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Ecological Survey of Aquatic Macrophytes in Tatabu Reservoir, Niger State, Nigeria

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Abstract: Tatabu reservoir water body was divided into three distinct sampling sites (Upper, Middle and Lower course). Three different sampling locations were established between each sampling site. The entire areas of each of the sampling plots were inventoried into details and the biological forms and spatial distributions of the aquatic macrophytes were noted, water and sediment samples were also collected for analysis and nutrient load. A total of 21 plant species belonging to 13 families were recorded during the low water regime while 24 plant species belonging to 14 families were recorded during the high water regime. The floristic biological life form of these plants consists of 17 emergent plant species, 5 floating and 2 submerged plant species during the low water regime while during the high water regime, there were14 emergent, 5 floating and 2 submerged macrophyte species. comparative studies of low and high water regime showed that the maccrophytic species composition during both water regimes were a bit similar. Nitrogen concentration (mg/l) in water samples ranges between 3.5 to 13.5 during the low water regime and 5.5-17.5 during high water regime, Phosphorous (mg/l) ranged between 2.8-15.7 and 2.7-17.5 during low and high water regime respectively. Potassium (mg/l) ranged between 3.5-14.0 and 3.0-16.5 during low and high water regime respectively. Nitrogen concentration (mg/l)in soil (sediments) samples ranges between 3.0 to 12.5 during low water regime and 3.0-6.0 during low and high water regime respectively, potassium (mg/kg) ranged between 3.0-12.5 and 3.0-13.5 during lowand high water regime respectively. Higher proliferation of aquatic macrophytes and more species were observed during the higher water regime than what was observed during the low water regime. This present study shows a dangerous trend in the rate at which invasive plants are colonizing the reservoir, it is therefore essential to monitor and manage the influx of these invasive plants in the reservoir, most especially typha spp, water lilly and other aquatic plants that can bore heavy financial loses.

KEYWORDS: tatabu reservoir, aquatic plants, nutrient loads, water regime.

I. Introduction

Reservoirs are created usually for a particular purpose either to generate electricity, irrigation or domestic usage. Irrespective of the main objective, the fish yield from such reservoirs may constitute a substantial contribution to a country's total domestic fish production (Dan-kishiya *et al*., 2012) but, the effectiveness of their contributions depends largely on adequate fish assemblages and proper management of the reservoir ecosystem and present organisms both flora and fauna(Mustapha, 2008). Organisms that occur in a particular place may be classified as an assemblage or composition of such place. Aquatic plants serve a critical role in lake and river ecosystems. Macrophytes provide food for waterfowl and wildlife, protect small fish and create spawning habitats, act as refuges for zooplankton, and oxygenate water. Macrophytes also play a crucial role in nutrient transport to and from sediments. They can be found throughout the littoral zone. While plants are important to the overall ecology of a water body, the proliferation of some species can be unhealthy; of particular concern are the exotic or non-native plants which can frequently crowd out native aquatic plants (Madsen, 2004). They can become nuisances primarily because there are no natural controls to their growth. Excess nutrients from runoff and other sources can also lead to overgrowth of both native and exotic species (Madsen, 2004). Aquatic plants are referred to as "weeds" when they are a non-native species, or a native species growing in such abundance that the use and enjoyment of recreational waters is impaired. Considering the importance of the water body to the surrounding communities and the problem associated with excessive macrophytes infestation, there should be proper monitoring through survey of the present aquatic macrophytes so as to identify the native, invasive and noxious species that are present in the water body for proper management purposes. The general objective of the study is to conduct a floristic and nutrient load survey in the reservoir with specific objectives to identify the plant species that are present and its diversity in Tatabu reservoir and to estimate the nutrient load (NPK) of water and soil sample collected from Tatabu reservoir.

II. Materials and Methods

Description of study area

Tatabu reservoir also called lake Ndakalowu is located between 9º 12 - 9º 14 N and 4º 53 - 4º 57 E 242 a.s.l along the Ilorin-

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Kaduna road precisely in between Jebba and Mokwa (about 24km from Jebba Township) in the guinea savannah region of North-West Nigeria.

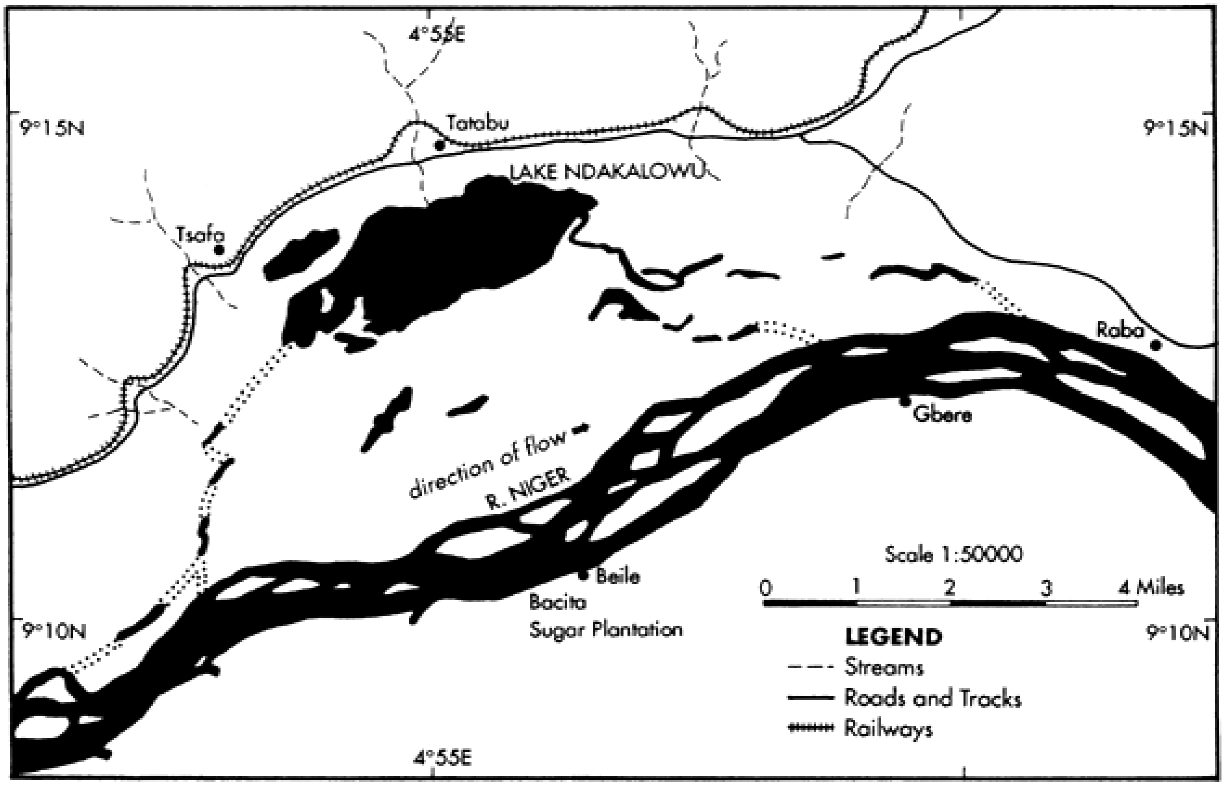

Fig. 1. Lake Ndakolowu and other floodplain pools cut off from the River Niger.

Plant diversity data collection.

The water body was divided into three distinct sampling sites (Upper, Middle and Lower Course) represented by station 1, station 2 and station 3. Three sampling plots with dimensions 30m x 30m were established extending from open water to shoreline in each sampling sites represented by site A, site B and site C. Sampling was done between second and third week of May 2023 *i.e* during low water regime and between second and third week of August 2023 *i.e* during high water regime. Based on the hydrological cycle of the water bodies, these periods coincide with the dry season and raining season respectively.The entire areas of each of the sampling plots were inventoried into details and the biological forms (Esteves, 1998) and spatial distributions of the aquatic macrophytes were noted.

The collected plants were identified and the one we were not able to identify were pressed and labeled in the field and subsequently identified by consulting the specialized literatures (Smith *et al.*, 2015)

A perpendicular line transect was laid and all plant species present along the established line transect in each sampling plots were recorded following the standard procedures as described by Hutchinson and Dalziel (1957-1972).

For plant species cover estimation, Braun-Blanquet scale of abundance rating was employed.

Water sample collection, preparation and analysis.

Composite samples of water were collected following the standard procedures described Ahlers *et al.*,1990, in pre-rinsed plastic containers and mixed to make representative samples from the three different sampling plots within the three sampling sites around the water body. The pH of collected water samples was recorded *in situ* using pH meter.Samples were obtained during the low water regime and high water regime.The collected water sample was analyzed to determine the nutrient load *i.e* Nitrogen, Phosphorus and Potassiumfollowing standard procedures. Determination of nitrogen (alkaline permangnate method)determination of phophorous (olsen's method) and determination of potassium (flame photometer)

Soil sample collection, preparation and analysis.

Soils samples were collected at varying depth of 5-10cm, 10-15cm and 15-20cm depth at random points at the three different sampling plots within the three different sampling sites and then mixed to get a composite representative sample of each sampling point. Samples were obtained during the low water regime and high water regime. The soil samples were air-dried and crushed

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with the help of a wooden mortar and pestle to pass through a 2 mm sieve. The sieved soil samples were analyzed to determine the nutrient load *i.e* Nitrogen, Phosphorus and Potassium following standard procedures. Determination of nitrogen (alkaline permangnate method) determination of phophorous (olsen's method) and determination of potassium (flame photometer).

III. Results

Plant diversity and floristic composition.

A total of 21 plant species belonging to 13 families were recorded,(Table 1) during the low water regime while 24 plant species belonging to 14 families were recorded during the high water regime as shown in Table 2. The floristic biological life form of these plants consists of 17 emergent plant species, 5 floating and 2 submerged plant species during low water regime while during high water regime there were 14 emergent, 5floating and 2submerged macrophyte species. Comparative studies of low and high water regime showed that the macrophytic species composition during low water regime period are a bit similar to those encountered during the high water regime period this was probably because the sources of plant propagules during both periods are same while the little disparity in diversity observed could be as a result of run offs during the raining season.

Table 1 Taxonomic list, distribution and occurrence of aquatic macrophytes at Tatabu reservoir during the low water regime.

Family	**Species**	**Biological Form**	**Station 1**	**Station 2**	**Station 3**
			SITE A B C	SITEA B C	SITE A B C
Typhaceae	*Typha latifolia*	E	- - -	+ + +	+ + +
Nymhaeaceae	*Nympea lotus*	S	+ + +	+ + +	+ + +
Cyperaceae	*Cyperus iria*	E	- - +	- + -	- - -
	Cyperus spp	E	- - -	- - +	+ - +
Araceae	*Pistia stratiotes*	F	+ + +	+ + -	+ + +
Polygonaceae	*Polygonum lanigerum*	E	+ + +	+ + +	+ + +
Amaranthaceae	*Alternanthera sessillis*	E	+ + +	+ + +	- - -
Onagraceae	*Ludwigia erecta*	E	- - -	+ + +	- - -
	Ludwigia hyssopifolia	E	- - -	- - -	+ + +
convolvulaceae	*Ipomoea aquatica*	F	- + +	- - -	- - -
	Ipeoma asarifolia	F	- - -	+ + +	- - +
Lemnaceae	*Lemna pauscicostata*	F	- - -	+ + -	- - -
Fabaceae	*Neptunia oleracea*	E	+ - -	+ - -	- - -
	Mimosa pigra	E	+ - +	- - +	- + +
Azollaceae	*Azolla Africana*	F	- - -	+ + +	- - -
Lentibulariaceae	*Ultricularia inflexa*	S	+ + -	- - +	+ - +
Poaceae(Graminae)	*Oryza logiostaminata*	E	- + -	+ - -	- + +
	Leersia hexandra	E	- - -	- - -	+ + +
	Phragmite karka	E	+ + +	- - -	- - -
	Echinochloa stagnina	E	+ + +	+ + +	- + -
	Rhytachne triaristata	E	- - -	- - -	+ - -

E = emergent; F = floating; S= submersed; + =Present; **-** = Absent

Table 2Taxonomic list, distribution and occurrence of aquatic macrophytes at reservoir collection stations in the kuble reservoir

Family	**Species**	**Biological Form**	**Station 1**	**Station 2**	**Station 3**
			Site A B C	Site A B C	Site A B C
Nymhaeaceae	*Nymphea lotus*	S	+ + +___	+ + +___	+ + +_
Cyperaceae	*Cyperus iria*	E	+ - +___	+ + -___	- + +___

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	Cyperus spp	E	+ + +___	+ + -___	- + +___
Araceae	*Pistia stratiotes*	F	+ + +___	+ + +___	+ + +___
Polygonaceae	*Polygonum lanigerum*	E	+ + +__	+ + +___	+ + +___
Amaranthaceae	*Alternanthera sessillis*	E	- + +___	- + -___	+ + +___
Onagraceae	*Ludwigia erecta*	E	+ + +___	- - -___	- + +___
	Ludwigia hyssopifolia	E	+ + +___	+ + +___	+ + +___
Asteraceae	*Eclipta alba*	E	+ + +___	+ + +___	+ + +___
Convolvulaceae	*Ipomoea aquatic*	F	- + -___	- - -	- - +___
	Ipeoma asarifolia	F	- - -___	- + -___	- - -__
Lemnaceae	*Lemna pauscicostata*	F	+ + +___	+ + +___	+ + +___
Fabaceae	*Neptunia oleracea*	E	+ - +___	+ + +___	- + +__
	Mimosa pigra	E	+ + +___	+ - -___	- + +___
Azollaceae	*Azolla Africana*	F _	+ + +___	+ + +___	+ + +___
Lentibulariaceae	*Ultricularia inflexa*	S	+ + +___	+ + +___	+ + +___
Hydrophyllaceae	*hydrolea palustris*	E	- + -___	- - -___	+ + +___
Poaceae(Graminae)	*Oryza logiostaminata*	E __	+ + +___	+ + -___	- + +___
	Leersia hexandra	E	+ + -___	- + +___	+ + +___
	Phragmite karka	E __	+ + +___	+ + +___	+ + +___
	Echinochloa stagnina	E	+ + +___	+ + +___	+ + +___
	Sorghum arundiceum	E	- - +___	- - -___	- + -___
	Acroceras zizanoides	E	- + +_	- - -___	- - -___
	Rhytachne triaristata	E	+ - +___	+ + +___	- - -___

E = emergent; F = floating; S = submersed; + =Present; **-** = Absent

Table 3. Comparison of Macrophytes Species Composition during Low and High water regime

Botanical Name	**Family**	**Low water Regime**	**High Water Regime**
Typha latifolia	*Typhaceae*	+	**-**
Nymphaea lotus	*Nymhaeaceae*	+	+
Cyperus iria	*Cyperaceae*	+	+
Pistia stratiotes	*Araceae*	+	+
Leersia hexandra	*Poaceae*	+	+
Polygonum lanigerum	*Polygonaceae*	+	+
Neptunia oleracea	*Fabaceae*	+	+
Phragmite karka	*Poaceae(Graminae)*	+	+
Alternanthera sessillis	*Amaranthaceae*	+	+
Ludwigia erecta	*Onagraceae*	+	+
Ludwigia hyssopifolia	*Onagraceae*	+	+

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Oryza logiostaminata	*Poaceae*	+	+
Cyperus	*Cyperaceae*	+	+
Rhytachne triaristata	*Poaceae*	+	+
Eclipta alba	*Asteraceae*	-	+
Ipomoea aquatic	*Convolvulaceae*	+	+
Echinochloa stagnina	*Poaceae(Graminae)*	+	+
Mimosa pigra	*Fabaceae*	+	+
Azolla africana	*Azollaceae*	+	+
Sorghum arundiceum	*Poaceae(Graminae)*	-	+
Ipeoma asarifolia	*Convolvulaceae*	+	+
Ultricularia inflexa	*Lentibulariaceae*	+	+
Lemna spp	*Lemnaceae*	+	+
Acroceras zizanoides	*Poaceae*	-	+
hydrolea palustris	*Hydrophyllaceae*	-	+

Fig 2. Field Sampling at Tatabu Reservoir

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Plate: A-R Showing a pictorial representation of some of the aquatic plant in Tatabu reservoir

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Table 4. Nutrient load in water samples collected from Tatabu reservoir during low and high water regime (mg/l)

Nutrient element	Conc.Range in low water regime (mg/l)	Conc. Range In high water regime (mg/l)
Nitrogen	3.5-13.5	3.5-17.0
Phosphorus	2.8-15.7	2.7-17.5
Potassium	3.5-14.0	3.0-16.5

Table 5. Nutrient load in soil samples collected from Tatabu reservoir during low and high water regime (mg/kg)

Nutrient element	Conc.Range in low water regime (mg/l)	Conc. Range In high water regime (mg/l)
Nitrogen	3.0-12.5	3.0-16.0
Phosphorus	2.3-13.5	2.2-15.5
Potassium	3.0-12.5	3.0-13.5

IV. Discussion

Some of the plants encountered during floristic survey are shown in plate A-R, *(A) Neptunia oleracea (B) Oryza logiostaminata (C)Ludwigia decurrens (D)Polygonum lanigerum (E)Cyperus spp (F)Typha latifolia (G) Ludwigia hyssopifolia (H)Echinochloa stagnina (I)Sorghum arundiceum (J)Azolla Africana (K)Ultricularia inflexa (L)Ipeoma asarifolia (M) Ludwigia hyssopifolia (N)Mimosa pigra (O)Nymphaea lotus (P) Ipomoea aquatica (Q)Pistia stratiotes (R)Alternanthera sessillis.* These are common freshwater aquatic plants as reported by O'Hare*et al.*,2018.

The effect of human impacts in terms of non-fishing activities like crop farming and animal husbandry in the riparian community indirectly enrich the reservoir through application of organic and inorganic fertilizers. The reservoir also services several livestock especially, cattle, goat and duck for grazing and water holes. These animals through grazing of diverse vegetation deposit viable seeds in addition which end up in the nearest riparian water body and later germinate thereby adding to the species diversity of vegetation within the reservoir catchments. However, the high abundance of Typha in the reservoir and the high abundance and proliferation of *Polygonum spp*and *nymphaea lotus*raises major threat to the existence of the reservoir, adequate control and management techniques must be in place to prevent their uncontrolled proliferation.

Higher proliferation of aquatic macrophytes and more species were observed during the higher water regime than what was observed during the low water regime and this can be attributed to increased agricultural activities at the shoreline and extends to available lands around the water body and more nutrients might have accumulated into the water body through runoffs which agree with the findings of Khan 2014 that runoff brings about debris that decays in the water body and also nutrients from the terrestrial environment thereby increasing the nutrient loads of the water body which supports proliferation of aquatic macrophytes.

V. Conclusion and Recommendation

This present study shows a dangerous trend in the rate at which invasive aquatic plants colonize water bodies in Nigeria with Tatabu reservoir as a case study. The importance of these water bodies to the riparian populace and other stakeholders that depend on water bodies for their economic activities cannot be overemphasized, it is therefore essential to monitor and manage the influx of these invasive plants in the reservoirs, most especially *Typha spp* and other aquatic plants that can bore heavy financial loses, hence the need to stem the tide of aquatic weed infestation in the reservoirs.

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