



Determination of Physico-Chemical Parameters of St. Nicholas River, Bayelsa State, Niger Delta, Nigeria

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ABSTRACT: The Physicochemical parameters of St. Nicholas River were determined from October, 2020 to September, 2021. Three sampling stations were identified and used throughout the duration of the studies. They were Meinmokiri, Ebierewo-bugo and Egeinkiri sampling stations. The physicochemical parameters were measured in situ with Mercury in Glass Thermometer for Temperature, Hand held Digital Salinometer for (Model AR8012) for Salinity, pH meter (Model PH-009(1)) for pH, Digital conductivity tester (Model AR8011) for Conductivity, TDS meter (Model AR8012) for Total Dissolved Solid, Digital Water Velocity meter (Model PF LV550) for Water Velocity, Secchi Disk for Transparency, Digital Depth Finder (Model SD-5) for Water Depth and Dissolved Oxygen Meter (Model OM-51-10) for Dissolved Oxygen. The mean values of the Physicochemical parameters of water at the three sampling stations are temperature; $29.98 \pm 0.55^{\circ}\text{C}$, Dissolved Oxygen DO; $11.89 \pm 0.33\text{mg/L}$, Biochemical Oxygen Demand BOD; $2.06 \pm 0.26\text{ mg/L}$, Salinity; $16.80 \pm 2.06\text{ PPT}$, Conductivity; $27.54 \pm 3.03\mu\text{S/cm}$, Total Dissolved Solids TDS; $9.44 \pm 0.50\text{mg/L}$, pH; 7.41 ± 0.14 , Water Depth; $0.58 \pm 0.06\text{m}$, Transparency; $27.27 \pm 0.03\text{cm}$ and Water Velocity; $54.79 \pm 5.71\text{m}^3/\text{s}$. These physicochemical parameters values are comparable with other water bodies in the Niger Delta indicating contaminated waters. The contamination was caused by anthropogenic activities in terms of parameters assessed, therefore mitigation should be put in place for biodiversity conservation and sustainability of the ecosystem.

KEY WORDS: Physico-chemical Parameters, St. Nicholas Rivers, Bayelsa State, Niger Delta, Nigeria.

INTRODUCTION

Most river quality parameters play important roles in the bioavailability and productivity of aquatic organisms (Seiyaboh, *et al.* 2016). The variation of water quality undoubtedly linked to pollutants and may affects the physicochemical composition of the ecosystem (Oyewo and Don-Pedro, 2003).

A delta is that part of a country's flood plain through which its rivers systems are discharged to the Atlantic Ocean. The Niger Delta in Nigeria is a wetland, with a population of over 20 million people belonging to more than 40 different ethnic groups, which floodplain is about 7.5 % of Nigeria's total land mass.

The assessment of physicochemical parameters like pH, Salinity, Electrical Conductivity, Dissolved Oxygen, Biochemical Oxygen Demand, Total Dissolved Solids, Temperature, Water Transparency, Water Velocity and Water Depth is generally considered to set guidelines and categorized the physicochemical water quality.

The objective of this research is to determine the level of some physicochemical parameters as they determine the level of pollution of the river system.

MATERIALS AND METHODS

Study Area

The study was carried out in St. Nicholas River, Bayelsa State, Niger Delta. The sampling was carried out for twelve (12) calendar months and twice per month in three sampling stations of Meinmokiri, Ebierewo-bugo and Egeinkiri. The St. Nicholas River is one of the major estuaries of the Niger River. It is situated between longitude $4^{\circ} 23' \text{ E}$ and 6° N $6^{\circ} 21' \text{ E}$ and latitude $4^{\circ} 31' \text{ N}$ and $4^{\circ} 56' \text{ N}$ (Fig. 1). The Stretch of the river is about 17km long and the mean width of the river is about .869km The vegetation is predominantly mangrove, *Rhizophora racemosa*, *Rhizophora mangle*, Sparsely *Avicenia africana* and normal forest vegetation at the coastline

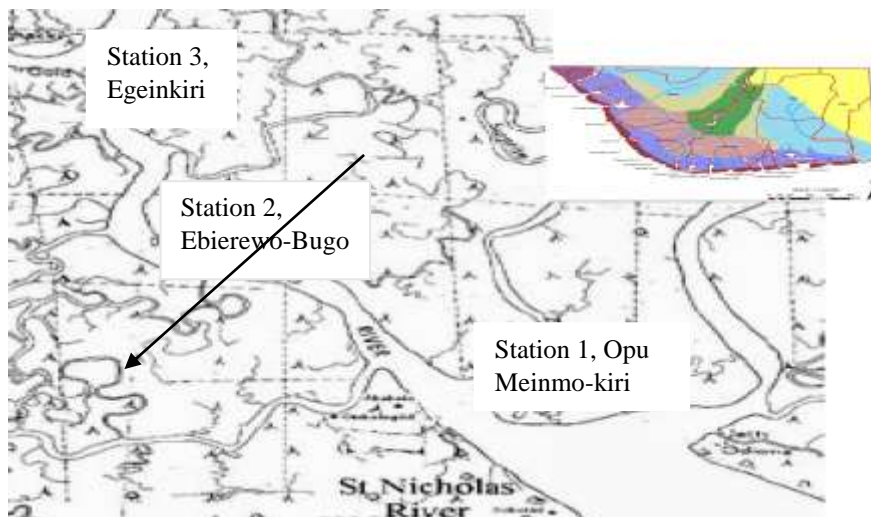


Fig. 3.2 Map showing the St. Nicholas River, the study Area.
Source: Akani et al. (2010)

Analysis of Samples

The Physicochemical parameters such as Temperature, Salinity, pH, Conductivity, Total Dissolved Solids TDS, Water Velocity Water Transparency, Water Depth and Dissolved Oxygen DO were measured in situ with Mercury Thermometer (Mercury in glass thermometer), Hand Held Digital Salinometer (Model AR8012), pH Meter (Model PH-009 (1)), Digital Conductivity Tester (Model AR8011), TDS Meter (Model AR8011), Digital Water Velocity Meter (Model PF LV550), Secchi Disk and Dissolved Oxygen Meter (Model OM-51-10) respectively.

Statistical Analysis

All statistical analysis for the purpose of this research were carried out (SPSS software). A one-way analysis of variance was carried out at P = 0.05
 Duncan Multiple Range Test was also used in comparing the mean

RESULTS

The mean and standard error values for monthly and seasonal variations of Physicochemical parameters of water sampled from October, 2020 to September 2021 on the three sampling stations are presented on Table1 and Table 2.

Table 1: Mean values for Physicochemical Parameters of water at the three sampling stations from October, 2020 to September, 2021 in St. Nicholas River, Bayelsa State, Nigeria

Parameters	Sampling Stations			Mean ± S. E
	1	2	3	
Temperature (°C)	29.77 ± 0.54	30.19 ± 0.54	29.98 ± 0.56	29.98 ± 0.55
D O (mg/L)	11.97 ± 0.37	11.86 ± 0.31	11.85 ± 0.31	11.89 ± 0.33
B O D (mg/L)	2.00 ± 0.31	2.08 ± 0.24	2.11 ± 0.23	2.06 ± 0.26
Salinity (PPT)	21.50 ± 2.26	15.41 ± 1.86	13.48 ± 2.09	16.80 ± 2.06
Conductivity (µS/cm)	35.59 ± 2.66	24.19 ± 3.41	22.85 ± 3.01	27.54 ± 3.03
T D S (mg/L)	10.41 ± 0.12	9.27 ± 0.58	8.65 ± 0.81	9.44 ± 0.50
pH	7.48 ± 0.12	7.37 ± 0.14	7.38 ± 0.16	7.41 ± 0.14



Water Depth (m)	0.42 ± 0.06	0.7 ± 0.08	0.58 ± 0.05	0.58 ± 0.06
Transparency (cm)	21.33 ± 0.01	30.67 ± 0.03	30.00 ± 0.04	27.33 ± 0.03
Water Velocity (m ³ /s)	47.75 ± 5.28	47.75 ± 5.28	55.88 ± 5.37	54.79 ± 5.71

1 = Meinmokiri, 2 = Ebierewo-bugo, 3 = Egeinkiri; S.E = Standard Error, D O = Dissolved Oxygen, B O D = Biochemical Oxygen Demand, T D S = Total Dissolved Solids, pH = Power of Hydrogen.

Table 2: Comparison of Mean values of Physicochemical parameters of water for Dry Season and Wet Season from October, 2020 to September, 2021 in St. Nicholas River, Bayelsa State, Niger Delta, Nigeria.

Parameters	Dry Season ± S. E	Wet Season ± S. E	Mean ± S. E
Temperature (°C)	30.35± 0.38	29.28±0.36	29.82±0.37
D O (mg/L)	11.68±0.38	12.10±0.30	11.89±0.34
BOD (mg/L)	1.98±0.47	2.15±0.29	2.07±0.38
Salinity (PPT)	15.02±2.28	18.58±2.70	16.80±2.49
Conductivity (µS/cm)	25.02±4.39	30.07±4.12	27.55±4.26
TDS (mg/L)	7.64±0.62	9.62±0.50	8.63±0.56
pH	7.17±0.11	7.77±0.14	7.47±0.13
Water Depth (m)	0.54±0.56	0.61±0.08	0.58±0.32
Transparency (cm)	29.54±0.05	25.00±0.03	27.27±0.04
Water Velocity (m ³ /s)	50.11±8.83	49.43±4.48	49.77±6.66

S.E = standard error, D O Dissolved Oxygen, TDS = Total dissolved Solids pH = Power of Hydrogen

DISCUSSION

The mean Temperature in this study as shown on Table 1 is higher than 25.433±0.218 °C reported in Amassoma by Ogamba *et al.* (2015) and 27.250 °C reported in Wilberforce Island, by Agedah *et al.* (2015). The dry and wet season shown on Table 2 recorded 30.35± 0.38 °C and 29.28±0.36 °C which is relatively comparable with reports of temperature in the range of; 28.7 – 30.5°C (dry season) and 27.3 – 29.3°C (wet season) in Epie creek in Yenagoa metropolis, Bayelsa State (Izonfuo & Bariweni, 2001), 30.22°C and 29.88 °C for dry and wet season respectively at Minichnda Stream (Allison & Otene, 2012), 26 - 27°C from River Olosun, Ibadan, Oyo State (Ewa *et al.*, 2014), but slightly higher than 26.9 – 28.7 °C, 26 °C value at Tombia Bridge Construction across Nun River (Seiyaboh *et al.*, 2013), 26.77 - 28.07 °C and 26.37 - 27.13°C in dry and wet seasons in (Seiyaboh *et al.*, 2016). The slight variation in temperature from this study with previous studies could be attributed to the time of sampling and environmental condition as well as the relative humidity of the days (Ogamba *et al.*, 2015). Although there is no regulatory limit for temperature; however, standard temperature that sustain life should be ambient; temperature variability might encourage the invasion of alien species, or adverse effect to biodiversity (Angaye & Mieiyepe, 2015).

The mean Dissolved Oxygen DO in this study as shown on Table 1 is higher than 10.200±0.283 mg/l at Igbedi, 4.8mg/l – 7.2mg/l (Seiyaboh *et al.*, 2013), 9.07-19.52mg/l for Efi Lake (Angaye, & Mieiyepe (2015), 5.0 – 7.92 mg/l for Kolo Creek (Aghoghovwia & Ohimain, 2014), and lower than 14.225±0.263mg/l at Ogobiri which were reported along the river Nun axis (Agedah *et al.*, 2015). The dry and wet season shown on Table 2 recorded 11.68±0.38 mg/l and 12.10±0.30 mg/l which is relatively higher when compared to 5.80 – 7.60 mg/l in dry season and 11.10 – 15.73 mg/l in wet season (Seiyaboh *et al.*, 2016), 1.38 – 9.06 and 1.76 – 5.68 mg/l for dry and wet seasons of Epie Creek respectively (Izonfuo *et al.*, 2001). Extremely low DO can be lethal to aquatic biota (Ezekiel *et al.*, 2011), especially in cases lower than 2.0mg/l (Ohimain *et al.*, 2013; Atobatele *et al.*, 2008).

The mean Biochemical oxygen demand BOD in this study as shown on Table 1, the dry and wet season shown on Table 2 recorded 1.98±0.47 and 2.15±0.29 respectively and were lower compared to BOD for dry season (12.58 - 41.17 mg/l), and wet season (6.77 – 8.10 mg/l) at Orashi River (Seiyaboh *et al.*, 2016). The lower BOD recorded could be due to low levels of organic waste. Omotoso *et al.* (2015), reported that higher BOD is due to increased degradable organic waste.



The mean Salinity in this study as shown on Table 2 is higher than 7.25 mg/l in Amassoma River in 2005 reported by (Nyananyo *et al.*, 2007), 0.000 – 0.017 mg/l, at Amassoma River (Ogamba *et al.*, 2015), 0.010 ‰ in 2007 reported by (Agedah *et al.*, 2015), 0.01 mg/l and 0.04 mg/l by (Allison & Otene, 2012). The higher concentration of salinity could be due to proximity to the adjacent Gulf of Guinea.

The mean Conductivity ($\mu\text{S}/\text{cm}$) in this study as shown on Table 1 is lower than 33.167 – 68.000 $\mu\text{S}/\text{cm}$ reported by (Ogamba *et al.*, 2015), but comparable to 28 $\mu\text{S}/\text{cm}$ by (Agedah *et al.*, 2015). The dry and wet season shown on table 2 recorded 25.02 \pm 4.39 $\mu\text{S}/\text{cm}$ and 30.07 \pm 4.12 $\mu\text{S}/\text{cm}$ which is lower than 78.33 – 89.33 $\mu\text{S}/\text{cm}$ (dry season) and 47.73 – 54.00 $\mu\text{S}/\text{cm}$ (wet season) from Epie Creek in Yenagoa metropolis (Izonfuo & Bariweni, 2001), 105.05 $\mu\text{S}/\text{cm}$ and 169.32 $\mu\text{S}/\text{cm}$ during dry and wet season respectively from Minichnda Stream (Allison & Otene, 2012). The magnitude of conductivity is a useful indication of the total concentration of the ionic solutes.

The mean Total Dissolved Solids T D S (mg/L) in this study as shown on Table 1 is comparable to 6.77 - 12.80 mg/l in Orashi River (Seiyaboh *et al.*, 2016). The dry and wet season shown on Table 2 recorded 7.64 \pm 0.62 mg/L and 9.62 \pm 0.50 which is lower compared to Kolo Creek which ranged from 41.5 – 51.0 mg/l (Aghoghovwia and Ohimain, 2014), Amassoma and Igbedi axis of River Nun were 28.180 \pm 0.048 and 32.550 \pm 0.666mg/l respectively (Agedah *et al.*, 2015) Epie Creek TDS had values of 55 - 62 and 33 – 37.33 mg/l in dry and wet seasons respectively (Izonfuo & Bariweni, 2001), while Tombia axis of the River Nun was 62.1 – 67.9 mg/l for (Seiyaboh *et al.*, 2013).

The mean pH in this study as shown on Table 1 is comparable to 6.910 – 7.350 at Amassoma by (Ogamba *et al.*, 2015). The dry and wet season shown on Table 2 recorded 7.17 \pm 0.11 and 7.77 \pm 0.14 which is higher than 5.25 and 5.93 at dry and wet season from Minichnda Stream (Allison & Otene, 2012) but comparable to 6.5 – 6.9 from River Olosun, Ibadan, Oyo State (Ewa *et al.*, 2014), 7.4 – 7.57 (dry season i.e. October, November, December, January, February and March) and 6.9 – 7.33 (wet season i.e. April, May, June, July, August and September) of Epie Creek (Izonfuo and Bariweni, 2001) and 7.4 – 7.5 at Tombia Bridge Construction across Nun River (Seiyaboh *et al.*, 2013).

The mean Water Depth (m) in this study as shown on Table 1 to be 0.58 \pm 0.06 m. The dry and wet season shown on Table 2 recorded 0.54 \pm 0.56 m and 0.61 \pm 0.08 m. This might suggest the species can be good candidates for culture as they are accessible in shallow waters.

The mean Transparency (cm) in this study as shown on Table 1 to be 27.33 \pm 0.03 cm. The dry and wet season shown on tables 2 recorded 29.54 \pm 0.05 cm and 25.00 \pm 0.03 cm. This indicates moderate light penetration.

The mean Water Velocity (m^3/s) in this study as shown on Table 1 to be 54.79 \pm 5.71 m^3/s . The dry and wet season shown on table 2 recorded 50.11 \pm 8.83 m^3/s and 49.43 \pm 4.48 m^3/s .

CONCLUSION

This study was carried out at St. Nicholas River in Bayelsa State, Niger Delta of Nigeria to obtain basic information on Physico-chemical parameters. The result showed that Physico-chemical parameters of the River which is essential to the sustenance of biodiversity, the environment and public health were within the range of parameters reported by researchers for drainage systems in the Niger Delta.

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