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Comparative Limnological Studies of Nnamdi Azikiwe University (Unizik) and Amansea Streams in Awka South L.G.A., Anambra State, Nigeria

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Abstract: The limnological studies of Unizik and Amansea streams, Awka South Local Governments Area, Anambra State, Nigeria, were carried out using standard methods. The mean water temperature, dissolved oxygen content, transparency and pH were 26.330C, 2.75 mg/l, 49.10cm and 7.80 respectively, in Unizik Stream. For Amansea Stream, the values were 26.580C, 2.40mg/l, 35.87cm and 7.70, respectively. The mean BOD, Alkalinity, water depth and water current values recorded in Unizik stream were 16.00mg/l 119.70mg/l, 58.25cm and 0.45m/s respectively, while in Amansea Stream the values were 11.50mg/l, 111.35mg/l, 59.43cm and 0.39/s respectively. The physicochemical parameters of the two streams vary spatially. Unizik and Amansea streams exhibited features that are typical of streams in tropical environment. The low dissolved oxygen content, high biochemical oxygen demand and low alkalinity values indicate that the water bodies are unsuitable to support aquatic life.

Keywords: Physico-chemical; Parameters; Streams; Nigeria.

1. Introduction

Water is the most vital factor for the existence of all living organisms [1]. Global aquatic ecosystems fall under two broad classes defined by salinity: freshwater ecosystem and saltwater ecosystem. Freshwater ecosystems are inland and have low concentration of salt. The saltwater ecosystems have high concentration of salt [1].

The study of freshwater habitat is known as limnology. Limnology is closely related to aquatic ecology and hydrobiology, which studies aquatic organisms in particular regard to their hydrological environment [2]. Limnologists work on lake and reservoir management, water pollution control and stream and river protection [3]. In a society where there is limited provision of pipe borne water or bore hole water supply, basic information on the physico-chemical components of the sources of natural water becomes very crucial [4].

Fortunately, data on these streams and rivers exist for comparison of the overall impact of urbanization and industrialization on their water qualities [4]. Unizik and Amansea Streams are lotic ecosystem and are still pristine but are relatively perturbed in their hydrological settings. Both streams play important role in the lives of the surrounding inhabitants. This paper therefore provides information on the limnological characteristics that support the life of aquatic organisms in both streams.

2. Geography of Study Sites

The study was carried out in Nnamdi Azikiwe University (UNIZIK) stream and Amansea stream located in Awka South Local Government Area, Anambra State (figure 1) and there is horizontal distance of about 100 feet between them. Unizik and Amansea streams are flowing freshwater located along the longitudes 07° 06' (E) 07° 08' (E) and latitudes 06° 10' (N), 06° 12' (N) respectively. They are both placed at an altitude between 150-155feet above sea level. They flow through the school (UNIZIK) premises, through Amansea town and finally drain into Ezu River in Amansea town. Both streams have sparse vegetation consisting of tall bamboo trees and oil palm trees at various points along the lengths of the streams which provide shade and a favourable temperature condition suitable for the aquatic organisms.

3. Materials and Methods

Water samples were collected from both streams at different locations (upstream, midstream and downstream).

The surface water temperature was measured with red-mercury-in-glass thermometer at about 10cm below the water surface. The dissolved oxygen concentration determinations were by titrimetric methods described by

Wrinkler's [5]. Transparency was measured with a 20cm diameter graduated, secchi disc. The pH of the samples was determined in the laboratory using a digital pH meter.

The biochemical oxygen demand content was determined using the methods described by Wrinkler's [5]. Total Alkalinity of the samples was determined following the procedures described by ALPHA (American Public Health Association) [6].

Water depth was measured with a weighted graduated rope by lowering the rope to the bottom of the stream. Water currents were determined using a weighted boat and two pts A and B marked out with a distance of 50m.

4. Results

4.1. Temperature

The variation in water temperature of UNIZIK and Amansea streams are illustrated in tables 1 and 2. The water temperature ranged from 24.70 to 28.00⁰C, (mean = 26.33⁰C) and 24.30 to 27.95⁰C, (Mean = 26.58⁰C) for UNIZIK and Amansea streams, respectively. In UNIZIK and Amansea streams, the lowest water temperatures were recorded in the midstream with values of 24.70⁰C and 24.30⁰C respectively. Highest water temperatures were recorded in the downstream with values of 28.00⁰C and 27.95⁰C for UNIZIK and Amansea streams, respectively.

4.2. Dissolved Oxygen (DO)

The dissolved oxygen content of the water varied between 2.50 and 3.00 mg/l, (mean = 2.75mg/l) and 2.10 and 2.60mg/l, (mean = 2.40 mg/l) for UNIZIK and Amansea streams, respectively. For UNIZIK stream, the least DO was recorded in the midstream with a value of 2.50 mg/l and 2.10mg/l for Amansea stream. The highest dissolved oxygen contents were recorded in the upstream of UNIZIK and Amansea streams with values of 3.00 and 2.60 mg/l respectively.

4.3. Turbidity

In Unizik stream, secchi disc transparency of the water ranged from 36.22 to 57.00cm, (mean= 49. 10cm). Highest secchi disc transparency occurred in the upstream with a value of 57.00cm. Decrease in transparency occurred in the midstream with a value of 36.22cm.

For Amansea stream, secchi disc transparency of the water ranged from 30.01 to 39.10cm, (mean =35.87 cm) transparency was lowest in the midstream with a value of 30.01cm and increased steadily to its highest value in the upstream when the secchi disc was visible at 39.10cm.

4.4. Hydrogen ion Concentration (pH)

In UNIZIK stream during the period of study, the pH of the water ranged between 7.1 and 8.4, (mean = 7.8), while in Amansea stream it was 7.4 to 8.0, (mean =7.7). The water was more acidic in the downstream than at any other locations in both streams with values of 7.1 and 7.4 for UNIZIK and Amansea streams, respectively.

4.5. Biochemical Oxygen Demand (BOD)

The BOD values varied between 13.00 and 20.00 mg/l (mean = 16.00mg/l) for Amansea stream. Highest value of BOD was recorded in the midstream with a value of 20.00mg/l, for UNIZIK stream and 12.00mg/l for Amansea stream. In both UNIZIK and Amansea streams, lower BOD values were recorded in the downstream with 13.00 and 11.10 mg/l respectively.

4.6. Total Alkalinity

In UNIZIK stream during the period of study, the Alkalinity of the water ranged from 76.65 to 190.00 mg/l, (mean = 119.70mg/l) while in Amansea stream it was 80.05 to 160.70mg/l,(111.35mg/l).The water was more alkaline in the downstream than at any other locations in both streams with values of 190.00 and 165.70mg/l for UNIZIK and Amansea streams, respectively.

4.7. Water Depth

The depth of water in UNIZIK stream ranged between 53.90 and 62.10cm, (mean = 58.25cm) and 56.10 and 62.50cm, (mean= 59.43cm) for Amansea stream. The lowest depth was recorded in the downstream and the highest depth was recorded in the midstream for both Unizik and Amansea streams. The upstream recorded depths of 58.75 and 59.70cm for Unizik and Amansea streams, respectively.

4.8. Water Current

The speed of the water current for Unizik stream ranged between 0.38 and 0.53m/s, (mean = 0.45m/s) and 0.28 and 0.57m/s, (mean =0.39m/s) for Amansea stream. The lowest speed of the water current was recorded at the midstream with values of 0.38 and 0.28m/s for Unizik and Amansea streams respectively. The highest value of the speed of the water current was recorded as 0.53 and 0.57m/s at the upstream of unizik and Amansea streams, respectively.

5. Discussion

In both study sites, the physicochemical parameters were recorded during the period of sample collection and were compared with the world approved WHO (World Health Organization) [7].

The mean variation in water temperature of 26.33 and 26.58⁰C observed in Unizik and Amansea streams, respectively, lie within the optimum temperature range of 25 to 30⁰C by WHO required for survival of tropical aquatic organisms. The highest mean temperature values in the downstream of both study sites could be due to the fact that most of the temperature readings were taken in the afternoon (13-15hrs) in these locations as suggested by Ayoade, *et al.* [8]. The similarity in temperature values of Unizik and Amansea streams may significantly favor biological activities of various life forms in the aquatic ecosystem. Life cycles and population densities of many stream organisms are very temperature dependent and alteration of the average stream temperature by a few degrees could alter the flora and fauna of the stream [9]. The dissolved oxygen content of water in Unizik stream (mean = 2.75 mg/l) and that of Amansea stream (mean = 2.40 mg/l) were not found satisfactory for aquatic organisms. The slightly higher value of DO in Unizik stream than Amansea stream may be attributed to higher transparency of Unizik stream, thus, causing photosynthetic activity to be higher, leading to release of more oxygen into the water body [8]. One major factor responsible for low levels of DO in tropical streams is the influx of discharge effluents from the surroundings into the streams. These effluents contain high organic matter [4].

Turbidity is a measure of the ability of water to receive light and is caused by small particles in the various measure of turbidity exist. The mean secchi disc values of 49.10cm and 35.87cm in Unizik and Amansea streams respectively fall within the range considered suitable by WHO (World Health Organization) [7] for fish growth. However, Unizik stream had a higher light extinction value, thus penetration of sunlight is more likely and sunlight energy is important in photosynthesis. It has been well documented that high transparency correlates with high productivity [8]. The lower transparency observed in Amansea stream could be attributed to influx from run offs into the stream thereby decreasing light penetration. It could also be due to decrease in sunlight intensity as a result of heavy cloud in the atmosphere which inturn reduced the quantity of light entering the water. Adebayo [9] and Davies and Ugwumba [3] working on Nigerian streams and rivers made similar observations.

The pH of water in Unizik and Amansea streams have a mean values of 7.8 and 7.7 respectively, thus, these waters are good for survival of aquatic organisms since Wetzel [2] reported waters with a pH range of 5.5 to 9.0 as most suitable for aquatic organism. Also when compared with WHO standard pH range of 6.5 – 8.5, it is suitable for aquatic ecosystem.

The BOD values of Unizik and Amansea streams ranged from 13.00 to 20.00 mg/l and 11.00 to 12.00 mg/l respectively which did not fall within the recommended range of 5.0mg/l by WHO (World Health Organization) [7]. Thus it is unsuitable for aquatic life. The BOD was generally high during the study. Waters with BOD levels less than 4mg/l are term reasonably clean and unpolluted while waters with level greater then 10mg/l are considered polluted since they contain large amounts of degradable organic materials [10]. In the research conducted by Idowu and Ugwumba [11] at Eleiyele reservoir, the BOD was in the range 3.1 to 4.3 mg/l which was said to support low organic enrichment of the reservoir. Austen and Widdicombe [12] noted that many streams and rivers in South America, Africa and Indian subcontinent show high coliform levels together with BOD and nutrient levels.

The Alkalinity of water may mean any water with pH value above 7.0, but often it means the total of alkaline substances present in association with bicarbonates, carbonates and hydroxides. Low alkalinity was recorded at the upstream locations of both study sites compared to the high values at downstream locations of both streams. Abowei and Ezeike [13] were of the view that low alkalinity in the upstream could be explained mainly in terms of absence of carbonate and bicarbonates, and the increasing values downstream due to greater presence of both ions. Also, increasing values of alkalinity with decreasing distance from the seas have been reported in Southeastern streams and rivers [14]. Minimum and maximum alkalinity value recorded in upstream and downstream respectively also support the findings of other previous workers like Olomukoro and Victor [15] and Ogbeibu [4].

In conclusion, the results of the physicochemical parameters that were obtained for Unizik and Amansea Streams fall within the range suggested by WHO standard except for the low dissolved oxygen, high Biochemical oxygen demand and low alkalinity which may be caused by runoffs from farm lands and domestic wastes released into the streams from surroundings, thus making the streams unsuitable for aquatic organisms.

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