

Microphytobenthos Distribution at the Down-stream Area of Taylor Creek, Niger Delta, Nigeria

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DOI: <https://doi.org/10.5281/zenodo.17541738>

Published Date: 06-November-2025

Abstract: This study investigated microphytobenthos distribution at the Down-stream Area in Taylor Creek, Niger Delta, Nigeria from May to October 2022. Samples of microphytobenthos were obtained from four sites at the down-stream of Taylor Creek using Van Veen grab under the topmost strata of the sediments in the water. Microphytobenthos samples were conserved in 2% formaldehyde and were observed with a microscope and identified using microphytobenthos illustration field guide and Sedgwick-Rafter counting chamber was used to estimate the microphytobenthos species. The result showed that a total of 180 microphytobenthos, comprising of 13 individuals belonging to 4 taxonomic group were identified namely; Bacillariophyta, Cyanophyta, Chrysophyta and Chlorophyta were identified. Bacillariophyta had 6 species with *Surirella flumiensis* (52) having the highest representation and *Gyrosigma scalproides* the lowest representation with 3 each, Cyanophyta 3 species with *Oscillatora labyrinthiform* (20) constituting the highest number and *Noctiluca scintillans* (3) the lowest number. Chlorophyta 3 species with *Chloserium moniliferum* (27) having the highest number and *Chlorella vulgaris* (10) having the lowest number. Bacillariophyta was the most dominant family in all the four sites examined. The microphytobenthos composition at the different sites indicated that site 1 (102) recorded the greatest species number of microphytobenthos and site 4 (14) the smallest species number. Based on the substantial role of microphytobenthos in the aquatic ecosystems. It is therefore recommended that more recurrent studies of microphytobenthos be conducted at the down-stream area of Taylor Creek in order to reveal more trends of the status of microphytobenthos distribution of the creek.

Keywords: Distribution, Microphytobenthos, Niger Delta.

1. INTRODUCTION

The littoral regions are known to be as one major productive regions in the aquatic environment (Ballu, 2019). Phytoplankton are the major primary producers in the aquatic systems that influences the abundance and distribution of aquatic organisms (Benyoucef *et al.*, 2014). Borja *et al.* (2013) and Ghosh *et al.* (2014) cited that primary production is the foundation for secondary producers. The littoral regions offer widespread environments and trophic relationships for a huge diversity of organisms such as micro and macro fauna and flora, paddling birds, bottom fishes etc. The importance of these zones goes beyond their ecological values but also have their commercial values such as fisheries, recreation areas, tourism etc. In the euphotic zones, the benthos constitutes both the macroscopically vegetated habitats and as well the relatively massive substrate areas which are occupied majorly by photo-synthetic microorganisms that are very active (Laueau, *et al.*, 2018; LeBris *et al.*, 2019). On the sediment surfaces, this is observed and it appears like naked deserts with no noticeable flora, but when looked properly the brown or green coloration on the surfaces are as a result of the presence microorganisms'

(microphytobenthos) accumulations, (Kelly, 2013). Microphytobenthos according to Cartaxana, *et al.* (2011) are the eukaryotic algae, unicellular and microscopic plants such as Dinophyceae, Bacillariophyceae etc. that lives on the surfaces of sediments. Microphytobenthos develop on environments such as salt marshes, mud flats, intertidal sand and subtidal sediments with submerged aquatic plants mats (Johnson *et al.*, 2013). Microphytobenthos play important role in the littoral zones that enhances primary production, though less noticeable than macro-algae, (Cartaxana *et al.*, 2011). In the superficial zone of aquatic environments, benthic microalgae population surpasses phytoplankton population in the water bodies (Georganos, *et al.*, 2018). According to Barsi *et al.* (2014) nutrients availability and light are the chief restrictive factors of microphytobenthos in the aquatic system. Consequently, micro-phytobenthic accumulations are noticeable on the topmost layers at the interface of water sediments. The distribution of benthic microalgae is restricted once light penetration is mostly confined to the upper part of 0.2-2 mm (Nwoke and Uwaideae, 2018). Light to a great extent regulate the photosynthetic strength of microphytobenthos in water sediments in the aquatic ecosystem (Daggars *et al.*, 2020). Most of the benthic microalgae are recognized for their movement and they demonstration diel rhythms of vertical migration, moving to and away from the surface in due to a number of factors such desiccation, tide cycles, light, predation etc. (Barille *et al.*, 2011). Woelfel *et al.* (2014) reported that several researchers have carried out studies of microphytobenthos in the temperate estuaries and even up to the tropics because of their wide distribution in the aquatic system. More often now, studies on microphytobenthos have become of interest to many scientists as a result of the significant role they play in the productivity of aquatic ecosystems (Hope *et al.*, 2019).

The Taylor Creek, most especially at the down-stream area of Taylor Creek has a thriving fisheries around the Polaku axis and has been of interest to researchers such as Kingdom and Kwen (2009), Kwen *et al.* (2012), Kingdom and Hart (2012), Kingdom and Ogbulagha (2014), Kwen *et al.* (2019) and Aghoghovwia *et al.* (2022) on different aspects of fisheries in this creek. Despite, the significant role of macro and micro phytobenthos and zoobenthos communities at the down-stream of Taylor Creek. Information on microphytobenthos community distribution is insufficient in the area, hence this study was carried out. The study therefore, is aimed at providing meaningful information on microphytobenthos distribution at the down-stream area of Taylor Creek, Niger Delta, Nigeria. Findings from the study would provide useful information for fisheries scientists, environmentalists, fisheries institutions and extension agencies.

2. METHODOLOGY

Area of Study

The study was conducted at the down-stream area in Taylor Creek, Niger Delta, Nigeria from May to October, 2022. It is geographically located between latitudes 50 01' and 50 02' North and longitudes 60 17' and 60 18' East of the Niger Delta (Figure 1). The Taylor Creek joins River Nun around Polaku town (Plate 1) in Yenagoa Local Government Area of Bayelsa State. Taylor Creek is endowed with diversity of natural resources such as micro and macro flora and fauna. Capture fisheries sector is the major artisanal fisheries operations ongoing in the creek alongside with agricultural, oil exploration and exploitation activities.

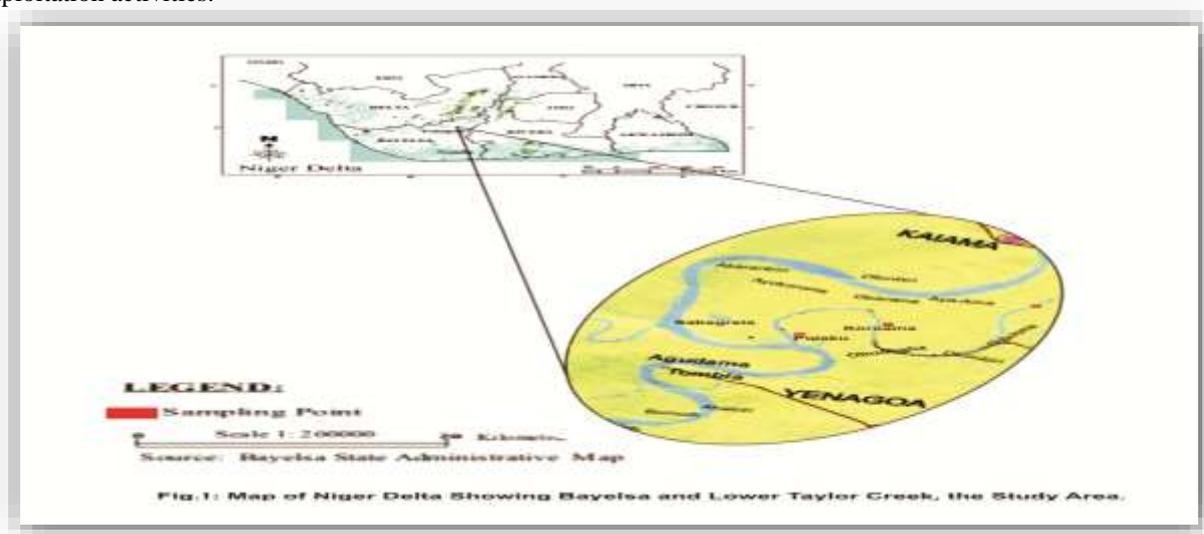


Figure 1: Showing the Down-stream Area of Taylor Creek, the Study Area

Sampling Sites

Four sampling sites were selected based on anthropogenic and geographical features; namely; Site 1 (Koroama), Site 2 (Okolobiri), Site 3 (Asingbene) and Site 4 (Ogboloma), all are located along the bank of the down-stream area of Taylor Creek.

Sampling Procedures

Physical and Chemical Parameters

Water samples were collected at different sites at the down-stream area of Taylor Creek using one litre sterilized plastic bottles, and analyzed according to APHA (2005) procedure for water quality examination. The temperature and dissolved oxygen (DO) measurements were collected in-situ using Ohaus portable meter (Model: STARTER300D), Hydrogen ion concentration (pH) was measured in-situ using HACH digital meter while the transparency measurement was with a 20 cm diameter Secchi disc.

Collection of Microphytobenthos

Microphytobenthos assemblages were obtained from water sediments at different sampling sites (muddy and sandy sites) at the down-stream area of Taylor Creek for six consecutive months between May and October, 2022. This was done by using a Van Veen grab under the topmost strata of the sediments in the water at various sites as prescribed by Nwoke and Uwadiae (2018). Contents of the water sediment were conserved in 2% formaldehyde solution for sedimentation and was allowed for 24 hours to get a clear supernatant which was decanted off, then the water samples were separated from the sediments for further analysis.

Analysis of Data

Data collected on the physical and chemical parameters were collated and analyzed using Microsoft Excel Software (2016) and Statistical Package for Social Sciences (SPSS) version 20 for performing the analysis of variance (ANOVA). Species of microphytobenthos obtained were identified using a microscope (Mode: Nikon Eclipse E400®) with the aid of identification keys/guides and enumerated to the lowest taxonomic group,

3. RESULTS

Physical and Chemical Parameters

Table 1 represents mean values of physical and chemical parameters recorded at the various sites at the down-stream area of Taylor Creek during the study period. Mean values of temperature illustrated that, air temperature values ranged from 29.83 ± 0.73 °C (at site 1) to 28.93 ± 0.75 °C (at site 4) while water temperature values ranged from 28.31 ± 0.45 °C (at site 4) to 27.02 ± 0.51 °C (at site 3). Site 1 (29.83 ± 0.73 °C) had the greatest mean temperature value while site 4 (28.93 ± 0.75 °C) had the smallest mean value. For water temperature, the smallest mean value was observed at site 3 (27.02 ± 0.51 °C) while the greatest mean value was observed at site 4 (28.31 ± 0.45 °C). The dissolved oxygen (DO) values ranged from 5.92 ± 0.23 mg/l (at site 1) to 3.90 ± 0.29 mg/l (at site 3) with site 1 (5.92 ± 0.23 mg/l) recording the greatest mean value. Hydrogen ion concentration (pH) values ranged from 6.81 ± 0.46 (at site 2) to 6.58 ± 0.36 (at site 4) with site 2 (6.81 ± 0.46 .) recording the greatest pH mean value. The transparency mean values ranged from 36.09 ± 2.22 cm (at site 2) to 32.18 ± 2.30 cm (site 4) with site 2 (36.09 ± 2.22 cm) having the greatest mean value.

Table 1: Mean values of physical and chemical parameters at various sites in the Down-stream Area of Taylor Creek

Water Parameter	Minimum Range	Maximum Range	Site 1 Koroama	Site 2 Okolobiri	Site 3 Asingbene	Site 4 Ogboloma
Temperature of air (°C)	28.02	30.34	29.83 ± 0.73^a	29.74 ± 0.732^a	29.22 ± 0.86^a	28.93 ± 0.57^a
Temperature of water (°C)	27.05	30.16	27.60 ± 0.56^a	27.33 ± 0.57^a	27.02 ± 0.51^a	28.31 ± 0.45^a
Dissolved oxygen (mg/l)	5.13	10.15	$5.92 \pm 0.23^{b^}$	4.67 ± 0.36^c	3.90 ± 0.29^a	3.98 ± 0.28^a
Hydrogen ion concentration	6.74	8.91	6.70 ± 0.41^a	6.81 ± 0.46^a	6.66 ± 0.35^a	6.58 ± 0.36^a
Transparency (cm)	16.64	39.12	34.13 ± 2.29^a	36.09 ± 2.22^b	33.17 ± 2.22^a	32.18 ± 2.30^a

Mean values on a row with the same superscripts are not significantly different ($P > 0.05$)

Microphytobenthos Spectrum

Table 2 presents the microphytobenthos spectrum of the down-stream of Taylor Creek. The result showed that a total of 180 microphytobenthos, comprising of 13 individuals belonging to 4 taxonomic group were identified namely; Bacillariophyta, Cyanophyta, Chrysophyta and Chlorophyta were identified. Bacillariophyta had 6 species with *Surirella flumiensis* (52) having the highest representation, followed by *Cymbella affinis* (8), *Navicular longissima* (7), *Cympladiscus clypeus* (6), and *Sellaphora capitala* and *Gyrosigma scalproides* the lowest representation with 3 each, Cyanophyta 3 species with *Oscillatora labyrinthiform* (20) constituting the highest number, followed by *Microcysties aeruginosis* (5) and *Lyngbya limnetica* (4) the lowest number. Chrysophyta 2 species with *Proocentrum rostratum* (17) accounting for the highest number and *Noctiluca scintillans* (3) the lowest number. Chlorophyta 3 species with *Chloserium moniliferum* (27) having the highest number, *Chladophora glomerata* (15) and *Chlorella vulgaris* (10) having the lowest number. Bacillariophyta was the most dominant taxa (family) in all the four stations examined. Similarly, the microphytobenthos composition at the different sites indicated that site 1 (102) constituted the greatest number of microphytobenthos species and site 4 (14) had the smallest species number out of the total species identified.

Microphytobenthos Distribution

Table 2 depicts microphytobenthos distribution at different sites in the down-stream area of the Taylor Creek. *Surirella flumiensis* dominated the entire species identified with sites 1 (32) and 2 (17) constituting the most abundant number. *Chloserium moniliferum* had the greatest abundance in Sites 1 (18) and 2 (2) while *Sellaphora capitala* in Sites 3 (2) and 4 (1), *Gyrosigma scalproides* in Sites 1 (1) and 3 (2), *Noctiluca scintillans* in Sites 3 (3) had the smallest species number.

Table 2: Microphytobenthos distribution at different sites in the Down-stream Area of Taylor Creek

Taxonomic Group	Identified Species	Site 1 Koroama	Site 2 Okolobiri	Site 3 Asingbene	Site 4 Ogboloma	Total No.
Bacillariophyta	<i>Cympladiscus clypeus</i>	3	1	1	1	6
	<i>Navicular longissima</i>	5	2	0	0	7
	<i>Sellaphora capitala</i>	0	0	2	1	3
	<i>Surirella flumiensis</i>	32	17	3	0	52
	<i>Cymbella affinis</i>	5	0	1	2	8
	<i>Gyrosigma scalproides</i>	1	0	2	0	3
Cyanophyta	<i>Microcysties aeruginosis</i>	0	1	2	2	5
	<i>Oscillatora labyrinthiform</i>	14	4	0	2	20
	<i>Lyngbya limnetica</i>	1	2	0	1	4
Chrysophyta	<i>Proocentrum rostratum</i>	10	4	2	1	17
	<i>Noctiluca scintillans</i>	0	0	3	0	3
Chlorophyta	<i>Chloserium moniliferum</i>	18	5	2	2	27
	<i>Chladophora glomerata</i>	9	3	2	1	15
	<i>Chlorella vulgaris</i>	4	4	1	1	10
Total Species		102	43	21	14	180

Figure 1 represents the microphytobenthos percentage abundance at the four different sites in the down-stream area of Taylor Creek. Spatially, Site 1 (Koroama) had the greatest (56.67%) percentage, followed by Site 2 (Okolobiri) (23.89%), Site 3 (Asingbene) (11.67%) and Site 4 (Ogboloma) had the smallest (7.77%) percentage.

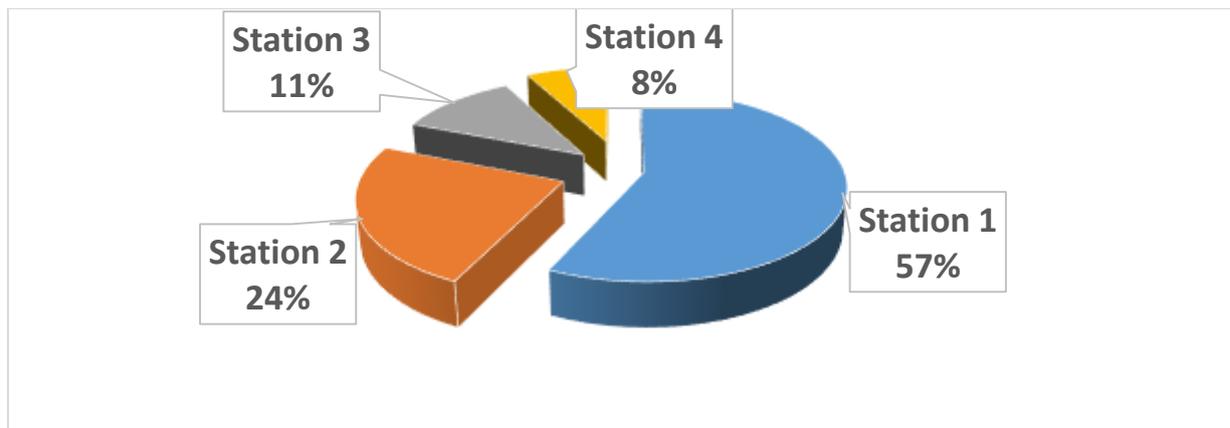


Figure. 1: Microphytobenthos percentage abundance at the different four sites in the down-stream area of Taylor Creek

4. DISCUSSION

Physical and chemical parameters are significant properties of water because they determine the organism composition, the types and also their population in the aquatic environment. The mean values of physical and chemical parameters recorded in the down-stream area of Taylor Creek fell within the recommended standard range (15 to 35 °C) already documented by APHA (1991) for water bodies in the coastal regions. The values of both air and water temperature of 27.02 to 29.83 °C recorded in this study is in agreement with the ranges recorded by Usman *et al.* (2017), Ibrahim *et al.* (2019), Ajibare *et al.* (2019) and ranges earlier documented by Boyd (1979) and WHO (2004) for fresh water bodies. However, the mean values of temperature recorded in this study was higher than that of Usman *et al.* (2017) who reported mean temperature range of 20.25 to 24.03 °C. The possible reasons for this variation could be due to the differences in water body, size of water and season of collection of samples. The dissolved oxygen (DO) mean values recorded in this study matched with the optimal range of 5.0 to 10.0 mg/l for natural water APHA (1991) and Ajani *et al.* (2011). The dissolved oxygen values revealed that there was no significant difference ($P > 0.05$) between Site 1 and Site 2 and Site 3 and Site 4. The low dissolve oxygen values recorded in Site 3 and Site 4 could be ascribed to the decomposition of organic materials discharged and deposited at the sites due to the type of anthropogenic activities ongoing. Hydrogen ion concentration (pH) mean value range of 6.58 to 6.81 in this study fell within the pH values of 6.5 to 9.0 as documented by Boyd (1981). Ugwumba and Ugwumba (1993) and Kigbu *et al.* (2017) gave a pH range of 5.0 to 0 9.5 as appropriate range for aquatic life. Zabbey *et al.* (2008) and Yakubu and Ugwumba (2009) cited pH of 5.5 to 10 as recommended range for tropical fishes. This range is in line with some researchers such as Imoobe and Oboh (2003) and Indabawa (2009) that it is suitable range for aquatic lives. The mean transparency values of 32. 18 to 34.13 cm in this study is high when compared with values reported for Orijimi Reservoir (22.84 cm) by Osimen, *et al.* (2015), for Southwestern Nigerian Reservoir (1.30 to 1.40 cm) by Olanrewaju *et al.* (2019) and is also higher than the 5 cm recommended earlier by the World Health Organisation (WHO, 2012). The likely reasons for the differences in transparency values could be as a result of the time or season the water samples were collected, amount of run-off discharge into the water, type of anthropogenic activities taking place and differences in water body. Usman (2015) citing Abolude, *et al.* (2012) stated that reduced transparency causes high turbidity which brings about reduce photosynthesis i.e less productivity of phytoplankton. The high transparency value recorded in site 2 revealed that it was a clearer zone when compared with the other sites. However, the four sites indicated fluctuations in the transparency values. Imoobe and Oboh (2003) had this same observation at River Jamieson in the Niger Delta, Tiseer *et al.*, 2008) at Samaru Stream in Zaria, Nigeria and Adeniyi and Akinwole (2017) at Lower River Niger in Edo State, Nigeria. The taxonomic group (Bacillariophyta, Chlorophyta, Cyanophyta and Chrysophyta) and species of microphytobenthos identified in this study were similar to those identified by Nwoko and Uwadiae (2017) in some parts of Lagos Lagoons, South-west Nigeria. Nevertheless, the total number of microphytobenthos species identified in this study was lesser in number than the species identified by Nwoko and Uwadiae (2017). The high number of Bacillariophyta identified in this study is in line with the observations of Ogbuagu and Ayoade (2012) in Imo River, Nigeria, and Nwoko and Uwadiae (2019) in Lagos Lagoons South-west Nigeria. The dominance of Bacillariophyta as identified in this study is in disagreement with reports of Kigbu *et al.* (2015) that recorded more Chlorophyta in Amba Lafia Reservoir in Nassarawa State, Nigeria, Erondun and Solomon

(2017) recorded more Cyanophyta from a Reservoir in University of Abuja in Nigeria. The total species identified from this study are contrary with the 32 species reported from Forcados River by Ansa *et al.* (2015), 32 species in Bonny estuary (Aujoru *et al.*, 2011), 34 species from Ikoweri Lake (Offem *et al.*, 2011), 54 species from Aare Lake (Odunlate *et al.*, 2017), 102 species Massluchowskie lake (Pasztaleiec and Poniewozike, 2010) but similar with the 20 species recorded from Nun River (Yakubu, *et al.*, 2000). This difference in species composition and abundance could be due to climate conditions and regional difference in sampling location. *Surirella flumiensis* were the most dominant species recorded, which is in agreement with the reports of Ogbuagu and Ayaola (2012) in Imo River, Nigeria that *Surirella flumiensi* dominance is a common occurrence in tropical waters. Greater number of microphytobenthos species were recorded in Site 1 and it could be ascribed to the high mud content observed at the site. De Jonge (1985) and Nwoko and Uwadiae (2017) also reported that mud substratum is more suitable for diatom growth than sand because mud particles are usually a source of organic compounds and nutrients. The low number of species recorded in Sites 3 and 4 might be due to the mining activities and other anthropogenic operations that are ongoing in the sites. This observation in support of the reports of Ohimain *et al.* (2002) in Warri River in the Niger Delta Area of Nigeria, where they also recorded low plankton composition mostly the zooplankton species in areas where different anthropogenic operations and sand dredging activities were ongoing. Edokpayi and Nkwoji (2007) also reported that sand dredging activities can lead to substratum instability and in turn increase siltation in aquatic ecosystems which could affect aquatic life.

5. CONCLUSION

Physico-chemical parameters in the down-stream of Taylor Creek are within the recommended range for biological organism survival. This study identified low species composition of microphytobenthos with the taxonomic group Bacillariophyta constituting the greatest species representation. *Surirella flumiensis* was the most abundant species. Site 1 recorded the most abundant species than the other sites. Based on the substantial role of microphytobenthos in the aquatic ecosystems. It is therefore recommended that more recurrent studies of microphytobenthos be conducted at the down-stream area of Taylor Creek in order to reveal more trends of the status of microphytobenthos distribution of the creek.

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