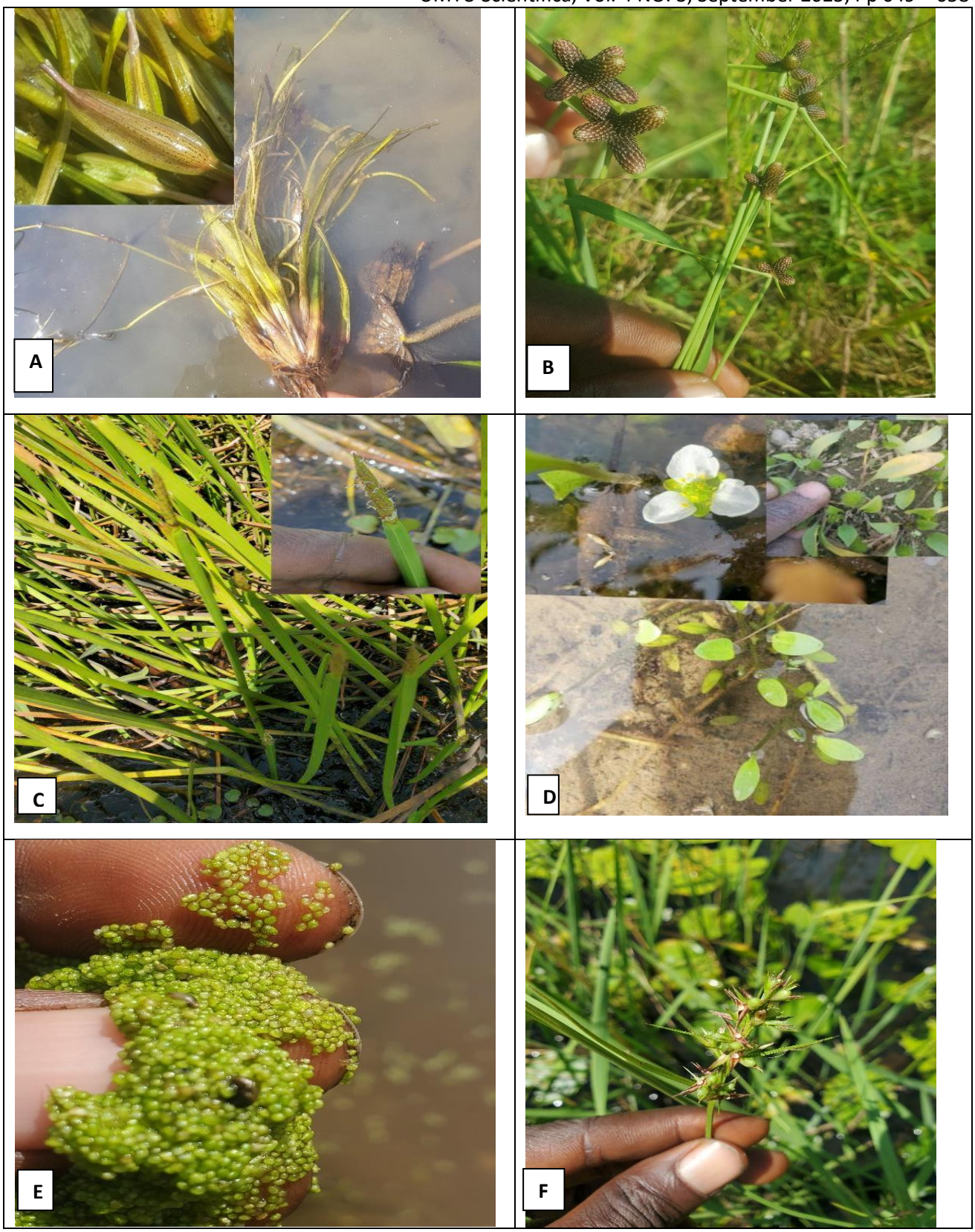

Figure 4: Aquatic vascular plants. A. *Uttelia ulvifolia*, B. *Cyperus albescence*, C. *Eleocharis acutagulata*, D. *Ranalisma humile* E. *Wolffia arrhiza*, F. *Scleria spp*, Photos A-F: Musa Umar, (2022 & 2024).

Also another study was conducted in South West Nigeria on diversity and distribution patterns of aquatic macrophytes in selected aquatic ecosystems by Oyebanji *et al.* (2020) were they reported 83 species of aquatic macrophytes belonging to 41 families, the number of species they reported was higher than number of macrophytes reported in Ganjuwa LGA with richness 49 macrophytes belonging to 20 families, this is because number of areas they covered in conducting their study is higher than locations of Ganjuwa LGA, were study was conducted, also in documenting macrophytes around Ganjuwa LGA, although this study skip several long rivers and other microhabitat such as rock pools and drainages.

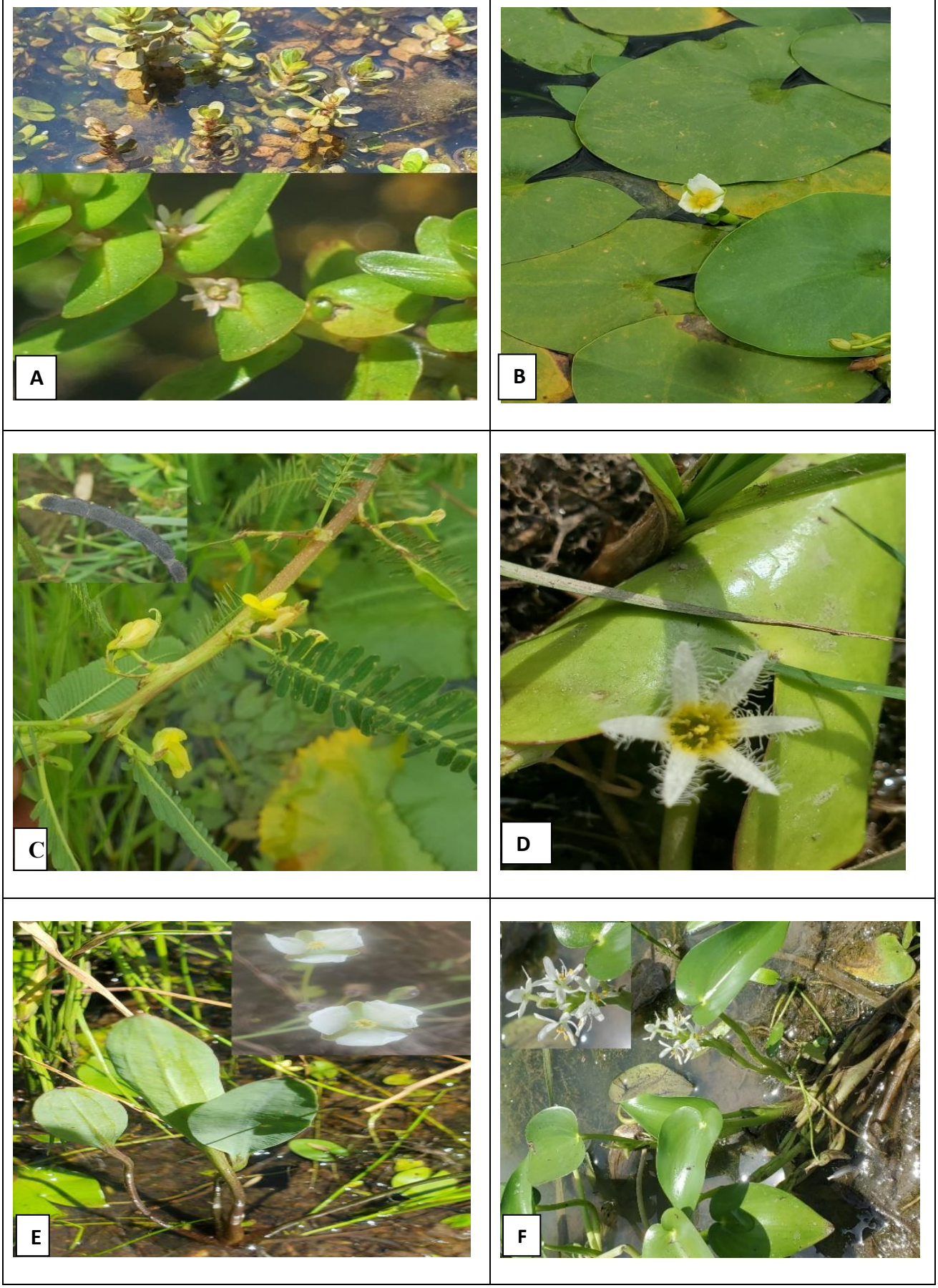

Figure 5: A. *Rotala stagnina*, B. *Sigittaria guayanensis*, C. *Aeshynomene sensitiva*, D. *Nymphoids senegalensis* E. *Butomopsis latifolia*, F. *Heteranthera califilia* Photos A-F: by Musa Umar, (2022 & 2024).

Plate 1: A. *Neptunia oleracea*, B. *Utricularia gibba*, C. *Schoenoplectiella senegalensis*, D, *Pontedaria natans*, E. *Vallisneria spiralis,* F. Oryza barthii. Photo A-F Musa Umar 2023-2024.

Past work done on macrophytes in Nigeria left huge gaps, as many macrophytes remained undocumented. in this paper, 49 macrophytes were reported in this paper, with family Cyperaceae being the highest number of species recorded. Twelve macrophytes were not reported by Uka et al. (2009) as they documented macrophytes of Nigeria,

including Bauchi. *Nymohea lotus* and *Nymphea micrantha* were encountered from majority of study locations including swamps and lake. Akwuma *et al.,* (2021) reported *Nymphaea lotus* and *Nymphaea micrantha* as floating macrophytes on assessment of emergent and floating macrophytes from Waya Pond in Ganjuwa. Some emergent aquatic vascular plants, such as *Typha domingensis* and *Cyperus articulatus*, were also documented in swamps and lakes. Aquatic vascular plant including *Aeshynomene fluitans* is now reported as a West African species, and was documented from swamp freshwater from one location in Ganjuwa Local Government Area.

Table 3: Sampling locations of macrophytes in Ganjuwa LGA of Bauchi State, Nigeria

Types of Aquatic Ecosystems	Location of Sampling	Sampling Unit	Coordinates (DD Format)
Swamps	Swamps along the roadside to the Gubi Campus, ATBU minor road, Ganjuwa	Unit 1	N 10.4546; E 9.82801
		Unit 2	N 10.4446; E 9.81733
Seasonal Swamps	Seasonal swamps along the roadside, Bauchi Airport Road, close to ATBU gate, Ganjuwa	Unit 1	N 10.44755; E 9.8065
		Unit 2	N 10.44480; E 9.80826
Seasonal Swamps	Seasonal swamps along roadside Ganjuwa	Unit 1	N 10.4253; E 9.81562
		Unit 2	N 10.4256; E 9.81578
		Unit 3	N 10.42579; E 9.81644
Swamp	Swamp at Junction between ATBU minor road Gubi Campus and Durum Road, Ganjuwa	Unit 1	N 10.4368; E 9.8157
Lake	Lake Gubi	Unit 1	N 10.40030; E 9.85560

CONCLUSION

Aquatic vascular plants from various freshwater ecosystems in Ganjuwa LGA provide multiple ecosystem services, including provisioning, supporting, and regulating services, as well as maintaining ecosystem properties. Ongoing infrastructural developments, such as road construction, urbanization, habitat degradation, and poor agricultural practices, are threats to aquatic ecosystems and their plant diversity.

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DISCLOSURE OF CONFLICT OF INTEREST

The authors have declared no competing interests.

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