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Research Article

Physico-chemical Parameters and Macroinvertebrates Fauna of Ona River at Oluyole Estate, Ibadan, Nigeria

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Abstract: The Physico-chemical parameters and macro invertebrate fauna of Ona River were studied from November, 2008 to January, 2009. Surface water and benthic samples were collected weekly from three sampling stations along the river. The range values of Surface water temperature was 20-29°C, Dissolved Oxygen (DO) 0.00-6.67 mg/L, Biological Oxygen Demand (BOD) 0.00-3.7 mgO_2/L, Conductivity 196-308 us/cm and Alkalinity 40-120 mg/L. Analysis of Variance (ANOVA) showed significant difference ($p<0.05$) in the mean values of conductivity and total dissolved solids between stations. A total of 10 taxa comprising of 1317 individual species were recorded. The aquatic insect larvae (*Chironomus sp*.), gastropods (*Physa sp*.) and (*Melaniodes tuberculata*) were the most abundant accounting for 43.5, 27.7 and 20% respectively of the total number of macro invertebrates encountered. The high value of BOD and dominant of the *Chironomus sp*. and *Melaniodes tuberculata* revealed that Ona River at Oluyole Estate is polluted and is not fit for drinking by water quality standard.

Keywords: Macroinvertebrate fauna, Ona River, physico-chemical parameters, pollution

INTRODUCTION

Pollution has becomes a global problem that affects rivers, lands, seas and atmosphere (Mason, 1991). Improper disposal of untreated wastes has been without regards for the consequences. Rivers are worst affected and the damaging effect of improper disposal of untreated wastes to rivers, seas and the people drinking the water is obvious (Ajao and Fagade, 2002). In different part of Nigeria, rivers are used for disposal of refuse, human sewage and waste waters from residential areas, abattoirs and industries (Fagade *et al*., 1993). Anthropogenic discharges into aquatic ecosystem reduces transparency and light penetration that have adverse effect on the existence of benthic community and other aquatic organisms (Esenowo and Ugwunba, 2010)

Macroinvertebrate organisms form an integral part of an aquatic environment and are of ecological and economic importance as they maintain various levels of interaction between the community and the environment (Arimoro *et al*., 2008). Benthic macro invertebrates are useful biological indicators which provide a more precise understanding of changes in aquatic conditions when compared to chemical and microbiological data, which rather presents short term fluctuation (Ravera, 2001). Biological assessment support physico-chemical analysis of water, providing a more robust measure of aquatic conditions. Although physico-chemical parameters represent water quality at the time of sampling, biological assessment determines long-term water quality trends (Rosenberg and Resh, 1993).

River Ona is one of the two major rivers draining the city of Ibadan, Oyo state. The river has a length of 55 km^2 and area of 81.0 km^2. Oluyole estate is basically an industrial area with some residential building located in the area through which Ona River flows and serves a major recipient of untreated effluent and domestic waste in the area. Several studies have been carried out on Ona River such as the physico-chemical characteristics, trace metal load, plankton and benthic macro invertebrates abundance in Ogunpa and Ona River (Akin-Oriola, 2003; Adem *et al*., 2012) but, there has been no previous study on the physico-chemical parameters and benthic macro invertebrates of Ona River at Oluyole Estate, hence, the need for the present study.

MATERIALS AND METHODS

Study area: Ona River is located within latitude 7'21'W and longitude 3'5'E Fig. 1. It flows in a North-south direction from its source at Onidundun in Akinyele Local Government Area through Eleyele catchment's area (Iddo Local Government Area) where it is dammed and also flows through Oluyole Estate (Ibadan South-west Local Government Area) to Podo (Oluyole Local Government) and eventually empties into the Lagos Lagoon.

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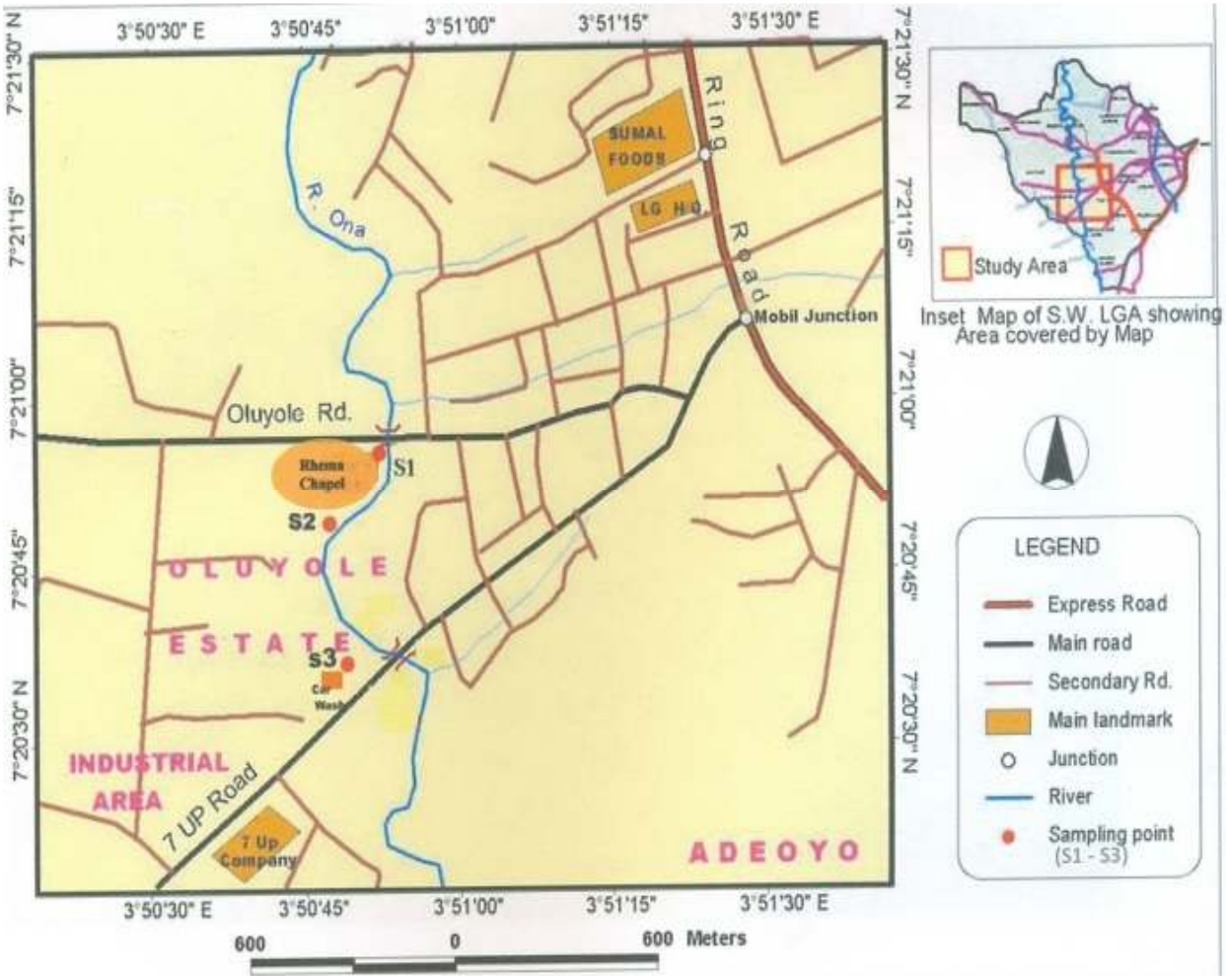

Fig. 1: Map of Oluyole Estate showing sampling point (1 1-3)

The river serves as source of water for domestic purpose such as washing and bathing, fishing activities also take place in the river. The river receives a lot of wastes ranging from industrial, agricultural and domestic sources including organic and inorganic matter.

Three stations, Station1 upstream, Station 2 first downstream and Station 3 second downstream were chosen along the course of River Ona at Oluyole Estate. Station 1 is upstream and directly receives domestic wastes and faecal materials. The vegetation is mostly bamboo tree (*Bambusa vulgaris*) flanked on both sides of the river forming a dense shade. Station 2 is about 0.5 km from Station 1. The vegetation includes submerged macrophytes; *Luffa ovegytiaca* and *Panicium maximum*. Station 3 receives some industrial waste and human activities such as car washing and bathing. The vegetation includes *Hydrolea palustris* and *Panicium maximum*.

Determination of physico-chemical parameters: The physico-chemical parameters of surface water measured are; temperature, hydrogen ion concentration (pH), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), alkalinity, Hardness, conductivity, total dissolved solids, total suspended solids, free carbon dioxide (CO_2), Ammonia (NH_3) and metals. Surface water temperature and pH were measured *in situ* with a mercury-in-glass thermometer calibrated in degree centigrade and buffered electronic pH meter (Kent 7020). Velocity (flow rate) was measured by floatation method. Conductivity and TDs were measured with An Extech meter Model ExStik EC400.As recommended by Clesceri *et al*. (1998); alkalinity, hardness, DO and BOD were measured titrimetrically and the result expressed as mg/L.Alkalinity was measured with LaMotte Freshwater Aquaculture Test Kit Model AQ-2.Heavy metal concentration was determined with the use of a Varian Spectr AA 600 Atomic Absorption Spectrometer. The results were expressed as mg/L.

Benthic Macro invertebrate: Macroinvertebrates samples were collected using a Van-veen grab of 0.6 m^2 surface area in three replicates from each sampling

Table 1: Values of physic-chemical parameters measured in Ona River at Oluyole estate

Parameters	Station 1	Station 2	Station 3
Temperature (°C)	26.5±0.824[a] (22–29)	26.6±0.925[a] (21–29)	26.3±1.149[a](20–29)
pH	8.37±0.147[a] (7.85–8.92)	8.34±0.113[a] (7.7–8.85)	8.6±0.113[a] (7.98–8.89)
Velocity (m/s)	0.173±0.03[a] (0.09–0.34)	0.154±0.057[a] (0.03–0.5)	0.029±0.006[b] (0.02–0.07)
Hardness (mg/L)	160±18.127[a] (100–250)	132.5±10.649[a] (90–170)	173.7±11.009[a] (110–210)
Dissolved Oxygen (mg/L)	2.874±0.672[a] (0.00–6.33)	3.428±0.762[a] (1.3–6.67)	2.87±0.711[a] (0.00–6.00)
Biochemical Oxygen Demand (mg/L)	1.295±0.403[a] (0.19–3.47)	1.544±0.361[a] (0.3–3. 76)	0.686±0.219[a] (0.00–1.58)
Alkalinity (mg/L)	77.5±7.962[a] (50–120)	67.5±5.261[a] (60–100)	82.5±9.210[a] (40–110)
Carbon dioxide (mg/L)	79.94±7.741[a] (41.95–116.86)	67.83±3.286[a] (54.93–82.91)	85.9±7.776[a] (49.94–120.85)
Conductivity (µS/cm)	265.63±9.405[a] (216–289)	245.13±10.283[ab] (196–276)	282.5±7.844[b] (242–308)
Ammonium Nitrogen (mg/L)	0.370±0.108[a] (0.08–0.96)	0.278±0.087[a] (0.06–0.82)	0.479±0.095[a] (0.18–0.98)
Total Dissolved Solid (mg/L)	148.04±5.623[a] (131.2–182.04)	159.54±6.479[b] (132.01–191.05)	181.7±3.601[b] (165.41–198.17)
Total Suspended Solid (mg/L)	41.74±7.374[a] (20.1–82.01)	31.21±7.908[a] (12.24–82.01)	49.4±8.502[a] (23.21–96.01)
Lead (ppm)	0.007±0.001[a] (0.004–0.01)	0.006±0.001[a] (0.003–0.012)	0.007±0.001[a] (0.004–0.011)
Chromium (ppm)	0.012±0.001[a] (0.005–0.018)	0.011±0.002[a] (0.004–0.012)	0.012±0.001[a] (0.004–0.019)
Iron (ppm)	1.873±0.625[a] (0.288–5.024)	1.892±0.726[a] (0.157–6.115)	1.864±0.644[a] (0.271–5.326)
Sodium (ppm)	10.523±1.26[a] (2.693–14.315)	10.36±1.298[a] (3.064–16.097)	9.344±1.293[a] (2.877–13.165)

Different superscript letters in a row show significant difference ($p<0.05$)

station. Each sediment sample was diluted with water and sieved with mesh sizes 0.5 mm (Holme and Mclntyre, 1984). The residuals retained on the screens of the sieves were washed into a shallow white tray with water for sorting. The sorted macro invertebrates organisms were preserved in 4% formalin in small glass jars. The individual organisms were identified macroscopically using the guides of Pennak (1978), Edmunds (1978), WHO (World Health Organization) (1984) and Brown, 1994. The numbers were counted.

Statistical analysis: Microsoft Excel 2007 was used for graphical illustrations. Shannon-wierner diversity index and evenness were determined using PAST software. Analysis of Variance (ANOVA) was used to compare the means of the physico-chemical parameters obtained from the three sites.

RESULTS

The mean, standard error and range of the physico-chemical parameters measured in Ona River at Oluyole estate are shown in Table 1.

The lowest and highest mean temperature was reported in Station 3 in January and December (Fig. 2). Higher pH was recorded in Stations 2 and 3 while the lowest was in Station 1 in December (Fig. 3). The lowest mean DO was recorded in Station 2 in February while the highest mean value was recorded in Station 1 in the same month (Fig. 4). Lowest mean BOD was recorded in Station 1 in February while highest mean value was recorded in Station 3 in January (Fig. 5). Station 1 recorded the lowest mean COD in February while the highest mean value was in Station 2 (Fig. 6). Nitrate and phosphate recorded the lowest mean value in Station 1 in February (Fig. 7 and 8). The lowest and highest mean Zinc were recorded in Stations 1 and 3, respectively (Fig. 9). The lowest mean lead was recorded in Station 3 while the highest mean value was recorded in Station 1 (Fig. 10). The lowest mean Cadmium was recorded in Station 2 while the highest mean value was recorded in Stations1 and 3 (Fig. 11 to 13).

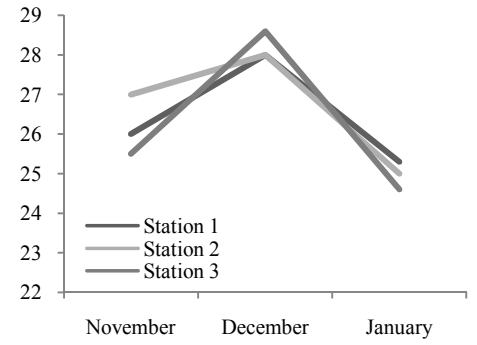

Fig. 2: Monthly variation of water temperature

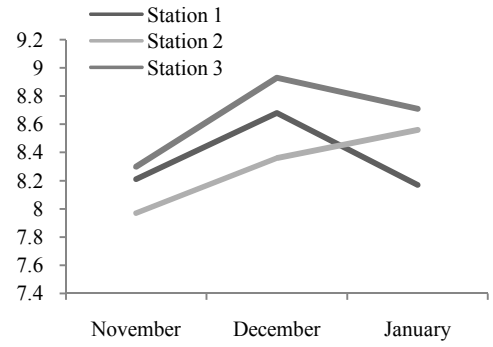

Fig. 3: Monthly variation of pH

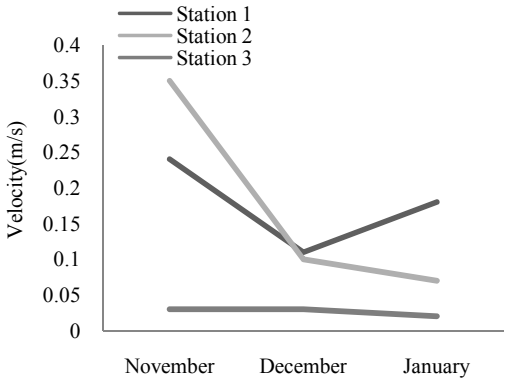

Fig. 4: Monthly variation of velocity

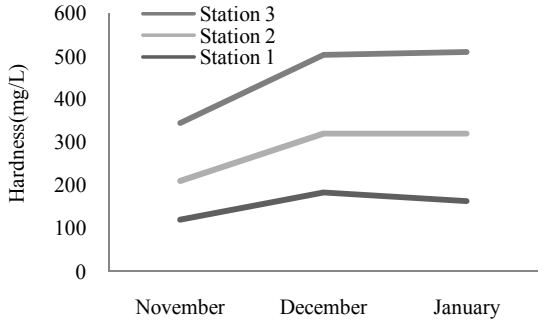

Fig. 5: Monthly variation of hardness

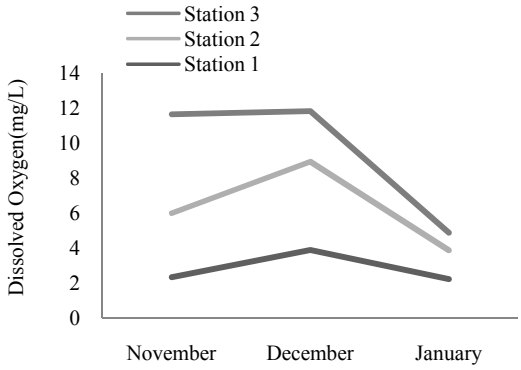

Fig. 6: Monthly variation of dissolved oxygen

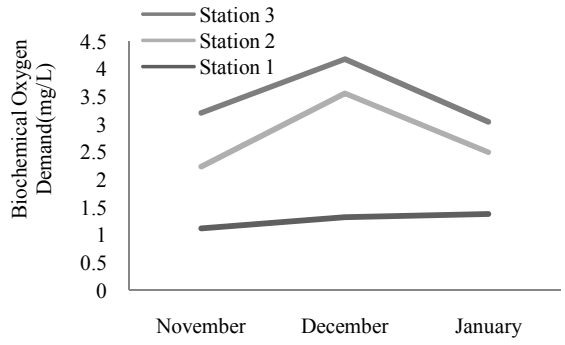

Fig. 7: Monthly variation of biochemical oxygen demand

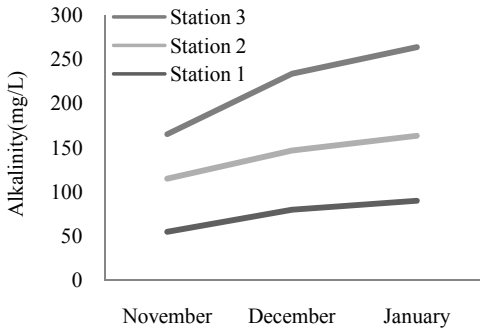

Fig. 8: Monthly variation of Alkalinity

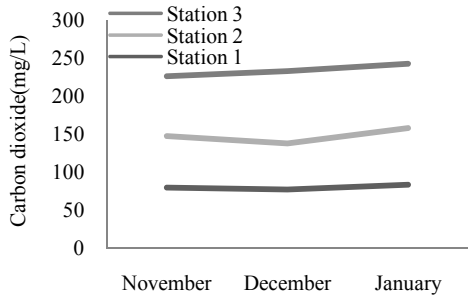

Fig. 9: Monthly variation of carbon dioxide

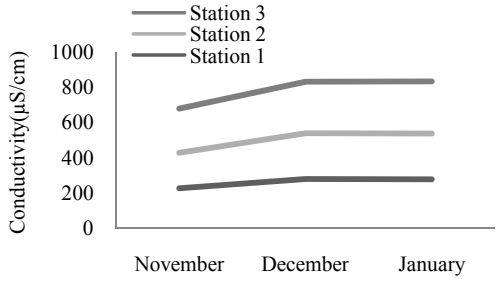

Fig 10: Monthly variation of conductivity

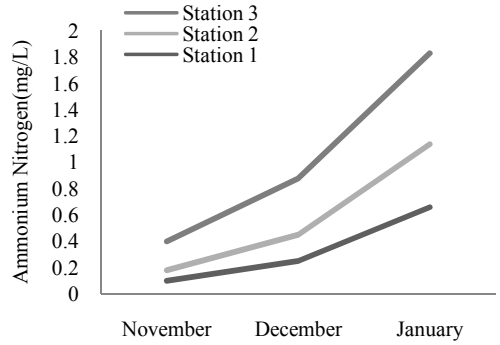

Fig. 11: Monthly variation of ammonium nitrogen

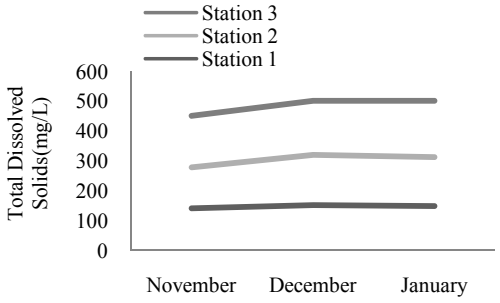

Fig. 12: Monthly variation of total dissolved solids

Macroinvertebrate composition and abundance: The relative abundance of benthic macro invertebrate encountered in Ona River during the study period is shown in Table 2. Ten families of a total one thousand three hundred and seventeen individual's species were

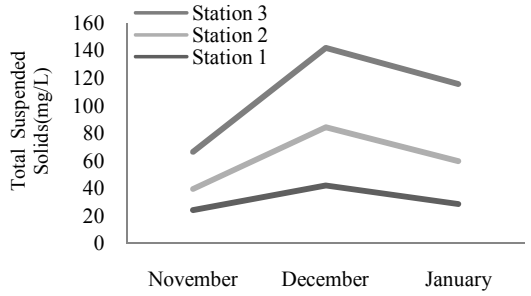

Fig. 13: Monthly variation of total suspended solids

Table 2: Relative abundance of macro invertebrates in one River during period of the study

Taxa	Station 1	2	3	Total no	Percentage abundance
Mollusca					
Family physidae					
Physa sp.	138	175	53	366	27.7
Family thiaridae					
Melanoides tuberculata	180	45	39	264	20.04
Family Palnoorboidea					
Biomphalaria sp.	1	1	1	3	0.22
Bulinus sp.	6	6	1	13	0.98
Family unionidae					
Unio sp	1	1	-	2	0.15
Arthropoda					
Family chironomidae					
Chironomus sp.	257	95	103	455	43.54
Family aeshnoidae					
Dragonfly nymph	9	9	3	21	1.59
Family gyrinidae					
Gyrinus sp	46	-	-	46	3.49
Family nepidae					
Nepa sp.	-	-	2	2	0.15
Annelida					
Family lumbricidae					
Lumbricus sp	12	13	119	144	10.93
Family hirudinidae					
Hirudo sp.	1	-	-	1	0.07
No of taxa	10	8	8		
No of individual	651	345	321		
Shannon weiner diversity	1.47	1.34	1.49		
Equitability	0.59	0.58	0.64		

recorded. The phylum Mollusca was the most abundant accounting for about 49.20%, followed by Arthropoda which accounted for 39.78% while Annelida was 11.00% of the percentage number. Shannon Weiner Diversity index (H) and Equitabilty of the benthic macro invertebrate is shown in Table 2 also.

DISCUSSION

Water temperature is important because of its influence on water chemistry. The mean temperature values for surface water recorded were within the stipulated range of 25-30°C for aquatic organism (WHO (World Health Organization), 1984). The mean value of velocity recorded although high upstream could be traceable to the wide cross sectional area of the bridge resulting in increased velocity. The slightly pH value recorded fall within the recommended range 6.5-9.0 as suitable for aquatic life (WHO (World Health Organization), 1984). Similar reports on slightly alkaline pH value were reported by Ogidiaka *et al*. (2012) in Ogunpa River at Bodija, Ibadan, Ogunwenmo and Osuala (2004) in an estuarine creek and artificial pond in Lagos. The high dissolved oxygen value recorded at Station 2 could possibly be due to the exposure of this station to enough sunlight and atmospheric air resulting in an increase in the rate of photosynthesis by the submerged plants in the water. Similar findings of high dissolved oxygen were also reported by Ikomi *et al*. (2005) in River Ethiope and Arimoro and Ikomi (2008) in River Warri, Delta State. Biochemical Oxygen Demand at upstream was almost the limit 4.0 mg/L as recommended unsuitable for aquatic organism (WHO (World Health Organization), 1984). The result could be attributed to a lot of wastes ranging from industrial, agricultural and domestic sources including organic and inorganic matter received by the river. Ogidiaka *et al*. (2012) reported high BOD in industrial area and area were waste are dumped in Ogunpa River. According to Sawyer and McCarthy (1967) classification of water hardness, the high value of hardness in all stations could be regarded as hard water. This could traceable to the presence of rock and granite and the discharge of chemical substances (detergents) from car washing and bathing at these stations. Also, the high values of alkalinity, conductivity, carbon dioxide, ammonium, nitrogen, total dissolved solids and total suspended solids could as a result of the impact of organic effluent discharge into the river at all stations. The high values of iron is expected since the basement complex of Ibadan is composed of Precambrian metamorphic rocks rich in iron, zinc and manganese ores (Hoore, 1964).

A total of ten families encountered in Ona River at Oluyole Estate during the study period can be said to be high when compared to 4 families reported by Ogidiaka *et al*. (2012) in Ogunpa River, Ibadan. The presence of pollution-tolerant macroinertebrate such as *Chironomus sp*., *Melanoides tuberculata*, *Physa and Bulinus sp*. could be attributed to the effect of domestic and industrial wastes discharge into the river. Also the high BOD values may have favour the presence of these pollution indicator species. Ogidiaka *et al*. (2012) also reported the presence of pollution indicator species in stations of high BOD in Ogunpa River, Ibadan. Their high presence is a common feature of organically polluted water bodies (Ogbogu and Olajide, 2002; Tyokumbur *et al*., 2002; Atobatele *et al*., 2005). The low species diversity from this study could partly be due to the fast flow of the river resulting in disruption of reproductive cycle, food chain and migration or imposed physiological stress on the tolerant species (Adakole and Annune, 2003). According to Shannon weiner diversity water quality index, the values obtained during the present study were more than 1.0 in all the station, confirming the pollution level of the river.

CONCLUSION

The low diversity of macroinvertebrate, presence of pollution indicator species and high BOD revealed that Ona River at Oluyole Estate is polluted.

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