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Macrobenthic Invertebrates Composition in Feroro Stream, Chikun Local Government Area of Kaduna State, Nigeria

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Abstract

Macrobenthic invertebrates are indicators of water quality due to their restricted range and persistence overtime. Feroro stream being imparted by anthropogenic activities disturb the composition of macrobenthic invertebrates. The stream sediment was collected from five stations along the stream on monthly basis for twenty-four months using eckman grab and washed to isolate the macrobenthic invertebrates. The macrobenthic invertebrates were identified in phyla of Mollusca (46.41%), Arthropoda (33.68%), Annelida (18.95%), and Crustacean (1.04%) and into 31 Families. Melanoides tuberculatus was the most abundant with 37.23% distribution and composition, followed by Lumbriculus variengatus with 8.58%. Highest abundance was recorded in the month of February and the lowest in July and August. February had the highest abundance in the dry season and the month of May in wet season. Macrobenthic invertebrate were composed in Station 5 (3.042) in the month of February during the dry season. Most of the species recorded are pollution-tolerant species indicating Feroro stream as moderately polluted and poor quality due to the anthropogenic activities.

Keywords: Abundance, Composition, Distribution, Feroro stream, Macrobenthic invertebrates.

INTRODUCTION

The quality of a stream is fundamental to the suitability of inhabiting the survival and growth of organisms (Ogbozige *et al*., 2018; Abdullahi and Tongjura, 2020). Feroro stream serves as source of water for different purposes such as domestic and agricultural, but the stream is impacted by anthropogenic activities.

Macrobenthic invertebrates are large enough to be seen with the naked eyes and lack backbone. They are good indicators of short- and long-term changes in aquatic environment due to their persistence overtime (Abdullahi and Tongjura, 2020). Stream quality gives adequate information about the extent of pollution in such water body within a given locality. Discharge of wastes both liquid and solid waste into Feroro stream has ecological and cumulative effects on the stream sediment which threaten the survival of macrobenthic organisms. The study was to evaluate macrobenthic invertebrates composition, distribution and relative abundance in Feroro stream.

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MATERIALS AND METHODS

Study area

Chikun Local Government Area (L.G.A) of Kaduna State has dendritic network of streams among which is Feroro stream. It lies between latitude 10º 20´N and 10º 31´N, longitude 6º 40´00´´E and 7º 50´00´´E (Figure 1). The stream flow throughout the year but its volume reduces and increases during dry and wet seasons respectively. Chikun Local Government Area has annual rainfall range of between 850mm to 1200mm. The area is drained by dendritic drainage network pattern of streams, among which is Feroro stream (Sadiq *et al*., 2022). The stream meanders through gullies and rocks. Five (5) sampling stations were selected along the stream based on anthropogenic activities. Station 1 was dominated by farming activities. Station 2 dominated by farming and indiscriminate waste dumps. Station 3 also dominated with activities such as farming, indiscriminate dumping of waste, washing/bathing, sand excavation by residence. Station 4 dominated by crop farming activity and indiscriminate waste dumps. Station 5 farming, fishing, waste dumping and sand excavation.

Sampling technique

Sediment from the stream was sampled on monthly bases using ekman grab for period of twenty-four months. The sediment was poured into a plastic container washed and passed through a sieve mesh of about 1mm size to separate the invertebrates from the sediment.

Data collection

The macrobenthic invertebrates were placed on Petri dish in the laboratory for sorting and screening. Large benthic macroinvertebrates were sorted with the naked eyes whereas the smaller ones were sorted under a magnifying lens (Wahizatul *et al*., 2011). The microbenthic invertebrates were preserved in 10% formalin (Edward and Ugwumba, 2011) and identified using taxonomic keys and manuals of Bouchard (2012), Easton *et al.* (2012), Pennak (1978), Needham and Needham (1962).

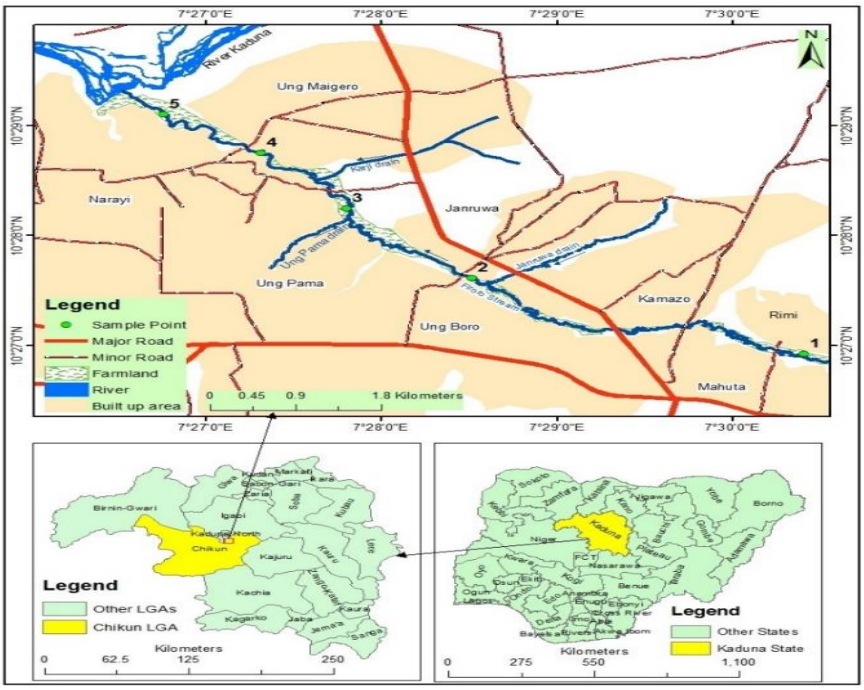

Figure 1: Map of study area showing sampling stations

Data analysis

the data obtained were subjected to descriptive statistic. The number of macrobenthic invertebrates per unit area was calculated as using the formular:

$$\text{Number of macrobenthic invertebrates in square metre} = \frac{N}{\text{A} \times \text{S}} \times 10000$$

Where; N = Number of organisms collected per sample,
A = Biting area of sampler (15 × 15 cm)
S = Number of samples taken (Sharma *et al*., 2013).

Relative Abundance of species was calculated as;

$$\% \text{ individual species} = \frac{number\ of\ individual\ species}{total\ number\ of\ macrobenthic\ inverterbrates\ identified} \times 100$$

$$\% \text{ composition} = \frac{number\ of\ individual\ phylla}{total\ number\ of\ macrobenthic\ inverterbrates\ identified} \times 100$$

RESULTS AND DISCUSSION

The abundance of the macrobenthic invertebrates across the stations shows how tolerant they are to physical and chemical variations in the stream environment. Table 1 is the composition of the macrobenthic invertebrates in Feroro Stream based on Phyla. Macrobenthic invertebrates of the stream vary due to interaction with physical, biological and chemical components of the stream environment. The highest composition of Phylum Mollusca (46.41%) followed by Arthropoda (33.68%) could be due to their levels of tolerance to pollution. This similar with the findings of Samuel *et al*. (2021) in Gurara Reserviour, Kaduna State, where Mollusca was the most composed accounting for 99.21%, followed by Coleoptera with 0.43% and Crustacean had the least number of individuals with 0.27%. The studies of Abdelmageed *et al*. (2022) and Anyanwu and Jerry (2017), also had Mollusca as the dominant phylum. The composition of phylum Annelida (18.95%) could be attributed to pollution tolerance. The abundance of *Melanoides tuberculatus, Indoplanorbis exustus, Potamopygus antipodarium, Thiara granifera* in Stations 2 to 5 also shows how tolerant they are to variations in the stream. The abundance of *Melanoides tuberculatus, Indoplanorbis exustus, Potamopygus antipodarium, Thiara granifera* in Stations 2 to 5 also shows how tolerant they are to variations in the stream. They are usually found in a wide range of freshwater habitats. The identified 31 Families, four phyla namely; Annelida, Arthropoda, Mollusca and Crustacean in this study was similar with the study of Abdelmageed *et al*. (2022) where 34 species of macrobenthic invertebrates belonging to three major phyla namely; Arthropoda, Annelida and Mollusca were recorded. This is similar with the findings of Daniels (2015) that relative abundance of gastropods and bivalves across the stations showed how tolerant they are to physical and chemical variations in the environment. The high relative abundance and distribution recorded in Stations 5 and 4 respectively, could be an indication that the macrobenthic invertebrates tolerate and are well adapted in such stations, despite the disturbed nature of the stream ecosystem due to anthropogenic activities such as direct municipal waste discharge, open defecation and leachates from solidwaste dumps along the banks of the stream at such stations.

Table 1: Composition of the Macrobenthic Invertebrates in Feroro Stream based on Phyla

Phylum	%
Mollusca	46.41
Arthropoda	33.68
Annelida	18.95
Crusteaean	1.04

Melanoides tuberculatus of family Thiaridae phylum Mollusca having the highest abundance and distribution of 37.23%, followed by *Lumbriculus variengatus* of the family Lumbricidae with 8.58% could be attributed to availability of nutrients and complex food web. This was also observed by Sarker *et al*. (2016) that high species correlated with longer food chain, complex food web and more stable community. *Melanoides tuberculatus* abundance could be due to similarity in ecological activities such as mode of nutrition, roles at a particular trophic level, irrigation farming and bathing within the stream which support their existence, similar with the observations of Alhassan *et al*. (2020).

Table 2: Relative Abundance and Distribution of Macrobenthic Invertebrates (individual/m^2) in Feroro Stream Across the Sampling Stations.

		Station						
Family	**Species**	**S1**	**S2**	**S3**	**S4**	**S5**	**Total**	**%**
Lumbricidae	*Lumbriculus variengatus*	430	604	252	489	430	2205	8.58
Glossiphoniidae	*Glossiphonia complanata*	-	370	356	444	325	1495	5.82
Tubificinae	*Tubifex tubifex*	163	267	148	370	222	1170	4.55
Ceratopogonidae	*Dasyhela Kieffer*	340	874	163	89	281	1747	6.80
Chironomidae	*Chironomus tentans*	193	563	296	222	281	1555	6.10
Gomphidae	*Progomphus serenus*	44	133	489	133	30	829	3.23
Libellulidae	*Brachymesia gravid*	-	-	59	119	30	208	0.81
Cordulegastridae	*Cordulegaster bidentata*	-	30	163	59	89	341	1.33
Aeshnidae	*Anax junius*	-	-	163	59	163	385	1.50
Ephemereliidae	*Drunella cornuta*	74	-	-	-	74	148	0.58
Coenagrionidae	*Schnura ramburii*	-	119	30	89	-	238	0.93
Tabanidae	*Tabanus reinwardtii*	59	178	133	119	30	519	2.02
Dytiscidae	*Dytiscus verticalis*	-	148	30	89	-	267	1.04
Perlodidae	*Isoperla ornate*	-	59	-	30	-	89	0.35
Perlodidae	*Periodes* sp	30	-	59	30	-	119	0.46
Nepidae	*Nepa cinera*	119	163	89	74	-	445	1.73
Spercheidae	*Sperchecus senegalensis*	563	178	148	-	59	948	3.69
Heplageniidae	*Caenis vanuatensis*	104	44	-	-	-	148	0.58
Hyrophiliidae	*Hydrophilini ovatus*	30	-	30	-	-	60	0.23
Hydrochidae	*Hydrochus abditus*	356	44	30	-	59	489	1.90
Belostomatidae	*Belostoma bakeri*	-	-	59	44	-	103	0.40
Polamonautidae	*Brachyura* sp	267	-	-	-	-	267	1.04
Thiaridae	*Melanoides tuberculatus*	-	44	859	2370	6296	9569	37.23
Melaniidae	*Ademietta bousei*	30	-	-	74	222	326	1.27
Cerithiidae	*Cerithiidae* sp	-	-	-	-	252	252	0.98
Lymnaemidae	*Lymnaea truncaluta*	-	-	59	-	30	89	0.35
Planorbidae	*Indoplanorbis exustus*	74	74	-	-	89	237	0.92
	Micronentus dilatatus	-	-	-	-	74	74	0.29
Pleuroceridae	*Pleurocea acuta*	-	-	193	163	341	697	2.71
Pilidae	*Pomacea paludosa*	-	-	-	-	74	74	0.29
Melanatrinae	*Brotia annamita*	-	-	-	-	30	30	0.12
Hydrobiidae	*Potamopygus antipodarium*	-	59	-	-	59	118	0.46
Thiarine	*Thiara granifera*	-	59	-	148	252	459	1.76
Total		**2876**	**4010**	**3808**	**5214**	**9792**	**25700**	**100**
%		**11.19**	**15.60**	**14.82**	**20.29**	**38.10**		

Note: S1= Station 1, S2= Station, S3= Station 3, S4= Station 4, S5= Station 5.

The quality of substrate of Feroro stream could have allowed the high abundance of the macrobenthic invertebrate. Similar with the studies of Suleiman and Abdullahi (2011) that the abundance of macrobenthic invertebrates in a waterbody is related to the water condition. Station 5 (38.10%) had the highest abundance of species while Station 1 (11.19%) had the lowest could be due to the quality of the stream in each station. The quality of substrate of Feroro stream could have allowed the high abundance of the macrobenthic invertebrate. This

is similar with the findings of Iyiola and Asiedu (2020) that reported lowest abundance of pollution tolerant species in Ogunpa River which was attributed to good quality of water when compared with the other stations.

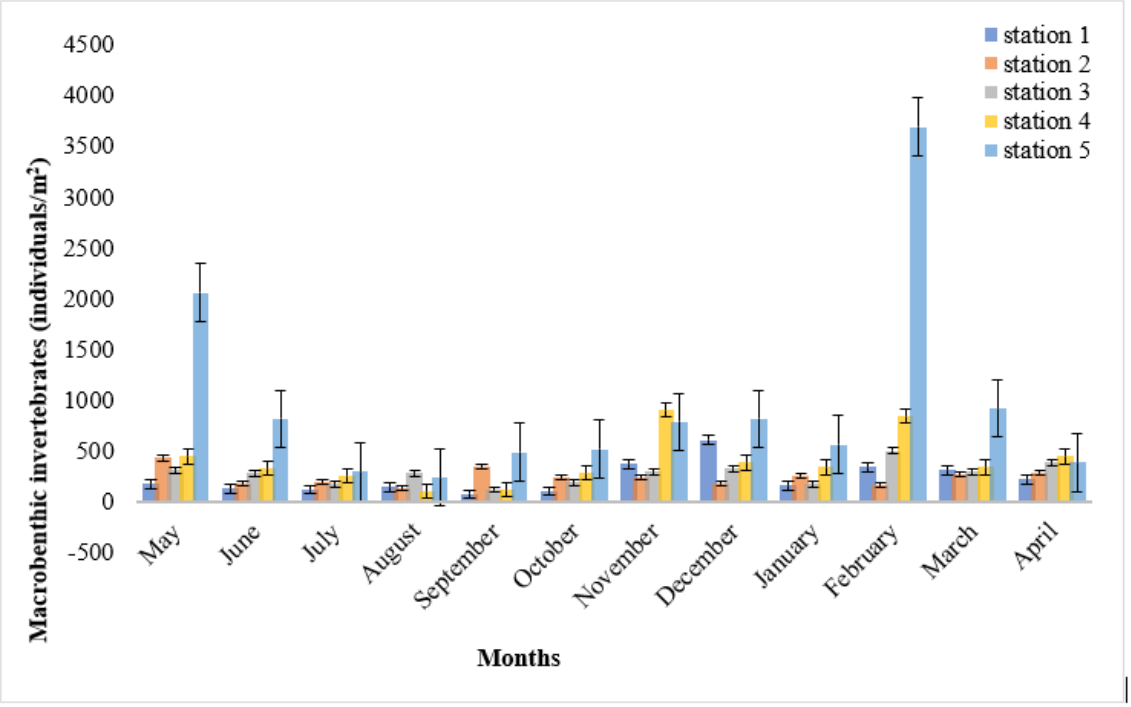

Figure 2: Macrobenthic Invertebrates Distribution and Relative Abundance across the Stations and Months

M. tuberculatus, Indoplanorbis exustus, Potamopygus antipodarium, Thiara granifera in Stations 2 to 5 of the stream. They are usually found in a wide range of freshwater habitats that favors their growth and distribution. This is similar to the report of Sharma *et al*. (2020) which state that the peak of molluscan density during winter season may be due to soft and organically rich bottom and alkaline nature of stream. The presence of *L. truncaluta* in Stations 3 and 5 is also an indication of organic pollution of such station, as suggested by Seiyabah and Izah (2017), that *L. truncaluta* indicates pollution.

CONCLUSION

Phyla Annelida, Arthropoda, Mollusca and Crustacean were richly composed distributed and abundant in all the Stations of Feroro stream in the dry season than in the wet season. *L. vareingatus, C. tentans* and *Melanoides tuberculatus* are the most abundant. *Melanoides tuberculatus* having the highest abundance of 37.56%, *T. tuifex, D. kieffer, P. setenus* and *T. reinwardtii* are pollution-tolerant species. Feroro stream is moderately polluted as indicated by the composition and abundance of the benthic macrobenthic invertebrate indicator pollution tolerant species.

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