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# Zooplankton Species Diversity and Physico-Chemical Parameters in the Lower Taylor Creek Area, Bayelsa State, Nigeria

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***ABSTRACT:*** *The zooplankton diversity and distribution was studied in the Lower Taylor Creek area, Bayelsa state, Nigeria between June 2016 and May 2017. Plankton samples were collected from four stations along the creek using a plankton net with mesh sieve of 50µm with a 10 ml bottle attached to the apex. Ten vertical and horizontal hauls were made and the net was dragged over a distance of 5 meters to make a semi-lunar arc. Samples were preserved in 10% formalin and were observed and identified using Olympus Inverted Compound Microscope with the aid illustration guide while number of plankters were estimated using Sedgwick-Rafter counting chamber. Seven families namely, Rotifers, Insecta, Annelida, Amoebide, Cladocerans, Tricladida and Hymenostomatida with a total of 14 species were recorded. The highest species was recorded in the family Rotifer with 4 species, followed by Annelida 3 species, Insecta and Cladocerans2 species, Amoebide, Tricladida and Hymenostomatida with 1 specie each. Rotifer had the highest representation in the zooplankton community in the Lower Taylor Creek with 4 species presents in all the stations, followed by Annelida, Insecta, Cladocerans while Amoebida, Tricladida and Hymenostomatida had the lowest number of species of 1 each. In terms of relative abundance of zooplankton, station 1 recorded the highest abundance, followed by station 2 while stations 3 and 4 contributed the least abundance. The spatial distribution of zooplankton revealed that the highest number of zooplankton species (32.43%) was recorded in station 1 (P<0.05).*

***KEYWORDS:*** *Lower Taylor Creek, Species Diversity, Zooplankton*

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## I. INTRODUCTION

In an aquatic environment, plankton (phytoplankton and zooplankton) plays a substantial role to man in terms of fish production and the health of the aquatic environment as pollution indicators (Ukaonuet al.,2015). The presence of adult and developmental stages of planktonic organisms in any water body reveals the suitability of the environment to support aquatic life. Zooplankton feed on the primary producers and organic debris in water thereby performing asignificant role in the trophic relationship in the role in the ecosystem (Kigbuet al., 2015, Ovieet al., 2015). The interaction between phytoplankton and zooplankton in an aquatic ecosystem links directly or indirectly with fisheries (Wiafe and Frid, 2001, Ukaonuet al., 2015). Their abundance can create adverse effect on future fish stock by preying on the eggs and larva such as salps, medusa and ctenophores that feed on them (fish, eggs and larva). These organisms are useful indicators of water quality and fisheries health as they serve as food sources to organisms at higher trophic level (Davies et al., 2008). The biological status of an aquatic system can be assessed using some indices like species composition, abundance, distribution and diversity of plankton (Izonfou and Bariweni, 2001, Ukanonuet al., 2015). According to Dejenet al. (2004) and Ezekiel et al. (2011) zooplankton play great role in regulating microbial and algal productivity of aquatic ecosystem through their grazing effect thereby transferring productivity to fishes and other aquatic organisms. Zooplankton are used as indicators in the biological monitoring of pollution in aquatic ecosystem especially the copepods that are filter – feeders (Davies et al., 2008, Ukaonuet al., 2015). Zooplankton migrate upward from the deeper strata at night and return to deeper strata at dawn. The population and distribution of zooplankton can be affected by changes in the physico-chemical parameters of the aquatic environment especially turbidity (which limits phytoplankton production upon which zooplankton deepens) and by river flow

(Ajuonuet al., 2011, Kigbuet al., 2015, Ukaonuet al., 2015). Climate changes and anthropogenic activities such as pollution and fishing operations affect the species, biomass, abundance, spatial and temporal distribution of aquatic organisms which are expression of the environmental health or biological integrity of water bodies (Ukaonuet al., 2015). Studies have shown that there is a close link between the quality of water and the composition and abundance of plankton in any aquatic system. Several studies have been carried out on plankton indifferent water bodies in Nigeria over the years with particular attention in the species composition and checklist of phytoplankton. These include the studies of Nwankwo et al. (2003) Ekwu and Sikoki (2006), Onuoha et al. (2010), Francis and Ikpewe (2012), Ekwu and Udo (2013), and Kigbuet al. (2015) to mention a few. Notwithstanding all these, there is dearth information on the zooplankton diversity and distribution in the Lower Taylor Creek Area. This study will therefore contribute basic information about the zooplankton diversity and distribution of the creek to the exiting literatures on plankton in Nigeria waters for the assessment of the productivity and biological status needed for the management of our aquatic living resources.

## II. MATERIALS AND METHODS

**The Study Area**

The study was carried out at the Lower Taylor Creek Area between Okolobiri and Polaku communities in Yenagoa Local Government Area of Bayelsa State, Nigeria. The area is a lotic non-tidal fresh water environment and is situated between latitudes $5^0$ 01' and $5^0$ 02'North and longitudes $6^0$ 17' and $6^0$ 18' East (Figure 1). Several creeks and flood channels interconnect fresh water swamp forest, linking the Nun River and Taylor Creek at various points and form a mass of water body during the high flood. These creeks and swamps with their associated floodplain lakes and fishing ponds constitute the main fishing system. Okoso Creek is at present the most prominent creek connected to the Taylor Creek which consequently empties in to the Nun River at its confluence at Polaku community. The Taylor Creek is subjected to mild tidal influence in the dry season. Water flows swiftly in one direction during the flood season but gently in the low water period. The creek system serves the residents in different forms ranging from domestic to commercial cassava tuber fermentation, washing of clothes, fetching water for drinking, fishing, bathing, waste disposal and sand mining. Lower Taylor Creek runs through vegetation that has palm trees, silk cotton and mahogany trees which stand in the flood free farmlands close to the creek. The creek is economically important and rich in biodiversity. Presently, oil exploration and exploitation activities and other rural developmental programs are going on in the area.

**Field sampling procedure**

The study was carried out for twelve months from June, 2016 - May, 2017 at four stationslabelled TC1 (station 1), TC2 (station 2), TC3 (station 3) and TC4 (station 4) covering both the dry and wet seasons. Water temperatures were measured at each sampling station with a mercury-in-glass thermometer to a depth of 5cm, dissolved oxygen meter of Model: Oxguard Hardy MK11 was used in measuring dissolved oxygen, pH was measured using pH meter (Model: Hanna Instrument Model No:H1 8915 ATC) and transparency was measured with a secchi disc. The average of the points of disappearance and re-appearance of the disc from view were recorded as the secchi disc transparencies. Temperature was measured in degrees centigrade ($^OC$), dissolved oxygen in milligrams per litre (mg/L), and transparency was in centimetres.Plankton samples were collected fromthe four stations at each sampling day throughout the study period using a plankton net with mesh sieve of 50µm with a 10 ml bottle attached to the apex. Ten vertical and horizontal hauls were made and the net was dragged over a distance of 5 meters to make a semi-lunar arc. Concentrated samples were poured into labelled one litre jars and 10 % formalin added to preserve the organisms. The covered jars were taken to the laboratory and allowed to stand for 24 hours to obtain 10 ml supernatant. Plankton species were identified using Olympus Inverted Compound Microscope with the aid of Grace (2013) illustration while number of plankters were estimated using Sedgwick-Rafter counting chamber as described by Ovieet al. (2015).

**Data Analysis**

Data obtained for physico-chemical parameters were subjected to One-way ANOVA using SPSS version 20. Means were separated using least significant difference.

## III. RESULTS

**Physico-chemical parameters**

The results of physico-chemical parameters examined at the various stations during the study are presented in Tables 1 and 2.The air temperature recorded in this study ranged from 27.2-30.2$^0$C in station 1, 27.3-30.0$^0$C station 2, 25.6-28.3$^0$C station 3 and 25.0-28.0$^0$C in station 4, with the highest range recorded in station 2(Table 1). The means and standard deviation in all the stations were 27.6±0.72$^0$C for station 1, and 27.6±0.72$^0$C station 2, 27.0±0.85$^0$C station 3 and 28.1±0.56$^0$C for station 4 (Table 2).The surface water temperature recorded ranged from 25.1 – 30.2$^0$C in station 1, 25.0 – 28.0$^0$C station 2, 24.1 – 28.5$^0$C station 3 and 24.0 – 28.0$^0$C in station 4. The highest was recorded in station 2 (Table 1). The means and standard deviation were 29.6 ± 0.55$^0$C for station 1, 29.3 ± 0.57$^0$C station 2, 29.0 $^0$C ± 0.51$^0$C station 3 and 28.3 ± 0.45$^0$C for station 4. (Table 2). The dissolved oxygen recorded ranged from 6.0 -7.0mg/l for station 1, 7.0 – 8.0 mg/l station 2, 6.1 – 78 mg/l and 6.7 – 85mg/l for station 3 and 8.0-9.24mg/l (Table 1). The highest range was recorded in station 4. The means and standard deviation in this study were 5.92 ± 0.23 mg/l for station 1 and 4.67 ± 0.36mg/l, 3.90 ± 0.29 mg/l and 3.98 ± 0.26 mg/l for station 2, 3 and 4 respectively (Table 2). pH values recorded ranged from 6.9 – 8.0 in station 1, 6.8 – 8.0 station 2, 6.1 – 7.8 station 3 and 6.7 – 8.5 in station 4 (Table 1). The mean and standard deviation of pH were 6.73 ± 0.04, 6.47 ± 0.04,6.52 ± 0.04 and 6.63 ± 0.06 respectively (Table 1). The highest pH mean 6.73 was recorded in station 1.The transparency values recorded ranged from 23.6 – 40.5 cm in station, 22.8 – 41.2cm station 2, 17.7 – 39.5 cm station 3 and 18.2 – 33.7cm in station 4 (Table 1). The means and standard deviation of transparency were 32.11 ± 3.29cm for station 1 and 35.10 ± 3.22cm, 32.15 ± 3.22cm and 30.16 ± 3.30cm for station 2, 3, and 4 respectively (Table 2). The highest mean value 35.10cm was recorded in station 2.

**Table 1:** The ranges of physico-chemical parameters at various stations

| Water parameter | Ranges | | | |
|---|---|---|---|---|
| | Station 1 | Station 2 | Station 3 | Station 4 |
| Air Temperature ($^0$C) | 27.2-30.2 | 27.3-30.0 | 25.6-28.3 | 25.0-28.0 |
| Water Temperature ($^0$C) | 25.0-28.2 | 25.1-30.2 | 24.1-26.5 | 24.0-28.0 |
| Dissolve Oxygen (mg/l) | 6.0-7.0 | 7.0-8.0 | 7.0-10.0 | 8.0-9.2 |
| Hydrogen ion concentration (pH) | 6.9-8.0 | 6.8-8.0 | 6.1-7.8 | 6.7-8.5 |
| Transparency (cm) | 23.6-40.5 | 22.8-41.2 | 17.7-39.5 | 18.2-33.7 |

**Table 2:** Mean values of the physico-chemical parameters for the various stations

| Water Parameter | Min | Max | Station 1 | Station 2 | Station 3 | Station 4 |
|---|---|---|---|---|---|---|
| Air Temperature ($^0$C) | 25.0 | 30.2 | 27.6 ± 0.72$^a$ | 27.6 ± 0.72$^a$ | 27.0 ± 0.85$^a$ | 28.1 ± 0.56$^a$ |
| Water Temperature ($^0$C) | 25.0 | 30.2 | 29.6 ± 0.56$^a$ | 29.3 ± 0.57$^a$ | 29.0 ± 0.51$^a$ | 28.3 ± 0.45$^a$ |
| Dissolved oxygen (mg/l) | 6.0 | 10.0 | 5.92 ± 0.23$^{b}$` | 4.67 ± 0.36$^c$ | 3.90 ± 0.29$^a$ | 3.98 ± 0.28$^a$ |
| pH | 6.1 | 8.5 | 6.73 ± 0.07$^a$ | 6.47 ± 0.04$^a$ | 6.52 ± 0.04$^a$ | 6.63 ± 0.06$^a$ |
| Transparency (cm) | 17.7 | 41.2 | 32.11 ±3.29$^a$ | 35.10 ±3.22$^a$ | 32.15 ±3.22$^a$ | 30.16 ±3.30$^a$ |

Means with different superscripts are significantly different (P<0.05)

**Zooplankton Distribution**

The results of zooplankton are shown in Table 3. The zooplankton composition comprises of 7 families namely, Rotifers, Insecta, Annelida, Amoebide, Cladocerans, Tricladida and Hymenostomatida with a total of 14 species recorded. The highest number of species was recorded in the family Rotifer with 4 species followed by Annelida with 3 species, Insecta and Cladocerans with 2 species, Amoebide, Tricladida and Hymenostomatida with 1 species each(Table 3). Rotifer had the highest representation in the zooplankton community in the Lower Taylor Creek with 4 species presents in all the stations while Amoebida, Tricladida and Hymenostomatida had the lowest representation of 1species each. Similarly, the relative abundance of zooplankton was recorded in station 1, followed by station 2 while stations 3 and 4 contributed the least abundance. Table 4 shows the spatial distribution of zooplankton in the study area. The results revealed that the highest number of zooplankton species (32.43%) was recorded in station 1 (P<0.05) and least number was in stations 3 and 4 which recorded 21.62% each.

**Table 3:** Presence of Zooplankton in the various stations during the study

| Family | Species identified | Station 1 | Station 2 | Station 3 | Station 4 |
|---|---|---|---|---|---|
| Rotifers | Triathra spp. | + | + | + | - |
| | Tubifextibifex | + | + | - | + |
| | Hexanthra spp. | + | - | + | + |
| | Branchionuscalyciflorus | + | + | + | + |
| Insecta | Nymph mayfly | + | + | + | + |
| | Larva of Orthoclaniidae spp. | - | - | - | + |
| Annelida | Larva-midge spp. | + | + | + | - |
| | Aelosoma spp. | + | + | + | - |
| | Chaetogasta spp. | + | + | + | + |
| Amoebide | Amoeba protus | - | + | + | + |
| Cladocerans | Daphnia pulex | + | + | + | + |
| | Moinamicrura | + | - | - | - |
| Tricladida | Dugesia spp. | + | + | - | - |
| Hymenostomatida | Paramecium spp. | + | - | - | - |

KEY: + = Present, - =Absent

**Table 4:** Number of zooplankton species in different families and spatial distribution in the various stations during the study

| Family | Stations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | % | 2 | % | 3 | % | 4 | % |
| Rotifers | $4^1$ | 33.33 | $3^1$ | 33.33 | $3^1$ | 37.50 | $3^1$ | 37.50 |
| Insecta | 1 | 8.33 | 1 | 11.11 | 1 | 12.50 | $2^2$ | 25.00 |
| Annelida | $3^2$ | 25.00 | $2^2$ | 22.22 | $2^2$ | 25.00 | 1 | 12.50 |
| Amoebide | 0 | 0.00 | 1 | 11.11 | 1 | 12.50 | 1 | 12.50 |
| Cladocerans | 2 | 16.67 | 1 | 11.11 | 1 | 12.50 | 1 | 12.50 |
| Tricladida | 1 | 8.33 | 1 | 11.11 | 0 | 0.00 | 0 | 0.00 |
| Hymenostomatida | 1 | 8.33 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Total species | 12 | | 9 | | 8 | | 8 | |
| Total percentage (%) | 32.43 | | 24.32 | | 21.62 | | 21.62 | |

**Note:**Superscripts denote ranks. Numbers with superscripts are ranked according to abundance of species. The two families with the most abundant species are the only ones ranked in each station.

## IV. DISCUSSION

The air and surface temperature in this study ranged from 24.1$^0$C to 30.2$^0$C. These results compared favourably with earlier study of the Upper Nun River around Polakuaxis by Kwen et al. (2012) who found temperature range of 25.5$^0$C to 30.5$^0$C. These values also agreed with results from other fresh water rivers and creeks in the Niger Delta region. For example, Seiyabohet al. (2013), reported the temperature range of 26.6$^0$C to 32.0$^0$C for Igbedi Creek. Seiyabohet al. (2016) recorded a temperature range of 24$^0$C to 28$^0$C in Epie Creek Stream Bayelsa state. The range of dissolved oxygen in this study is in agreement with that reported by Kwen et al. (2012) 6.0 to 10.0mg/l in the Upper Nun River, Niger Delta. These values are within the range recommended for warm water fish production (Oviaet al., 2015), Ogambaet al. (2015a) recorded dissolved oxygen values of 3.6 to 7.79mg/l in the Nun River around Amassoma axis. Seiyabohet al. (2017) reported a range of 4.4 to 7.9mg/l in Sagbama Creek, Niger Delta. Adeleke and Babalola (2014) reported a range of 1.18 to 2.95 mg/l. Idodo-Umeh (2002) recorded higher values of 6.73 to 34.0 mg/l in River Areba at Olomoro, Isoko South, Delta state and attributed it to high dissolved oxygen caused by environmental factors. The pH valves recorded in this study were within the preferred pH valves of 6.1 to 8.5 recommended for fish production (Boyd and Lichktoppler, 1985). The difference in pH valves recorded in this study is in line with results of previous studies carried out by Ekeh and Sikoki (2003) in New Calabar River, Kwen et al. (2012) in the Upper Nun River, Niger Delta, Ogambaet al. (2015a) in the Nun River around Amassoma axis. Seiyabohet al. (2017) in Sagbama Creek, Niger Delta. The highest mean transparency valve was recorded in station 2. The results of the analysis showed significant correlation between the variables at different stations. The association between the environmental variables in the Lower Taylor Creek was generally similar. This is expected as the water at the stations is seemingly from the same source.In this study, Rotifers were the most abundant species throughout the study period. This observation is in agreement with the report of Ovieet al. (2015) in the Kontogora Reservoir. The bulk of zooplankton identified during this study were contributed from station 1, which has a quiescent water column structure. Rotifers have been known to thrive and flourish under quiet and near stagnant condition (Ekwu and Sikoki, 2005, Adeogunet al., 2005,Ajuonuet al., 2011, Ekwu and Udo, 2013, Ovieet al., 2015). The Sorenson's index of similarity for zooplankton species between stations showed that there was similarity during the period of study. The spatial distribution of zooplankton was highest in station 1. The possible reason why station 1 had the highest zooplankton species from other stations could be due to the fact that this station had a favourable water quality which encouraged their growth and survivalEzekiel et al. (2011).Offemet al. (2014), Ovieet al. (2015) and Seiyabohet al. (2017) had already reported that favourable water quality parameters influences the spatial distribution of zooplankton compositions in aquatic water bodies.

## V. CONCLUSION

The quality of water in the Lower Taylor Creek is relatively safe for now with regards to thephysico-chemical parameters recorded in the study period. This is because all the parameters monitored were within the recommended limits for fish production and other usages. The high diversity of zooplankton recorded around the study area may be due to nutrient abundance in the small water body as a result of agricultural activities ongoing in the area. The good quality of water also favoured their growth. However, the presence of Microcystis, AnabeanaandAphanocapsa species were indication that the lower Taylor Creek Area is slightly contaminated. This could be attributed to the anthropogenic activities that are carried out in the study area such as washing of clothes, motorbikes, cars, and bathing done around the creek. A more detailed and comprehensive study is recommended to be undertaken in the creek in order to reveal the full extent of its zooplankton composition, abundance and distribution. Such studies would have immeasurable benefits for better understanding of the ecosystem structure, function and management.

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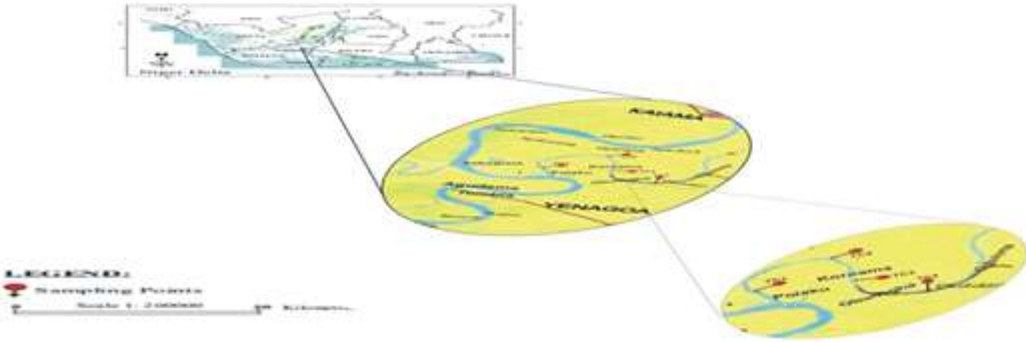


**Figure 1**: Map of Niger Delta Showing Bayelsa and Lower Taylor Creek, the Study Area

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