UJMR, Conference Special Issue Vol. 9 No. 3. June, 2024, pp. 420 - 426

E-ISSN: 2814 – 1822; P-ISSN: 2616 – 0668

https://doi.org/10.47430/ujmr.2493.050

Received: 12 December 2023 **Accepted:** 14 March 2024

Benthic Macroinvertebrates Composition, Diversity and Distribution of Daberam Reservoir, Katsina State, Nigeria

[1]Musa, M. A., [2]Babatunde, T. A., [2]Babangida, A., [1]Hassan. H., and [3]Raubilu I. A.

[1]Department of Science Laboratory Technology, School of Engineering, Science and Technology, Federal Polytechnic Daura, Nigeria

[2]Department of Biology, Faculty of Natural and Applied Sciences, Umaru Musa Yar'adua University Katsina, Nigeria

[3]Department of Science Laboratory Technology, College of Science and Technology, Hassan Usman Katsina Polytechnic Katsina, Katsina State Nigeria

*Correspondence author: musa.muhammad@fedpolydaura.edu.ng,

Abstract

Macrobenthic invertebrates are significantly considered to be bioindicators by providing a key concept in understanding the dynamics in aquatic conditions rather than chemical and microbiological data, which at least give short-term fluctuations. Recent trends in hydrobiological research show a drastic decline in the aquatic fauna. However, this research aimed to identify the benthic macroinvertebrates' diversity and distribution in the Daberam reservoir of Katsina State. The reservoir serves multiple purposes for different individuals, ranging from domestic to economic activities such as fishing and irrigation farming around the reservoir. The water samples were collected from four (4) different sampling stations (A, B, C and D). Collection of the Bethic Macro invertebrates was conducted around 8:00 am monthly for 10 months from each sampling station using a circular framed sieve (250µm mesh size). The samples collected were fixed in the field with 10% formalin and subsequently preserved in 70% ethyl alcohol for further analysis. A standard identification chart (Identification guide to freshwater macroinvertebrates) was used to classify the Benthic Macro invertebrates into various taxa and species. The abundance and distribution of macro benthic invertebrates were compared using One Way ANOVA) and significant differences between the sampling stations were tested using chi-square at 5% level of significance. The present study has identified 1483 individuals of benthic macro invertebrates in the Daberam Reservoir of Katsina state. Mollusca (29.63%) is the most dominant group, followed by Diptera (22.22%), Coleoptera (14.81%), Oligochaetae (14.81%); Hemiptera (11.11%), Ephemeroptera (3.70%): and Odonata (3.70%) are the least prevalent with only one specie each. Melanoides tuberculata was found to have the highest number of occurrences, with a total number of 332 individuals across all the sampling sites representing (22.25%). The highest number of benthic macro invertebrates recorded was in Site D, with a cumulative total number of 603 (40.42%) organisms. Site B recorded the least total number of benthic macro invertebrates with a cumulative total number of 250 (16.76%) organisms. The low diversity of macrobenthic invertebrates in some sample stations in the study area was an indication of the presence of high levels of pollutants in the water bodies. Strict environmental protective measures are required to reduce human stressors within the study area.

Keywords: Abundance, Daberam, Benthic Macro Invertebrates, Diversity, Distribution

INTRODUCTION

Macrobenthic invertebrates are significantly considered to be bioindicators, providing key concepts in understanding the dynamics in aquatic conditions than chemical and microbiological data, which at least give short-term fluctuations (Ravera, 2000; Ikomi *et al.*, 2005). Benthic macroinvertebrates are small aquatic animals and the aquatic larval stages of insects (Environmental Protection Agency [EPA], 2016). Macrobenthic fauna are part of the aquatic ecosystem as they form part of the aquatic food chain and food web. They are also pollution indicators used to assess water quality in an aquatic ecosystem (APHA, AWWA, and WEF, 1998). They include insect larvae, annelids (leeches), worms, crustaceans (crayfish and shrimp), molluscs (snails), etc.) that can be

E-ISSN: 2814 – 1822; P-ISSN: 2616 – 0668

found at the bottom substrates e (Rosenberg and Resh 1993).

The abundance, distribution, and Diversity of benthic macro-invertebrates are dependent on the chance settlement of pelagic larval forms of different species, affinity to suitable substratum, and also the degree of stress effect caused by strong waves and tide currents (Kumar and Khan, 2013). Macroinvertebrate diversity and abundance are significantly important community contributors that are controlled by several mechanisms at different levels. However, numerous of literatures are available on how macroinvertebrate assemblages respond to environmental variables and which variables best explain their distribution and abundance (Buss *et al.*, 2002). Benthic macro invertebrates are commonly used as indicators of the biological condition of water bodies. Many microbenthic species communities have been used as bioindicators due to their relative stability and their sensitivity to changes in the aquatic environment (Ogbeibu and Oribhabor, 2001). They also have long larval life cycles, and this makes them perfect for conducting aquatic ecological studies to determine any decline in environmental quality (Ajao and Fagade, 2002). However, the present study was to identify the benthic macro invertebrates, their abundance, diversity, and distribution in the Daberam reservoir, Katsina State.

MATERIALS AND METHODS

Study site

The Daberam Reservoir (Figure 1) is located at latitude13°21Nandlongitude8°21E in the Dutsi Local Governments area of Katsina State. According to Bala *et al*. (2009), the dam drives its sources from rivers Kigo and Riniyal, which are seasonal. The reservoir lies in the northern Sudan savannah zone. The climate is characterized by distinct wet and dry seasons with an annual rainfall of about 600 – 640mm. The reservoir has a capacity of 12.5 million cubic meters, covering about 400 hectares of land. The depth of the reservoir is 42.6 meters with a crest length of 2377.44 meters (Bala *et al.*, 2009).

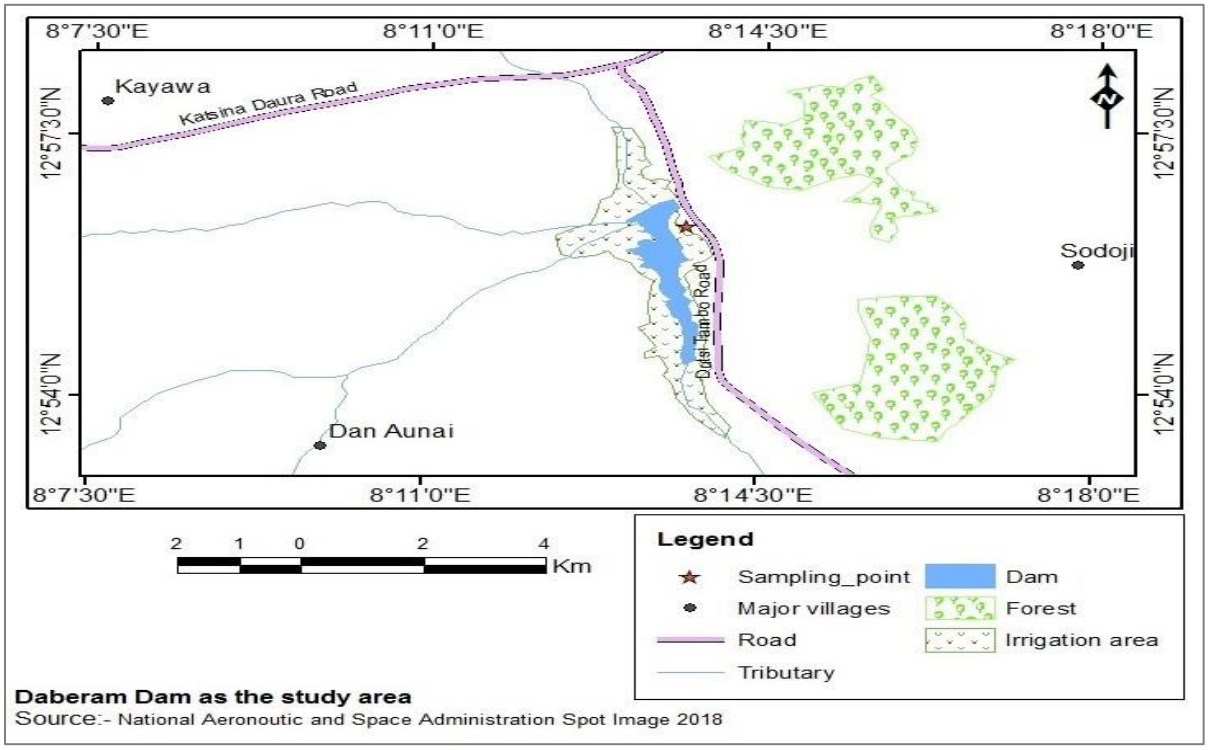

Figure 1: Map of Daberam Reservoir Katsina State, Nigeria

Samples Identification

The samples collected were then transferred to the Biology Laboratory of the Department of Science Laboratory Technology Federal Polytechnic Daura for sorting and identification. The Sorting was done by pouring out the contents of each container into a separate large tray. Samples were picked with the aid of a pair of forceps or a pipette as required. Dissecting and compound microscope was used for the identification of the specimens. A standard identification chart (Identification guide to freshwater macroinvertebrates) was used to classify the sample into various taxa and species (Gill, 2011).

Statistical analysis

The Data collected were processed using Microsoft Excel 2010. The abundance and distribution of micro benthic invertebrates were compared using One Way ANOVA) and significant differences between stations was tested using chi-square at 5% level of significance using Microsoft Excel 2010. Macro benthic invertebrate species richness and diversity were determined using biological indices such as Margalef's index, Menhinick index, Simpson diversity index, Shannon-Weiner index (H), and Evenness (E).

RESULT

The present study recorded 1483 number of individual benthic macro invertebrates in the Daberam Reservoir of Katsina state. Seven groups of macro benthos invertebrates have been identified in the Daberam reservoir, and these are well represented in the four sampling sites. Mollusca (29.63%) is the most dominant group represented by *Anadontaanatine*, *Anadontacygnea*, *Bulinussp*, *Biophlaria sp*, *Cleopatrabulimoides*, *Lymaneanatalensis*, *Melanoidestubaculata*, *Physa sp*. The second most dominant group is Diptera (22.22%) is mainly represented by *Chironomus* sp, *Chiromanus borealis*, *Culexrichetri*, *Tanytarsus* sp, *Polypediumpedestri*and *Tanypus*sp; Coleoptera (14.81%) represented by *Acilussulcatus*, *Dyticusmarginalis*, *Onychohydrus* sp, and *Hydrophilus* sp; Oligochaetae (14.81%) is represented by *Diplogaster* sp, *Eisenniella* sp, *Lumbriculus* sp, and *Tubifex* sp. Hebrussp, Hepasp, and Plea sp represent the Hemiptera (11.11%) group; Ephemeroptera (3.70%) and Odonata (3.70%) are the least prevalent with only one species each and are represented by *Caenis* sp and *Lestes* sp respectively. Out of the total species identified in this study, *Melanoides tuberculate* was found to have the highest number of occurrences, with a total number of 332 individuals across all the sampling sites representing (22.25%), and the least abundant species are *Caenissp and Lestes sp* with a total of 10 and 4 species (0.67% and 0.27%) respectively (Table1). The highest number of benthic macro invertebrates recorded was in Site D, with a cumulative total number of 603 (40.42%) organisms (Table 1). Site A recorded the least total number of benthic macroinvertebrates with a cumulative total number of 250 (16.76%) organisms. The Community structure of benthic macro invertebrates of the Daberam reservoir shows that Magalef's index (3.75) and Shannon index (2.85) indicated that site D is more diverse. However, the specie evenness was also highest in the site d with (0.90).

A total of 1483 Macrobenthic invertebrates were identified. The percentage composition of the major taxonomic groups to the overall macrobenthic population at the different sampled stations indicated that Mollusca is the most dominant group in the study area (29.00%), followed by Diptera, representing 22%, followed by Coleoptera and Oligochaeta representing 15% each. Hemiptera is represented by 11%. However, the least groups were Ephemerophtera and Odonata, represented by 4% each (Figure 2).

E-ISSN: 2814 – 1822; P-ISSN: 2616 – 0668

Table 1: Benthic macro invertebrate Composition and relative abundance in Daberam Reservoir

Taxon	Site A	Site B	Site C	Site D	Total	Relative. Abundance (%)
Coleoptera (14.81%)						
Acilussulcatus	6	2	0	5	13	0.87
Dyticusmarginalis	3	0	0	5	8	0.54
Onychohydrus sp	11	0	3	21	35	2.35
*Hydrophylus*sp	16	0	4	18	38	2.55
Diptera (22.22%)						
Chironomus sp	14	12	8	26	60	4.02
Chiromanus borealis	10	5	4	12	31	2.08
Culexrichetri	66	18	19	36	139	9.32
Tanytarsus sp	18	8	11	25	62	4.16
Tanypus sp	2	0	0	8	10	0.67
Ephemeroptera (3.70)						
Caenis sp	4	0	1	8	10	0.67
Hemiptera (11.11)						
Hebrus sp	6	1	1	9	17	1.14
Hepatatica sp	1	0	0	0	1	0.07
Plea sp	1	0	0	1	2	0.13
Mullusca (29.63%)						
Anadontaanatine	0	4	12	37	53	3.55
Anadontacygnea	0	5	11	27	43	2.88
Bulinus sp	14	8	11	23	56	3.75
Biophlaria sp	10	1	1	9	21	1.41
Cleopatra sp	8	4	3	13	28	1.88
Lymaneanatalensis	42	45	51	81	219	14.68
Melanoides tubaculata	68	84	86	94	332	22.25
Physa sp	2	1	1	4	8	0.54
Odonata(3.70%)						
Lestes sp	1	0	0	1	4	0.27
Oligochaetae(14.81%)						
Diplogaster sp	0	0	8	10	18	1.21
Eisenniella sp.	8	8	8	38	62	4.16
Lumbriculus sp	12	26	24	34	96	6.43
Tubifex sp	22	18	25	52	117	7.84
Total No. of organism	345	250	292	597	1483	100.00

E-ISSN: 2814 – 1822; P-ISSN: 2616 – 0668

Table 2: Community structure of benthic macro invertebrates of Daberam reservoir

DIVERSITY INDEX	Site A	Site B	Site C	Site D
Margalefs'	3.56	2.90	3.35	3.75
Menhinick	1.1793	1.08	1.1704	1.02
Shannon index _H	2.60	2.16	2.35	2.85
Simpson index _I_H	0.11	0.17	0.14	0.06
Evenness	0.82	0.68	0.74	0.90
Taxa	24.00	16.00	19.00	25.00

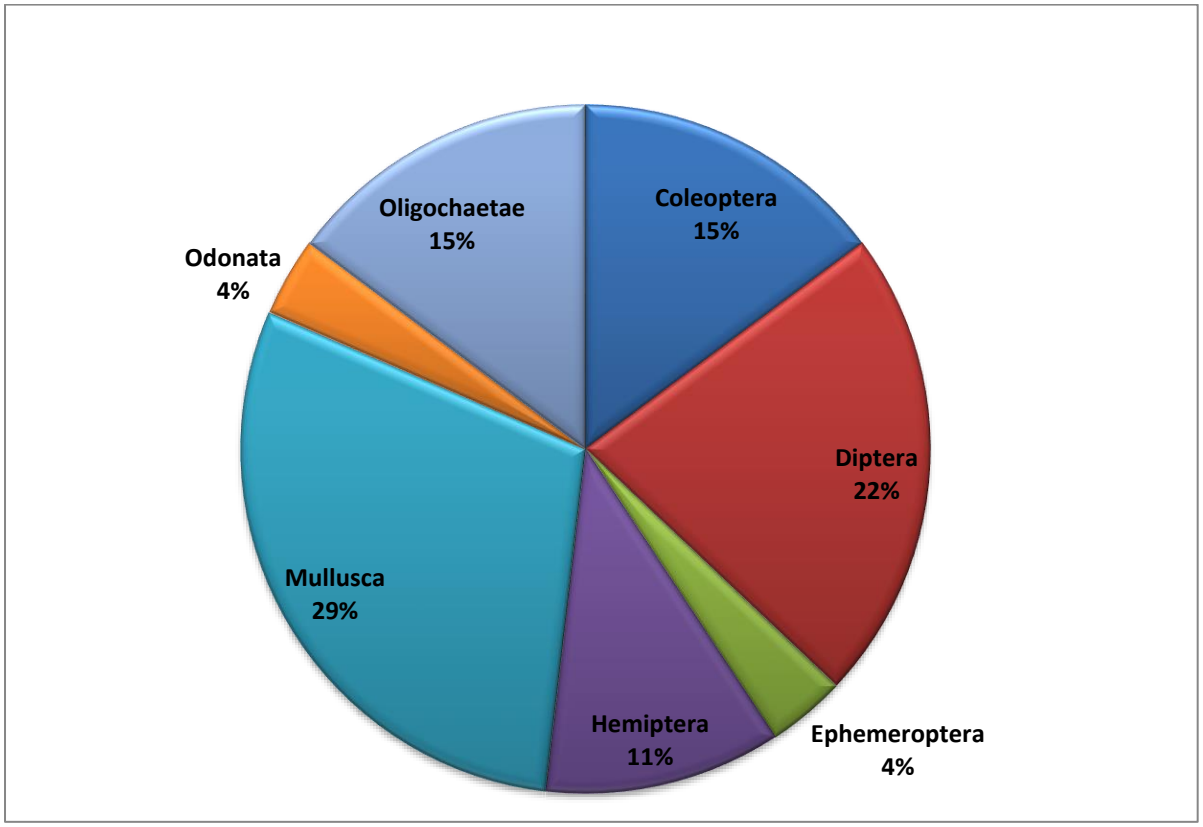

Figure 2: Percentage of the benthic macroinvertebrate Groups in Daberam Reservoir

DISCUSSION

During the present study, 1483 number of individual benthic macro invertebrates were recorded in the Daberam reservoir of Katsina State. However, in comparison with the existing studies of inland waters, the macrobenthic invertebrate species recorded in the Daberam reservoir can be considered rich in taxa. This is in line with the study conducted by Usman and Adakole (2017), who recorded 1420 during a study period of 12 months in Ajiwa dam. In this study, it was observed that the highest number of macrobenthic invertebrates were recorded in site D and site A, with (345 and 597 individuals) respectively. Stations B and C record a relatively lower number of macrobenthic invertebrates. This variation may occur due to fewer human activities in sites A and D at the time of the study. This is in line with the findings of Zahraddeen *et al.* (2019), whose findings stated that the macro invertebrates were mostly found where there is limited or no human activity in the Nasarawa reservoir in Jibia LGA. The abundance, composition, and diversity of the benthic macro invertebrate species at all four sampling stations in the study area show that the species

Melanoides tubaculata was in abundance while *Lestes* sp was the lowest in terms of abundance across all the sampling stations. This can be attributed to the dynamics of anthropogenic activities as a result of some changes in biota and subsequent changes in the ecology of sediment. This finding was in line with the reports of Nkwoji *et al.*, 2010 who stressed that the low abundance or high abundance of Macro benthic species was as a result of seasonal fluctuation or human stressors. The diversity of the macrobenthic invertebrates estimated by Margalef, Menhinick, Shannon-Wiener, Simpson, and Evenness indexes in the study area was generally high when compared with the studies of Nkwoji *et al.* (2010); Usman and Adakole (2017); Zahradeen *et al.*,(2019) who reported lower values in Margalef species richness and diversity indexes.

The findings from this study also revealed that Mollusca had the highest number of species with 29.63%. The relatively high percentage observed in Mollusca reflects their superior natural adaptation, such as the presence of hard protective shells that can withstand harsh environmental conditions and also protect them against predators and drought (Zahraddeen *et al.*, 2019). There was a moderate richness index in the study area at different sampling stations. The occurrence of higher taxa and individuals in some sampling stations in the study area is an indication of a lower degree of anthropogenic activities at these sampling stations compared to sites A and D. The low species abundance recorded in almost the sample sites B and C in the months are attributable to increase in human activities such as open laundry, bathing, defecating, fishing activities, among others occurring at the sample stations. This is in line with findings of Onyena, (2019). Therefore, there is a need for resealable action to be taken to reduce the anthropogenic activities around the reservoir in order to maintain the species richness of the dam.

CONCLUSION

The low diversity of benthic macro invertebrates in some sample stations in the study area was an indication of the presence of high levels of pollutants in the water bodies. The high level of human activities within the cost area accounted for the changes in the species and community diversity of the benthic macro invertebrates, notable as bio-indicators of pollution. Strict environmental protective measures are required to reduce human stressors within the study area.

REFERENCES

Ajao, E. A. and Fagade, S. O. (2002). The benthic macrofauna of Lagos Lagoon. The Zoologist 1(2): 1-15.

American Public Health Association, American Water Works Association and Water Environment Federation (APHA, AWWA and WEF) (1998). Standard Methods for the Examination of Water and Wastewater. 20th Edition, APHA, AWWA and WEF, Washington DC, 112-113.

Bala U. Lawal, Bolorunduro P. I., Oniye S. J., Abdullahi S. A., Bichi A. H. (2009). Study of ichty of aunaofdaberamreservoir,Katsinastate. *BayeroJournalofPureandAppliedSciences*,**2**(2): 172–174.

Buss, D. F., Baptista, D. F., Silveira, M. P., Nessimian, J. L., &Dorvillé, L. F. (2002). Influence of water chemistry and environmental degradation on macroinvertebrate assemblages in a river basin in south-east Brazil. Hydrobiologia, 481(1-3), 125-136. **[Crossref]**

EPA. (2016). Indicators: Benthic Macroinvertebrates Retrieved August 16, 2018 from https://www.epa.gov/national-aquatic-resourcesurveys/indicators-benthic macroinvertebrates

Gill, K. (2011). Identification Guide to Freshwater Macroinvertebrates. Retrieved November 18, 2018, from stroudcenter.org.

Ikomi, RB;Arimoro, FO; Odihirin, OK (2005). Composition, distribution and abundance of macroinvertebrates of the Upper Reaches of River Ethiope Delta State, Nigeria. The Zoolog. 3: 68-81.

Kalyoncu, H. and Zeybek, M. (2010). An application of different biotic and diversity indices for assessing water quality. African Journal of Agricultural Research 6(1):19-27.

Kumar, P. S., & Khan, A. B. (2013). The distribution and diversity of benthic macroinvertebrate fauna in Pondicherry mangroves, India. Aquatic biosystems, 9(1), pp 15-19. **[Crossref]**

Nkwoji, JA; Yakub, A; Ajani, GE; Balogun, KJ; Renner, KO; Igbo, JK; Ariyo, AA; Bello, BO(2010). Seasonal Variations in the Water Chemistry and Benthic Macroinvertebrates of a South Western Lagoon, Lagos, Nigeria. J.Americ. Sci. 6(3): 85-92.

Ogbeibu, A.E and Oribhabor, B.J, (2001). Ecological impact of stream regulation using benthic macroinvertebrates as bioindicators. *Journal of Aquatic science*. 16: 000-0002. **[Crossref]**

Onyena, A.P. (2019). Composition, Distribution, and Diversity of Benthic Macroinvertebrate from Creeks around Lagos Lagoon, Nigeria. *Journal of Applied Science and Environmental Management*. Vol. 23 (5) 857-863. **[Crossref]**

Ravera, O(2000). Ecological monitoring for water body management. Proceedings of Monitoring Tailormade III. International Workshop on Information for Sustainable Water Management. 157-167pp.

Rosenberg, DM; Resh, VH (1993). Freshwater biomonitoring and benthic macroinvertebrates. Chapman and Hall. 488pp.

Usman, L. U. and Adakole, J. A. (2017). Biodiversity Assessment of Some Benthic Macro Invertebrates in Ajiwa Reservoir, Katsina State, Nigeria. *Umyu journal of microbiology research*. Vol 2. Pp. **[Crossref]**

Zahraddeen, H. Y., Babangida, A. and Isiyaku, I. (2019). Diversity and distribution of benthic macroinvertebrate fauna of Nasarawa reservoir in Jibia, Katsina State Nigeria. FUDMA Journal of sciences (FJS). Vol. 3. pp 146 - 151