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Macrophytic Vegetation of River Ethiope at Umuaja Ukwani Local Government Area of Delta State, Nigeria †

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Abstract: This abstract presents an overview of aquatic macrophytes and their importance for the structure and function of aquatic ecosystems. It also discusses the effect of water quality and nutrient enrichment on macrophyte distribution, and the development of survey and monitoring techniques for characterizing waterside habitats. Finally, it highlights the need for detailed data for detecting change at individual sites. Physicochemical parameters are major factors when considering the quality of water samples to the presence of macrophytes in an aquatic ecosystem. A study carried out from January to March in 2019 shows that the mean value of water temperature was the highest in February with a mean value of 26.5 °C; PH, alkalinity, sulfate (SO_4^{2-}) and nitrate (NO_3^-) were the highest in January while conductivity, total hardness of water, magnesium, biological oxygen demand (BOD) and phosphate were the highest in March. Moreover, water was 100% transparent during the whole study period. Twelve (12) macrophytes belonging to ten (10) families were encountered. The most abundant macrophytes encountered were the species *Bumbusa vulgaris* (Poaceae family). A single emergent macrophyte Ipomoea aquatic (Convolvulaceae family) was encountered. Free-floating and submerged macrophytes were absent due to the high flow rate of the river. It was observed that the physiocochemical parameters of River Ethiope fall under the normal range of good quality water supporting Macrophytic vegetation.

Keywords: diversity; aquatic macrophytes; physiochemical parameter; river ethiope

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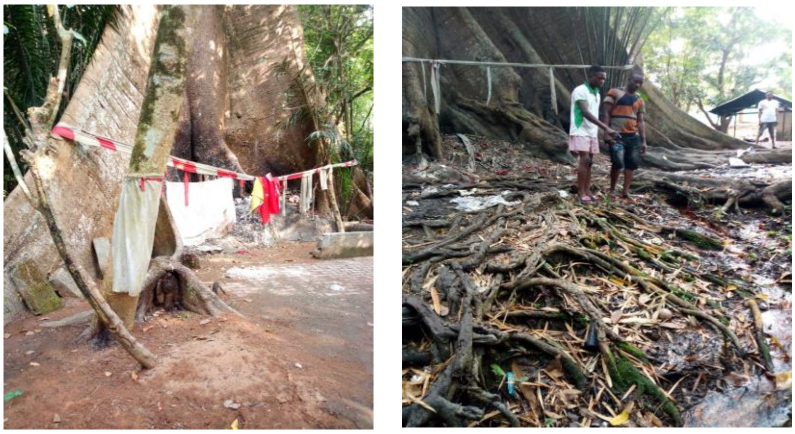
1. Introduction

Macrophytes can be functionally classified to life-forms, based on the occurrence of emergent, floating and submerged leaves. Aquatic macrophytes are water vegetations comprising macro algae and the true angiosperms [1,2]. The presence of macrophytes is influenced by many factors: water quality, water depth, substrate characteristics, indentation and slope of the shoreline and pollution of nutrients. Although a number of techniques have been developed for survey and monitoring of aquatic macrophytes in rivers and for characterizing waterside habitats particularly in relation to its need for detailed data for detecting change at individual sites [3,4]. The effect of nutrient enrichment on macrophyte distribution from the effect of other environmental factors (such as conductivity), and the effect of pH from phosphate and ammonium enrichment [5]. Aquatic macrophytes play an important role in the structure and function of aquatic ecosystems by altering water movement regimes (flow and wave impact conditions), providing shelter and refuge, serving as a food source, and altering water and sediment quality [6,7]. Aquatic macrophytes not only are affected by water quality, but they also affect water quality and provide food and refugia for aquatic invertebrates and fish [8,9]. This study takes into account the rationale and methods adopted in the analysis of River Ethiope source at Umuaja as one of the most important rivers (aquatic resource) in Delta State and

Nigeria at large. The River Ethiope in Delta State, Nigeria originates from the foot of a giant silk-cotton tree and is unique for its cavernous size and unnaturally pure water. Despite appearing shallow, the river is deep enough to accommodate ocean-going vessels. Its source is considered sacred and some areas are restricted to visitors due to their spiritual affiliation, with a footpath leading to the Onoku shrine. However, much of its biotic information (macrophyte and physicochemical variables) is still unknown. Therefore, this study is aimed at providing baseline information on the species richness of aquatic macrophytes and physicochemical variables.



(**A**) (**B**)

Figure 1. (**A**) Some areas of the groove surrounding the river source are restricted to visitors, Spiritual affiliation (**B**) River Ethiope, unlike sources of other rivers, originated from the foot of a giant silk-cotton tree, the river sprouts out from four different locations with two of these locations directly underneath the tree, while the other two from around the tree.

2. Materials and Methods

2.1. Sample Collection

Water Samples in River Ethiope source Ukwuani were collected from the month of January 2019 to March 2019 (3 months study period). Aquatic macrophytes were collected along river bank of Ethiopia River and on the surface water for the floating macrophytes each time a trip was made to the site for the period of four months; both creeping and standing macrophytes were collected. The macrophytes collected were arranged and preserved in white paper and covered with brown paper envelop to avoid drying up. It was quickly transported to Applied Biology Laboratory for identification. Water samples from the river were collected. During the collection, some water quality parameters were determined in situ.

2.2. Physicochemical Parameters

Chemical-, and biological parameters of the water samples (Nitrate (NO_3), Phosphate (PO_4) and Sulphate (SO_4),Calcium (Ca^{2+}), chloride (Cl^-), Magnesium (Mg^{2+}), Total alkalinity, Biological Oxygen Demand (BOD), conductivity, transparency, temperature and Total hardness were analyzed in an applied biological laboratory within an hour after the sampling. In situ measurements (Temperature) was also carried out by a water quality portable thermometer. These measurements provided the same results as laboratory surveying. For detection of Nitrate (NO_3), Phosphate (PO_4) and Sulphate (SO_4) an ICP-OES spectrometer (Vista-Pro, Varian Inc., USA) was used. Calcium (Ca^{2+}), chloride (Cl^-), Magnesium (Mg^{2+}), Total hardness and Total alkalinity was determined by titration method. For determination of pH in the laboratory by a SenTix electrode (UNISCOPE PHS-3E pH meter, Surgifriend) and conductivity by a laboratory conductometer (DDS-307 JENWAY) were used. Dissolved Oxygen (DO): The amount of dissolved oxygen was determined in situ by Winkler's methods.

3. Results and Disscusson

The result of physiochemical parameters of river Ethiope source at Umuaja is shown in Table 1.

Table 1. Physicochemical parameters of River Ethiope.

Pararmeters	January	February	March
	Mean ± SD	**Mean ± SD**	**Mean ± SD**
Temperature (°C)	26.5 ± 0.602	27.2 ± 0.19	26.6 ± 0.16
Conductivity (ms/m)	133.9 ± 0.637	110.06 ± 0.34	114.2 ± 0.42
Alkalinity (mg/L)	73.33 ± 26.26	58.33 ± 19.29	59.00 ± 17.45
pH	7.93 ± 0.367	4.25 ± 0.39	5.76 ± 0.25
Calcium (mg/L)	7.46 ± 0.754	13.00 ± 0.18	9.07 ± 1.36
Total Hardnes (mg/L)	10.00 ± 1.63	13.74 ± 0.81	14.53 ± 1.80
Magnesium (mg/L)	2.54 ± 0.88	0.74 ± 0.63	5.46 ± 0.44
DO (mg/L)	4.13 ± 0.94	9.73 ± 2.97	8.26 ± 1.00
BOD (mg/L)	1.16 ± 0.19	3.00 ± 0.38	5.67 ± 0.57
Sulphate (mg/L)	190.63 ± 2.81	180.4 ± 0.92	165.46 ± 4.24
Transparency (%)	100 ± 0	100 ± 0	100 ± 0
Chloride (mg/L)	−0.04 ± 0.039	−0.12 ± 0.027	−0.10 ± 0.01
Nitrate (mg/L)	7.60 ± 0.66	10.13 ± 0.66	7.33 ± 0.57
Phosphate (mg/L)	0.14 ± 0.02	0.40 ± 0.37	0.76 ± 0.48

The study investigated water quality parameters over a three-month period at a particular location. In February, the mean water temperature was recorded as 26.5 °C, whereas the mean temperatures in January and March were lower and higher, respectively. Conductivity exhibited a mean value of 114.2 ms/mL in March, which was higher than the means observed in February and January. The pH mean value was highest in January and lowest in February, while alkalinity showed a similar trend, with the highest mean value in January and the lowest in February. Total hardness, calcium, and magnesium all exhibited seasonal variations, with the highest mean values observed in March and the lowest in either January or February. Dissolved oxygen showed the opposite trend, with the highest mean value observed in February and the lowest in January. Biological oxygen demand exhibited the same seasonal variation as total hardness, calcium, and magnesium, with the highest mean value observed in March and the lowest in January. Sulphate was found to have the highest mean value in January and the lowest in March. In contrast, the mean value of chloride was the highest in February and the lowest in January. Nitrate exhibited a seasonal variation with the highest mean value observed in January and the lowest in March. Finally, phosphate showed the highest mean value in March and the lowest in January. Overall, the study found that water quality parameters exhibited seasonal variations, with some parameters showing the highest mean values in January, some in February, and others in March.

- **Biodiversity of aquatic macrophyte**

The percentage abundance of macrophytic types is shown in Table 2. Below, Embankment species had a percentage greater than 90%. There were more embankment species in the study area than any other form. The percentage abundance of the emergent macrophytes was less than 8%. Floating and Submerged macrophytes were 0%. No floating or Submerge macrophytes was encountered in the study area. The absence of floating and submerge macrophytes may be due to the high flow rate which is evident in the study area.

(A) (B)

Figure 2. (**A**) = *Tectona grandis*, (**B**) = *Azonopus compressus*.

Table 2. Biodiversity of aquatic macrophyte.

Botanical Name	Family Name	Life Form	Abundance	Ecological Status
Bumbus vulgaris	Poaceae	Embankment	5	Abundance
Cieba pentandra	Malvaceae	Embankment	1	Rare
carex spp	Cyperaceae	Embankment	4	Abundance
Elaeis guineensis	Areceae	Embankment	4	Abundance
Azonopus compressus	Poaceae	Embankment	4	Abundance
Acanthus montanus	Acanthaceae	Embankment	2	Rare
Tectona grandis	Lamiaceae	Embankment	4	Abundance
Calopogonium mucunoids	Fabaceae	Embankment	2	Rare
Anacardium occidentale	Anacardiaceae	Embankment	2	Rare
Alternanthera sessilis	Amaranthaceae	Embankment	3	Abundance
Ipomoea aquatica	Convolvulaceae	Emergent	2	Rare
Leersia hexandra	Convolvulaceae	Embankment	3	Abundance

4. Conclusions

River Ethiope source at Umuaja supports the growth of Poaceae which has higher important plants like *Bumbusa vulgaris and Azonopus compressus.* It is observed that the physicochemical parameters of water quality of River Ethiope source falls under moderate range that shows good quality water. The pH value proved that the river is freshwater which supports the growth of aquatic macrophytes they were identified.

References

1. Antti, K. Aquatic macrophytes in status assessment and monitoring of boreal lakes. *Jyvaswa Stud. Biol. Environ. Sci.* **2012**, *254*, 1–151.
2. Burm, P.R.; Prast, A.E.; Esteves, F.A. Changes in the structures of *Oryza glumaepatuta* (steud) in an Amazonian lake subjected to anthropogenic impact. In *Proceedings of the 11th International Symposium on Aquatic Weeds, European Weed Research Society, Macrophytes in Aquatic Ecosystems: From Biology to Management*; Caffrey, J.M., Ed.; 2006; Volume 570, pp. ix–xi.
3. Chambers, P.A.; Lacoul, P.; Murphy, K.J.; Thomaz, S.M. Global diversity of aquatic ecosystem in freshwater. *J. Hydrobiol.* **2008**, *595*, 9–26.
4. Igor, Z.; Mateja, P.; Alenka, G. Environmental conditions and macrophytes of karst ponds. *Pol. J. Environ. Stud.* **2012**, *21*, 1911–1920.
5. Marina, T.; Dragana, P.; Aleksandar, O. Temporaerbial and habitat distribution of macrophytes in lowland eutrophic reservoir gruza in serbia. *Period. Biol.* **2015**, *117*, 67–73.
6. Okayi, R.G.; Daku, V.; Mbata, F.U. Some aquatic macrophytes and water quality parameters of river guma, benue, Nigeria. *Niger. J. Fish. Aquacultre* **2013**, *1*, 25–30.
7. Onaindia, M.; Amezaga, I.; Garbisu., C.; Garcia-Bikuna, B. Aquatic macrophytes as biological indicators of environmental conditions of rivers in north-eastern span. *Int. J. Limnol.* **2005**, *41*, 175–182.

8. Oyedeji, A.A.; Abowei, J.F.N. The classification, distribution, control and economic importance of aquatic plants. *Int. J. Fish. Aquat. Sci.* **2012**, *1*, 118–128.
9. Shah, M.; Hashmi, H.M.; Ghumman, A.R.; Zeeshan. Performance assessment of aquatic macrophytes for treatment of municipal wastewater. *J. S. Afr. Inst. Civ. Engineeering* **2015**, *57*, 18–25.