Benthic Macro Invertebrates Composition And Physico-Chemical Characteristics Of Garin Garba Stream, Tumu, Gombe State, Nigeria

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ABSTRACT

Macro invertebrates composition and physico-chemical characteristics of Garin Garba Stream Tumu, Gombe, Nigeria was investigated between April and June, 2019. Physical and chemical characteristics includes temperature, pH, Electrical conductivity, turbidity, depth and width and macro invertebrates were sampled fortnightly for a period of three months. It was recorded that physico-chemical characteristics of the four sampling stations shows no variation in all the sampling stations. Shannon Weiner index was employed to determine the abundance of macro invertebrates in each sampling station. The results showed a total of 68 individual organisms of Macro invertebrates in 5 family among the four invertebrates taxa of Coleoptera, Hemiptera, Odonata and Mollusca. The taxa abundance of Garin Garba Stream arranged in lessening trend as Mollusca > Odonata > Coleoptera >Hemiptera with percentage composition of invertebrates values 45.59%, 38.23%, 8.82%, and 7.52% respectively. The Shannon Weiner diversity index for the four sampling stations of A, B, C and D were 1.5, 1.11, 1.03 and 1.54 respectively. The Macro invertebrates abundance and distribution observed in this study showed Garin Garba Stream can support and sustain various organisms.

Keywords: **Physico-chemical, macro invertebrates, streams, Garin Garba Tumu**

INTRODUCTION

Water is the most essential assets and general solvent that all living organisms depend on for their survival, growth and reproduction (Abbati *et al*., 2019). Without water living organisms does not likely to be survive, growth and reproduce because it's the element of life. Good water quality is obligatory in maintaining the composition of aquatic flora and fauna, reversion of the water quality can causes turn down in productivity and biodiversity of aquatic biota (Faithful and Finlayson, 2005). The quality of water is determined by its physical and chemical characteristics. Due to high population growth and heedlessness of humans, water quality is dwindling each day (Alrumman *et al*., 2016). Deterioration of lentic water quality has been linked to both biogenic and anthropogenic activities, including volcanic eruptions, earthquake, climate change, precipitation, agricultural land use, and sewage discharge.

Pollution is said to have transpired when the values of certain physico-chemical characteristics such as pH, temperature, Dissolved Oxygen (DO), Electrical Conductivity (EC), turbidity, Total Dissolved Solid (TDS), Biochemical Oxygen Demand (BOD5), Phosphate and Nitrate are above the recommended benchmark for drinking (Kamal *et al.,* 2007). Garin Garba Stream receives large amount of wastes, nonstop from the agricultural effluents and in some way from the human activities such as washing and bathing consequent in absolute declining of water quality. The robust environment and adequate nutrients are vital

for living and growth of aquatic organisms (Alam *et al.*, 2007). Physico-chemical characteristics of the water body facilitate to determine the productivity level of aquatic ecosystem. The highest productivity is obtained when the physical and chemical characteristics are at the ultimate level. Water quality plays a part in plateful decision-making process for pollution control in environment protection purpose (Kamal *et al.*, 2007). Water quality assessment is an incessant process as it gives an update of the health status of water and its fitness for various purposes such as bathing, drinking, irrigation and its capability to support aquatic lives (Akpomie *et al*., 2014).

Water desires in all living creatures, from minute to larger organisms are ever-increasing on a daily basis, but the supply of drinking water is a considerable setback, as all water resources have got to the point of predicament due to increase in population growth and unexpected industrial revolution (Bibbi *et al*., 2016).

Benthic invertebrates possess several proliferative strategies and life cycles, with some categories such as snails and worms spending their entire lives in aquatic ecosystem, while others, for example some insect larvae or nymphs, only spend part of their life in the water, their winged adults live in terrestrial ecosystem (Umar *et al.,* 2013).

Benthic invertebrates can be abundant in freshwater and can be used as indicators of changes in water quality; they also form an important part of aquatic food webs. Because of their capability to respond to physico-chemical changes in freshwater conditions, benthic invertebrates are mostly used as biomarkers ñ can provide vital information on the level of biogenic and anthropogenic disturbance (Umar *et al.*, 2013).

Benthic Macro invertebrates are aquatic organisms that can be seen with the naked eyes inhabited in the bottom of the aquatic ecosystems such as lakes, stream, river and ponds. Some are found often restricted at the bottom of the stream for their feeding and at the top for respiration. They play an essential role in cycling of nutrients and transfer of energy from lower trophic level to higher in a food chain. They are classified as shredders, filter feeders and scrappers depending on the size of food such as FPOM, CFOM and organic debris as well as their functional feeding habit (Umar *et al*.,2014).

Macro invertebrates are organisms used as a biological makers of water quality base on their responsiveness to alteration in ecological conditions of the environment, some can only be seen when the quality of water is within the acceptable or recommended limit while others can only be found when the quality of water is totally polluted (Umar, 2017).

Regardless of an assortment of studies on Physico-chemical characteristics and Benthic macro invertebrates distribution and abundance of water in Gombe state, readily available was no known study on water physico-chemical characteristics and Benthic macro invertebrates abundance and distribution of Garin Garba Stream, Tumu. Consequently, this investigation served as baseline information for further research. Its aimed at investigation of the physico-chemical characteristics and Benthic macro invertebrates distribution and abundance of Garin Garba Stream, Tumu, Gombe, Nigeria.

MATERIALS AND METHOD

Study Area

Garin Garba stream situated in the eastern part of Tumu Village in Akko Local Government Area of Gombe State. This Stream sourced its water from hilly rocks and discharge the water to Garin Garba river. It forms part of the abundant ecological habitat connected with Freshwater ecosystems in Gombe State. The Stream lies between latitude $10.02^{0}8.8$N and longitude $11.02^{0}38.9$E.

Figure 1: Map of study area showing Tumu, Gombe State, Nigeria

Sampling method

The Macro invertebrates collected using scoop net of mesh size 500um in each sampling station following the method employed by Umar *et al.,* (2014). The sample was collected fortnightly for a period of three months (April-June, 2019). Samples collected were cautiously preserved in 70% ethanol and 4% formalin and transported to the laboratory for sorting and identification to the lowest possible taxonomic level, using binocular microscope and taxa keys such as Umar *et al.,* (2013**).**

Physico-chemical characteristics

Water samples were collected from four different stations on the stream and mean values of the four stations were worked out and recorded. The sampling was conducted fortnightly between April-June, 2019. Sampling was done between 8.00am and 10.00am. The physico-chemical characteristics determined includes Temperature, pH, Electrical conductivity, Total dissolved solid, depth and width using digital meters as described by Umar *et al.,* (2018).

Benthic invertebrates Abundance and Distribution Estimation

The Macro invertebrates abundance were analyzed and presented using Excel Microsoft office. Shannon Weiner biodiversity index was employed to determine the Macro invertebrates abundance of each sampling station in Garin Garba Stream. Shannon Weiner's equation is given by:

$H=-E\ Pi\ In\ Pi$

$Hmax= ln\ S$

$Evenness\ (E)= H/Hmax$

Where:

P=Proportion of total samples represented by species i

S= Species richness

Hmax= Maximum diversity possible.

RESULTS AND DISCUSSION

Physico-chemical Characteristics

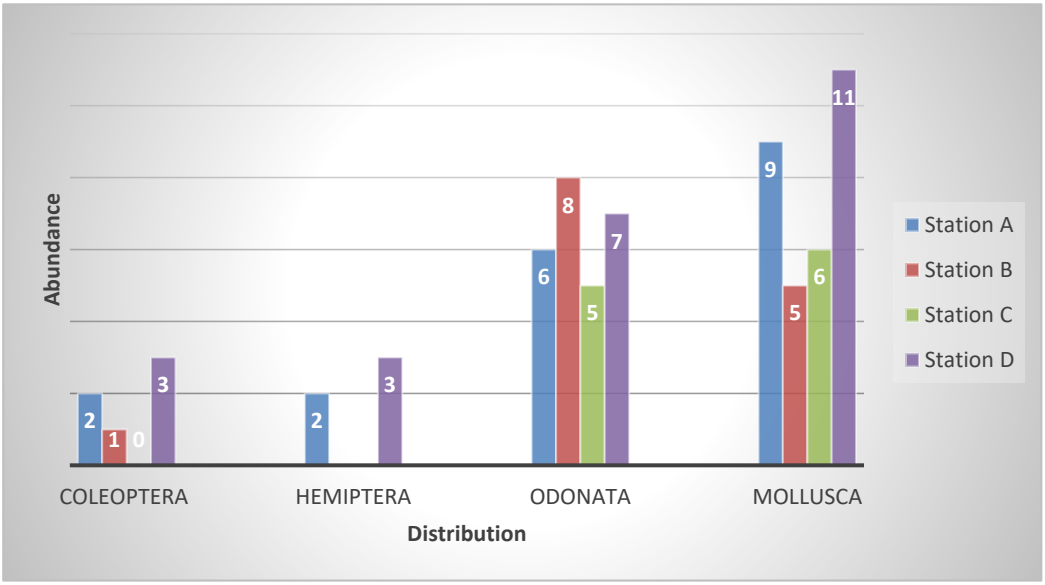
The results of physical and chemical characteristics of water in Garin Garba stream at four different sampling stations A, B, C and D were presented in table 1. Water temperature ranged between 25.8-27^{0}C with the mean values of 26.3^{0}C in the four stations of the stream. Station D had the highest mean temperature of 27^{0}C while station B had the lowest temperature of 25.8^{0}C (Table 1). The hydrogen ion concentration (pH) variation indicates that all the stations (A, B, C and D) had varied pH values of 7.9, 7.5, 7.7 and 7.8 respectively. Dissolved oxygen ranged from 6.4-6.9 mg/L in all the stations. Station A had the highest dissolved oxygen and stream C was lowest (Table 1). The highest turbidity was observed in station D with 0.4 NTU and the least turbidity level was in station B with 0.1 NTU respectively. The electrical conductivity of the four sampling stations ranged from 280-320 µS/cm. Station D recorded the highest with 320 while station A had the lowest with 280µS/cm. In terms of width and depth, all the stations ranged 2.0-4.0m depth and 3.8-5.2 width respectively (Table 1).

Table 1: The physico-chemical characteristics of Garin Garba Stream during the study period (April-June, 2019).

Physico-chemical characteristics	Station A	Station B	Station C	Station D	Range
Temperature (^{0}C)	26.4	25.9	25.8	27	25.8-27
pH	7.9	7.5	7.7	7.8	7.5-7.9
Dissolved Oxygen (mg/L)	6.9	6.8	6.4	6.6	6.4-6.9
Turbidity (NTU)	0.3	0.1	0.2	0.4	0.1-0.4
Electrical Conductivity (uS/cm)	280	290	286	320	280-320
Depth(m)	2	3	3	4	2.0-4.0
Width (m)	5.2	3.8	4.6	4.2	3.8-5.2

Macro Invertebrates

The results of macro invertebrates recorded at four different sampling stations comprises of a total of 68 individuals' organisms of Macro invertebrates consists of five (5) numbers of family among the four (4) taxa of Coleoptera, Hemiptera, Odonata and



Mollusca were recorded through out the study period. The Mollusca were the most abundant benthic macro invertebrates taxon comprising 45.59% of the invertebrates abundance followed by Odonata with 38.24%, Coleoptera with 8.8%, and least abundant Hemiptera with 7.35%, (table 3, Fig. 2).

Figure 2: The distribution and abundance of macro invertebrates among four sampling stations in Garin Garba stream, 2019.

Table 2: Checklist of Macro invertebrates present in Garin Garba stream, Tumu, Gombe, Nigeria, 2019.

Macroinvertebrates taxa	Station A	Station B	Station C	Station D	Total(%)
Coleoptera					
Dytisdae	2	1	0	3	**6(8.8)**
Hemiptera					
Notonectidae	2	0	0	3	**5(7.4)**
Odonata					
Gomphidae	6	8	5	7	**26(38.24)**
Mollusca					
Mellanoidaea	4	3	2	4	**13(19.12)**
Limnaea	5	2	4	7	**16(26.47)**
Shannon Weiner index (H)	**1.5**	**1.11**	**1.03**	**1.54**	
Evenness (E)	**0.94**	**0.69**	**0.65**	**0.96**	

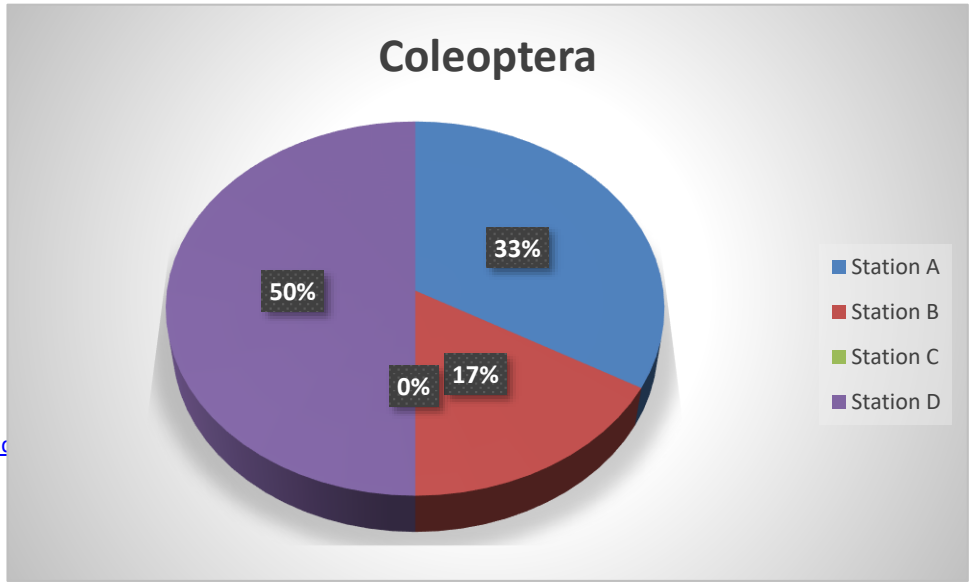
Richness(S)	**5**	**4**	**3**	**5**
Maximum diversity (Hmax)	**1.6**	**1.39**	**1.2**	**1.6**

Table 3: Distribution and abundance of macro invertebrates among four sampling stations in Garin Garba stream, 2019.

Macroinvertebrates taxa	**Station A**	**Station B**	**Station C**	**Station D**	Total	Abundance (%)
Coleoptera	2	1	0	3	6	8.82
Hemiptera	2	0	0	3	5	7.35
Odonata	6	8	5	7	26	38.23
Mollusca	9	5	6	11	31	45.59
Total	19	14	11	24	68	
Distribution (%)	27.94	21.88	16.18	35.29		100%

Coleoptera

Stations variation of Coleoptera showed that there was highest population count at station D and lowest count at station C (Figure 3). Stations variation showed that stations D and A with total population count of 3 and 2 individual organisms respectively higher than stations B and C with total population count of 1 and 0 individual organisms (Table 3). The Coleoptera identified



during the study period include family Dytisdae (Table 2).

Figure 3: Distribution and abundance of Coleoptera among four sampling stations in Garin Garba stream, 2019.

Hemiptera

The Hemiptera accounted for 7.35% of the population count of benthic invertebrates (68) with a total of five (5) individual organisms identified during the study period (Table 3). The study revealed that there was higher Hemiptera in station D with 60% of individuals followed by station A with 40%, while station C and B no species recorded (Fig. 4). Hemiptera identified during the study period include family Notonectidae

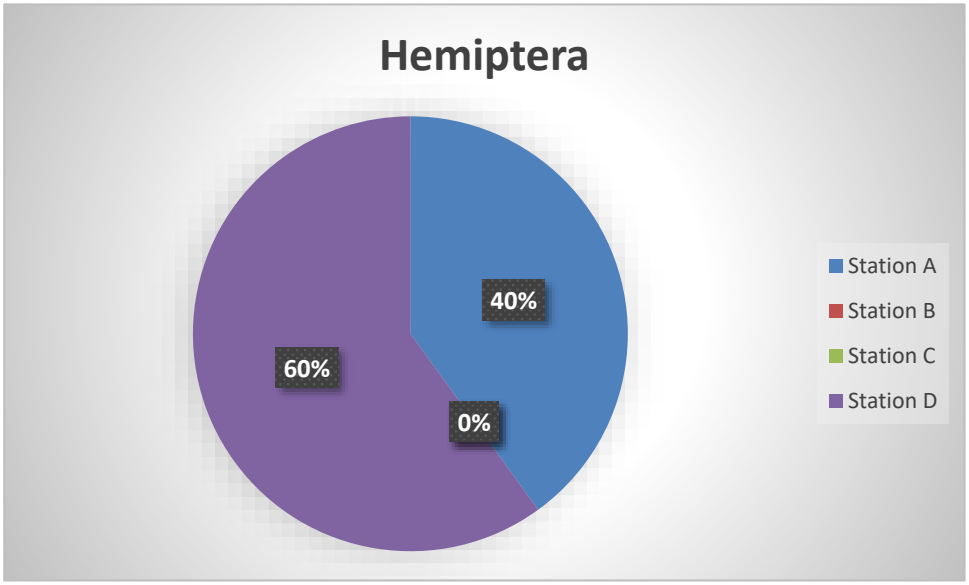


Figure 4: Distribution and abundance of macro invertebrates among four sampling stations in Garin Garba stream, 2019.

Odonata

The Odonata accounted for 38.23% of the population count of Macro invertebrate (68) with a total of twenty six (26) individual organisms identified during the study period (Table 3). The study revealed that there was higher Odonata in station B with 31% of individuals followed by station D with 27%, station A with 23% and C with 19% (Fig. 5). Odonata identified during the study period include family Gomphidae.

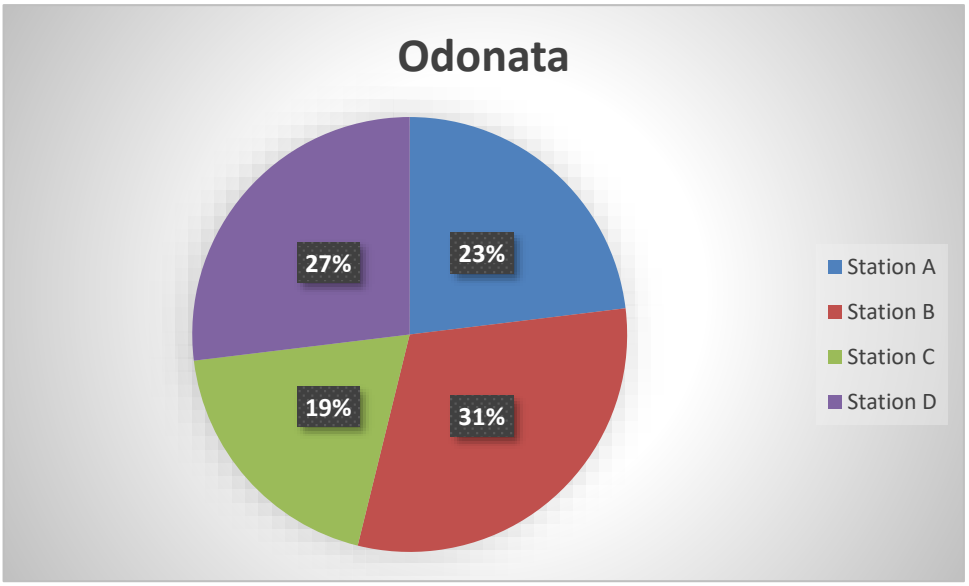
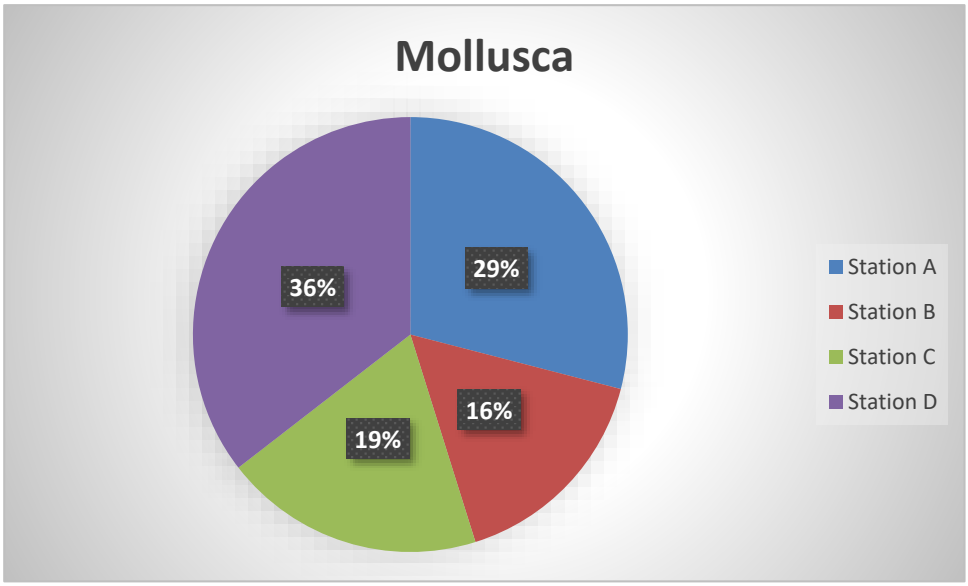


Figure 5: Distribution and abundance of macro invertebrates among four sampling stations in Garin Garba stream, 2019.

Mollusca

Stations variation of Mollusca showed that there was highest population count at station D and lowest count at station B (Figure 6). Stations variation showed that stations D and A with percentage of 36 and 29 respectively higher than stations B and C with 19 and 16 percent (Table 3). The Mollusca identified during the study period include Mellanoides and Lymnadae (Table 2)

Figure 6: Distribution and abundance of macro invertebrates among four sampling stations in Garin Garba stream, 2019.



DISCUSSION

The physical and chemical characteristics of the four sampling stations in Garin Garbage stream were in line with condition of some lowland tropical streams, which indicated that the temperatures recorded in all the sampling stations of the stream were within the tolerable limit for the proliferation, continued existence and development of aquatic organisms and it is in agreement with the findings of Umar *et al.*,(2018) in Dadin Kowa Streams. Longevity and abundance of various streams are mostly dependant on water temperature and any slight change of the mean temperature in the stream could alter the abundance and distribution of flora and fauna of the water (Umar *et al*., 2018). The hydrogen ion concentration (pH) values recorded throughout

the period of study lies within the recommended range (6.5-9) as suitable for survival, reproduction and growth of aquatic living organisms. Adjustment in pH may directly or indirectly affects the aquatic life because all metabolic processes exhibited by water organisms are pH dependant (Okafor *et al.,* 2013). Turbidity in the water may resulted due to organic and inorganic constituents. Throughout this study the recorded turbidity mean were between 0.1-0.4m which is below the recommended standard figure for turbidity by WHO, (2011). Consequently, this finding agrees with the findings of an ealier study which reported a mean turbidity value of 0.06m in some streams in Dadin Kowa (Isah *et al.,* 2018 and Umar et al., 2018). Dissolved oxygen concentration in natural waters depends on the physical, chemical and biochemical activities in the water body. Dissolve oxygen values recorded during this study were slightly higher than the permissible limit of 5.0mg/l. This agrees with the findings of Umar *et al.,* (2018) who reported highier DO of 7.0mg more than the WHO standard value in a study conducted in Dadin Kowa, Gombe, Nigeria. Electrical Conductivity indicates the presence of ions such as magnesium ion, calcium ion in the water which is usually due to the salt intrusion and leaching. The electrical conductivity is an essential water quality characteristic for indicating risks associated with salinity and dissolved substances in the water. The value of electrical conductivity recorded were intermediate and hence suitable for the abundance and distribution of organisms.

The total number of invertebrates observed from this research is quite abundant and this is conform by the fact that streams in tropical were mostly dominated a huge number of invertebrates compared to temperate streams (Sharma and Samita, 2011). In addition, rivers found in tropical region tend to proliferate rapidly; the rate of reproduction and relatively high primary productivity has been suggested as factors responsible (Oscar *et al*., 2015). Macro invertebrates are very essential in indicating ecosystem dynamism in water environment in relation to human disturbances. Benthic invertebrates distribution is mostly affected by the nutrients available and habitat rather than the chemical and physical characteristics (Oscar *et al.,* 2015).

Similar results of distribution and abundance of Macro invertebrates have been reported by Hassan and Umar (2018) and Abbati *et al.* (2020) stated that Mollusca is the most frequent organisms found in Kodon Stream, Gombe State and Lande Stream Tumu, Gombe State and contrary to the finding of Umar *et al*.,(2014) who reported Odonata as the most abundant macro invertebrates in three contrasting streams of Dadin Kowa, Gombe State Nigeria. The abundance of Mollusca in Garin Garba Stream, Tumu may be due to their adaptation strategy to changes in ecological condition and ability to bear up different ecological struggle. Dynamism and alteration in the substrate composition around the Stream stations caused by anthropogenic activities such as bathing, car washing and farming is believed to add more external substances into the water which eventually affects the whole physical and chemical characteristics of the water and hence made it an unfavorable condition for proliferation, survival and development of aquatic organisms. This is in agreement with a work reported by Hassan and Umar, (2018) and Hynes, (1970) who simultaneously reported that the alteration of substrate composition associated with various types of organic contamination have key impact on the bottom community in the stream.

Mostly, the benthic invertebrates found in the Stream served as a biological indicator or biomarkers of water quality. Therefore, any inputs of foreign substances from riparian land used may deplete the amount of dissolved oxygen present and seriously affect the living organisms that largely required an oxygen for their metabolic activities. The higher the invertebrates that utilized more oxygen, the higher will be the quality of water and vice versa. Therefore, Mollusca are organisms that can survived high ecological struggle (Umar, 2014). The abundance of Mollusca in Garin Garba Stream Tumu indicated that, the Stream is very susceptible to pollution**.**

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