MACROPHYTIC VEGETATION AND PHYSICO – CHEMICAL PARAMETERS OF RIVER ETHIOPE AT UMUTU, DELTA STATE, NIGERIA

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ABSTRACT
The study evaluated the macrophytic vegetation of River Ethiope at Umutu, Delta State with a view to providing baseline information on the diversity of macrophytes and the physicochemical parameters of the river. The study carried out for three months showed a seasonal variation in the physical and chemical parameters of the water including flowrate, pH, conductivity, transparency, temperature, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), alkalinity, acidity, calcium, total hardness, phosphate and nitrate. Thirteen macrophytes belonging to eleven families were encountered, which were dorminantly Bambusa vulgaris (poaceae family), followed by Tectona grandis (Lamiaceae family). Free floating and submerged macrophytes were absent due to the nature of the substratum. Embankment macrophytes showed dorminance in the study area. The presence of nutrients and dissolved oxygen played crucial role in the macrophytic diversity of River Ethiope at Umutu. This study has contributed to knowledge in the area of aquatic biology and species diversity.

KEYWORDS: *Macrophytes, dynamics, physicochemical parameters, River Ethiope.*

INTRODUCTION

Aquatic macrophytes are plants which grow in submerged soil or in soil that is saturated with water. They are larger aquatic plants large enough to be seen with the unaided eyes (Agbogidi, 2015). They are represented in 7 plant divisions: Cyanobacteria, Chlorophyta, Rhodophyta, Xanthophyta, Bryophyta, Pteridophyta, and Spermatophyta (Chambers et al., 2008). They can also be ferns or angiosperms (including both monocotyledons and dicotyledons) (Uneke and Okereke, 2015). They may be classified as emergent (e.g., cattails), free-floating (e.g., water lilies), or submerged macrophytes (Oyedeji and Abowei, 2012).

Aquatic macrophytes constitute important components of many freshwater ecosystems. The manifold role of aquatic macrophytes in freshwater habitats is closely linked to their distribution, which in turn depends on a myriad of factors. Foremost, among these are light, water, temperature, water quality changes and nutrient enrichment, sediment composition and fluctuations in water levels (Dar et al., 2014). Aquatic macrophytes possess special adaptive features like possession of parenchyma, possession of tissues with large intercellular spaces or cavities (Agbogidi, 2015), which make them specially adapted to their environment. They are important nitrogen fixers, used for soil amendments, they are used in culture media and serves for medicinal purposes (Bamidele and Agbogidi, 2002;

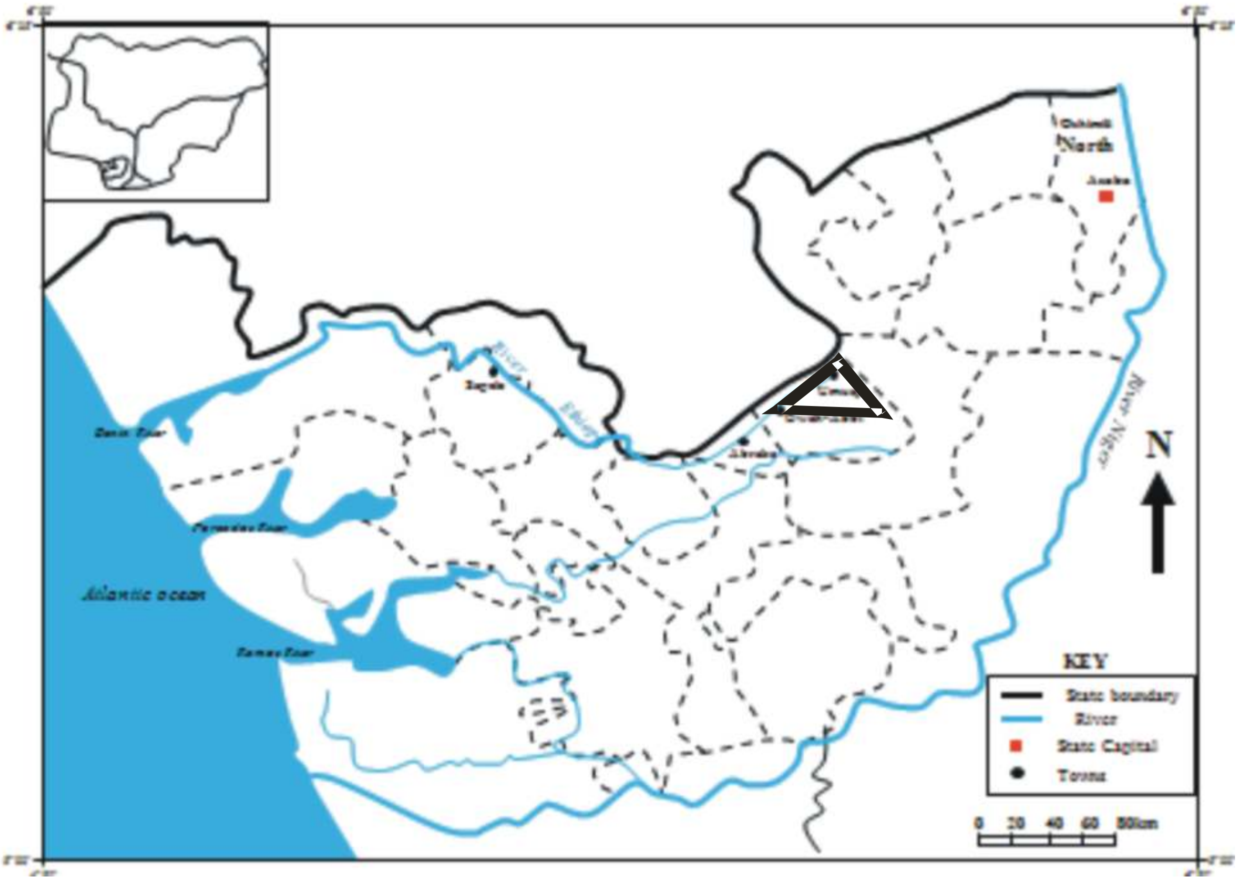
Oyedeji and Abowei, 2012). Some of the negative effects of aquatic macrophytes are; prevention of recreational activities such as swimming, fishing, and boating, reduced population of fishes, provision of stagnant habitat ideal for mosquito breeding, provision of toxic substances in water making it unsafe for drinking, decrease of aesthetic values (Agbogidi and Olele, 2005; Jimin et al., 2014) and preventing the free flow of transportation.

Important physical and chemical parameters influencing the aquatic environment are pH, nutrient, temperature, salinity, dissolved oxygen and biochemical oxygen demand, chemical oxygen demand, colour, flow velocity. Others are total suspended and dissolved solids, total alkalinity and acidity and heavy metal contaminants. These parameters are the limiting factors for the survival of aquatic organisms (flora and fauna) (Stachr, 2012; Meme et al., 2014). Aquatic ecosystems are affected by several health stressors that significantly deplete biodiversity. In the future, the loss of biodiversity and its effects are predicted to be greater for aquatic ecosystems than for terrestrial ecosystems (Adeyemo et al, 2008). This study investigates the macrophytic vegetation of River Ethiope at Umutu as influenced by the physicochemical parameters of the water.

MATERIALS AND METHODS

Study Area

This study was carried out in Umutu axis of the River Ethiope. It is the closest town to Umuaja, which is the source of River ethiope. The two towns both in Ndokwa L.G.A of Delta state lie within latitude 5°40' N and longitude 6°14' E. (Okocha and Atakpo, 2013). The river flows through a number of towns including Abraka, Aghaiokpe, Warri, Sapele and Koko from where it empties itself to the sea covering a distance of about 103km. The River is used as a source of drinking water and other domestic uses by people settling close to it. It is also a tourist centre. The area falls within the equatorial climate belt of the world and tropical rainforest belt of Nigeria with mean temperature of 30^{0}C. Annual rainfall amounts to 3,098mm, with mean monthly rainfall ranging from 25.8mm in December to 628.9mm in September. Double rain maxima and August break is witnessed in the area (Okumagba and Ozabor, 2014). The vegetation is of the freshwater swamp type. The riverbank supports rich riparian vegetation, which includes Raphia vinifera, Elaeis guineensis, Hevea brasiliensis and Cocos nucifera. The substratum is mainly sand and pebbles (Iloba, 2017), with other plants including Poaceae, Combretaceae, Cyperaceae, Malvaceae, fabiaceae. It flows into The Atlantic Ocean through the Benin River. It has its source (watershed) at Umuaja in Nkwani Local Government Area. The upper course channel is very narrow and flows very fast and widens, deepens and flows less swiftly at the middle course. The riverbed has white sand, pepples and polish rock surfaces. The river becomes fur bid due mainly to materials in solution or suspension and meanders all along its course.



Source:(Okumagba and Ozabor, 2014).

Figure 1: Map showing study area

Sample collection
Three locations on the river at Umutu were chosen during the study period of February to April, 2017. Water samples and macrophytes were collected at the three locations.

Water collection
Water samples were collected at about 7:00am. At each sampling location; composite surface water was collected and stored in clean polyethylene bottles. Samples for dissolved oxygen were fixed *in-situ* with 4 ml dilute H_2SO_4. Nonconservable parameter such as temperature was determined at the time of sampling in the field with a mercury in glass thermometer.

Collection and Identification of macrophytes
Both standing and creeping macrophytes were collected. Macrophytes were identified from family to species level with the use of a catalogue (Uneke and Okereke, 2015).

Macrophyte Abundance (MA)
Macrophyte Abundance (MA) was measured using a descriptive scale (Rare, Occasional, Frequent, Abundant, Dominant, using the Kohler scale of 1 to 5, where 1= Rare and 5= Dominant, (Jimin *et al*., 2014).

Analysis of physicochemical parameters
Water quality parameters including dissolved oxygen(DO), flowrate, pH, conductivity, alkalinity, hardness, calcium, magnesium, total dissolved solids (TDS), phosphate, acididity, temperature, transparency, nitrates were analyzed using the standard methods of APHA (1998).

Results and Discussion

The results of the physico-chemical parameters of river Ethiope at Umutu is shown in Table 1. It explained the different values obtained and recorded in the different parameters during the study period. Dissolved oxygen was highest in the month of February and lowest in the month of March with a mean of 3.467 mg/l. The water temperature was recorded highest in the month of February and lowest in the month of April with a mean of 26.7°C. The pH value was recorded lowest in the month of February and highest in the month of March and April with a mean of 8.67. The flow rate was recorded in m/s having its highest speed in the month of February and lowest speed in the month of March with a mean speed of 0.247 m/s. The values for alkalinity was highest in the month of February and lowest in the month of March with a mean of 21.667 mg/l. Acidity was lowest in the month of March and highest in the month of April with a mean value of 36.667 mg/l. The values for conductivity was observed to be lowest in the month of February and highest in the month of April with a mean of 14.573 ms/m. The water was observed to be 100% clear during the study period. The values for calcium and total hardness were highest in the month of February and lowest in the month of April with a mean of 5.667 mg/l and 8.067mg/l. The values for magnesium was observed to be highest in the month of March and lowest in the month of April with a mean of 2.4 mg/l. The values for phosphate was highest in the month of February and lowest in the month of April with a mean of 6.5 mg/l, the values for nitrate was observed to be lowest in the month of March and highest in the month of April with a mean of 11.567 mg/l, the values for Total Dissolved Solids(TDS) was observed to be highest in the month of February and lowest in the month of March with a mean of 321.67mg/l while Total Suspended Solids(TSS) was observed to be lowest in February and highest in April with a mean of 246 mg/l. This may be due to the presence of rainfall. The dissolved oxygen, water temperature, flow rate, Alkalinity, Calcium, Total Hardness, phosphate and total dissolved solids showed high values in the month of February and low values of pH, Conductivity and total dissolved solids. The value for pH, Acidity, Nitrate, total dissolved solids was highest in the month of April while Magnesium was highest in the month of March. Physicochemical parameters have been documented as having seasonal patterns. Seasonal variations are evident in all the physico-chemical parameters examined in this study (**Adeyemo,** 2008). The transparency was 100% all through the study period as objects could be seen with crystal clearness.

Table 1. Physico-chemical parameters of River Ethiope at Umutu

Parameters	February Mean ± SD	March Mean ± SD	April Mean ± SD
Temperature (°C)	27.17 ± 0.624	27 ± 0	26.7 ± 0.294
conductivity (ms/m)	13.53 ± 0.0169	13.8 ± 0	14.573 ± 0.012
Acidity (mg/l)	33.3 ± 2.357	31.667 ± 2.357	36.667 ± 2.357
Alkalinity (mg/l)	53.33 ± 4.714	21.667 ± 2.357	35 ± 4.082
pH-value	6.45 ± 0.029	8.67 ± 0.155	8.667 ± 0.0368
Calcium (mg/l)	12.33 ± 0.471	10.333 ± 0.4715	5.667 ± 0.471
Magnesium (mg/l)	2.67 ± 0.249	3.887 ± 0.0125	2.4 ± 0.0816
Total hard (mg/l)	15.267 ± 0.659	14.22 ± 0.473	8.067 ± 0.403
DO (mg/l)	5.33 ± 0.094	3.467 ± 0.249	4.933 ± 0.339
Flowrate (m/s)	0.33 ± 0.195	0.247 ± 0.059	0.277 ± 0.021
Transparency %	100 ± 0	100 ± 0	100 ± 0
TDS (mg/l)	336.67 ± 16.997	321.67 ± 10.274	354 ± 2.944
TSS (mg/l)	208.33 ± 6.236	243.33 ± 12.472	246 ± 6.481
Nitrate (mg/l)	9.167 ± 0.124	3.967 ± 0.449	11.567 ± 0.403
Phosphate (mg/l)	11.5 ± 0.989	11.7 ± 0.294	6.5 ± 0.408

Source : (Field Survey, 2017)

Table 2. The relative abundance of macrophytes encountered

S/N	Botanical Name	Common Name	Family Name	Life Form	Abundance	Ecological Status
1	*Calopogonium mucunoides*	Wild groundnut	Fabaceae	Embankment	2	Rare
2	*Acanthus montanus*	-	Acanthaceae	Embankment	2	Rare
3	*Terminalia ivorensis*	black afara	Combretaceae	Embankment	1	Rare
4	*Terminalia catappa*	Tropical almond	Combretaceae	Embankment	2	Rare
5	*Bambusa vulgaris*	Bamboo	Poaceae	Embankment	4	Abundant
6	*Cieba pentandra*	Silk Cotton tree	Malvaceae	Embankment	1	Rare
7	*Azonopus compressus*	Carpet grass	Poaceae	Embankment	1	Rare
8	*Tectona grandis*	Teak	Lamiaceae	Embankment	3	Abundant
9	*Elaeis guineensis*	Oil palm	Arecaceae.	Embankment	1	Rare
10	*Hevea brasiliensis*	rubber	Euphorbiaceae	Embankment	1	Rare
11	*Sagittaria guayanensis*	Arrow head	Alismataceae	Emergent	2	rare
12	*Irvingia gabonensis*	Bush mango	Irvingiaceae	Embankment	1	rare
13	*Carex spp*	Sedge	Cyperaceae	Embankment	2	rare

Source: (Field Survey, 2017)

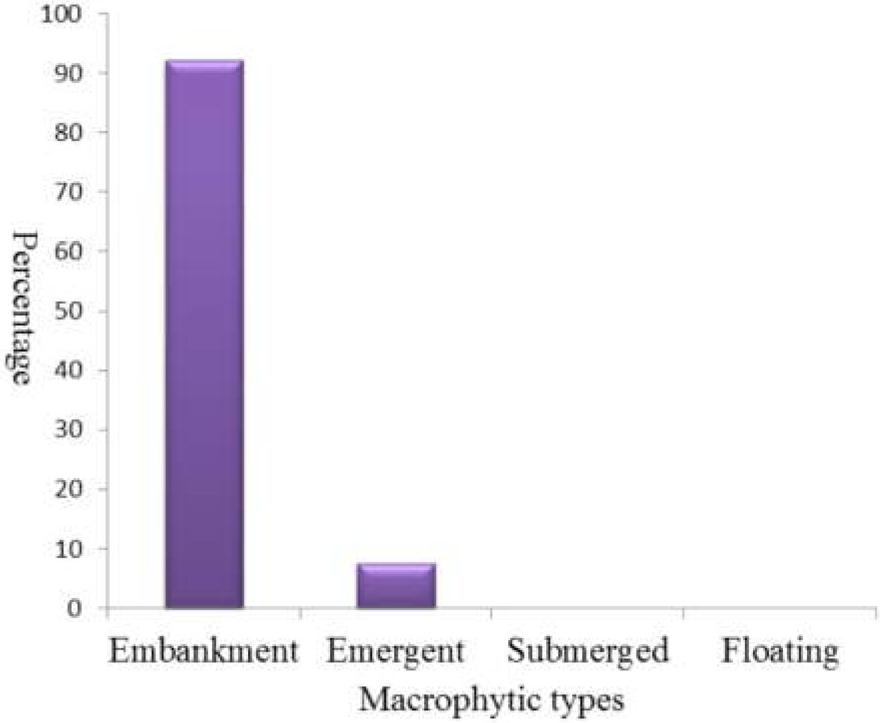


Figure 2: Percentage abundance of macrophytic types

Table 2. shows the percentage abundance of each families and species of the macrophytes as well as their life forms. A total nunber of 11 families (Fabiaceae, Achanthaceae, Combretaceae, Poaceae, Malvaceae. Lamiaceae, Arecaceae, Euphorbiaceae, Alismataceae, Irvingaceae and cyperaceae) were encountered during the study period with Poaceae having the highest abundance. *Calopogonium mucunoides* is a leguminous plant belonging to the Fabiaceae family. It is commonly known as the wild groundnut, It is an embankment species rare in study area. *Acanthus montanus* has a characteristic lobed leaf, It belongs to the Acanthaceae family and it is an embankment species rare in the study area. *Terminalia ivorensis* is a timber species commonly known as black Afara, belonging to the Terminalia genus. It belongs to the family Combretaceae, it is an embankment species of rare ecological status in the study area. *Terminalia catappa* is a relative of black Afara. It is commonly known as the tropical almond, it has a broad obovate leaf. It belongs to the Combretaceae family, it is an embankment species of rare ecological status in study area. *Bambusa vulgaris* is a grass-like plant belonging to the Poaceae family (grass family). It is commonly known as bamboo, it is an embankment macrophyte abundant in study area. *Cieba pentandra*, commonly known as silk cotton tree belongs to the family of the Malvaceaea. It is an embankment species of rare ecological status in study area. *Tectona grandis* is a timber species commonly known as teak. It belongs to the Lamiaceae family. It is an embankment species of abundant ecological status in study area. *Hevea brasiliensis* is a plant special for it's latex(white exhudates) , it is commonly known as the rubber tree. It belongs to the Euphorbiaceae family. It is an embankment species rare in study area. ***Sagittaria guayanensis*** is an emergent macrophyte commonly known as arrowhead. It belongs to the Alismataceae family and it is rare in study area. *Irvingia gabonensis* is special for

it's fruit whose seed can serve for culinary purposes. It is commonly known as the bush mango. It is an embankment species and it belongs to the family Irvingiaceae. It is rare in study area. *Carex spp* is an embankment species belonging to the Cyperaceae family. It is commonly known as sedge and it is rare in study area.

The percentage abundance of macrophytic types is shown in Figure 2. The percentage abundance of the emergent macrophyte was less than 10%. Very few emergent macrophytes were found in study area. Embankment species had percentage greater than 90%. There were more embankment species in study area than any forms of macrophytes. Submerged and floating macrophytes were 0%. No submerged or floating macrophyte was encountered in study area. Embankment species showed the most dominant in the study area. Similar reports of embankment macrophytes as the most dominant species have be made by Bamidele and Nyamali (2008) for Ossiomo River, Agbogidi (2014) for Onah Lake, Asaba Jimin *et al*. (2014) for River Benue, as well as Dar *et al*. (2014). This may be attributable to the stabilization potential of the embarkment species. This observation is in agreement with Iloba (2017), who documented that the river bank supports rich riparian vegetation including *Raphia vinifera, Elaeis guineensis, Hevea brasiliensis,* and *Cocos nucifera* species in. The absence of floating and submerged macrophytes in River Ethiope at Umutu may be due to the presence of sandy and pebbly substratum as well as a loosed soil structure which may not have allowed the macrophytes to be well rooted in the soil. It may also be due to the high rate of flow which is evident in the study area attributable to the nearness to the source of River Ethiope at Umuaja.

Conclusion

The present study has been able to provide baseline information on the macrophytic vegetation of River Ethiope at Umutu as influenced by the physico - chemical parameters hence serving as a guide for further studies and contributing to the knowledge of aquatic biology and species diversity.

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