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DIVERSITY AND DISTRIBUTION OF BENTHIC MACROINVERTEBRATE FAUNA OF NASARAWA RESERVOIR IN JIBIA, KATSINA STATE NIGERIA

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ABSTRACT
A study was conducted for a period of 10 months from February to November, 2018 to evaluate the macroinvertebrate structure, abundance, distribution and diversity of benthic fauna of Nasarawa reservoir, Jibia, Katsina State. The benthic fauna were collected using Identification guide to freshwater macroinvertebrates manual on monthly basis from 5 sampling sites. A total of 4460 macrobenthic invertebrates comprising 3 phyla, 3 classes, 6 families and 17 species were recorded. Overall macrobenthic population at the different stations revealed that the study area was dominated by Mollusca (41.18%), Oligochaetae (23.53.56%), Coleoptera and Diptera (11.77%), Ephemerophtera and Odonata (5.89%). More macrobenthic invertebrate were recorded in the dry season than in the wet season. Simpson (1-D), Shannon (H) and evenness were higher during the dry season than in the wet season but dominance was higher in the wet season. Mollusca were the most dominant taxa recorded during the study period. Species richness as revealed by the Margaleff and Menhinick index was higher during the wet season than in the dry season. The variations in taxa and number of individuals during the months of sampling was not significantly different (P>0.05). Nature of the water body, habitat richness and stability, immediate substrate of occupation, tropic condition, resource partitioning and predation are factors that are likely to influence diversity and distribution of benthic macroinvertebrate fauna of Nasarawa reservoir.

Keywords: Diversity, Benthos, Fauna, Macroinvertebrate, Reservoir

INTRODUCTION

Benthic (meaning "bottom-dwelling") macroinvertebrates are small aquatic animals and the aquatic larval stages of insects (Environmental Protection Agency [EPA], 2016). They include dragonfly, stonefly larvae, snails, worms, and beetles. They lack a backbone, are visible without the aid of a microscope and are found in and around water bodies during some period of their lives. Benthic macro invertebrates are often found attached to rocks, vegetation, logs and sticks or burrowed into the bottom sand and sediments. Diversity and density of the macrobenthos is dependent on 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 significant community attributes that are controlled by a variety of mechanisms at different spatial scales. A number of studies have documented 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. They are reliable indicators because they spend all or most of their lives in water, are easy to collect and differ in their tolerance to pollution (EPA, 2016). The relative stability of benthic communities and their sensitivity to changes in the aquatic environment have made many species as bio-indicators of water quality (Ogbeibu and Oribhabor, 2001). Their long larval life cycles allow studies conducted by aquatic ecologists to determine any decline in environmental quality (Ajao and Fagade, 2002. No earlier study has been done on the benthic fauna of Nasarawa reservoir. Besides, the reservoir serves as a major source of domestic water supply for household use and irrigation to the Nasarawa community and the neighbouring communities. This research, aims to provide a baseline data on the diversity and distribution of benthic macro invertebrates of Nasarawa reservoir, Jibia Local Government, Katsina State.

MATERIALS AND METHODS

Study area

Nasarawa reservoir is located at latitude 12º59' 33'' North and longitude 7º 30' 48'' East . (Bugaje, n.d) (Fig 1) in Nasarawa village, Jibia Local Government Area, Katsina State. From the results of the preliminary visit to the reservoir, five sampling sites were selected for the purpose of sample collection. Stratified sampling technique was used to establish the sampling sites.

Fig. 1: Study Area Showing the Sampling Sites

Benthic Macroinvertebrates collection

Samples were collected from bottom sediments in the all sampling stations. This was accomplished with the use of rectangular framed sieve (250µm mesh size), bowl and sorting tray. Here the bowl was used to collect the sediments together with the water and poured into the rectangular frame and then sieved. The contents were transferred in sorting trays to ease separating the macroinvertebrates from other particles. The samples collected were transferred into specimen bottles, and immediately fixed in the field with 10% formalin and also subsequently preserved in 70% ethyl alcohol (Kalyoncu and Zeybek, 2010). A standard identification chart (Identification guide to freshwater macroinvertebrates) was used to classify the sample into various taxa and species (Gill, 2011).

Statistical analysis

Benthic macrinvertebrate species richness and diversity was determined using biological indices such as Margalef's index, Menhinick index, Simpson diversity index, Shannon-Weiner index (H) and Evenness (E).

Data were processed by Microsoft Excel. Mean distribution and abundance of micro-invertebrates were compared by One Way Analysis of Variance (ANOVA) and significant differences between seasons was tested using T-test at 5% level of significance using SPSS software version Graphpad instat version 3.06.

RESULTS

A total of 4460 macrobenthic invertebrates comprising three phyla, three classes, six families and seventeen species were recorded. These include one species each of Odonata and Ephemerophtera, two species each of Coleoptera and Diptera, four species each of Oligochaeta and seven species each of Mollusca. The relative percentage composition of the major taxonomic groups to the overall macrobenthic population at the different sampled stations revealed that the study area was dominated by Mollusca (41.18%), Oligochaetae (23.53.56%), Coleoptera and Diptera (11.77%), Ephemerophtera and Odonata (5.89%) (Table 1, Figure 1). These groups were well represented in the five sampling sites. Coleoptera represented by *Onychohydrous sp*. and *Hydrophilus sp*; Diptera is mainly represented by *Chironomus sp* and *Tanitarsus sp*; Ephemeroptera and Odonata were represented by *Caenis sp* and *Lestes sp* respectively. The Mollusca is the most dominant group represented by *Anadonta anatine Anadonta cygna, Bulinus sp, Cleopatra bulimoides, Lymanea natalensis, Melanoides tubaculata* and *Physa sp*. The second most dominant group is Oligochaeta, represented by *Diplogaster sp, Eisenniella sp, Lumbriculus sp* and *Tubifex sp* . Of the total species identified in this study, *Melanoides tuberculata* was found to have the highest number of occurrence with a total number of 1572 species (35.81%),and the least abundant species is *Lestes sp* with a total of 6 species (0.14%) (Table 1). The highest number of benthic macroinvertebrates recorded was in Site C with a cumulative total number of 1189 organisms (Table 1 and Fig1). Site A recorded the least total number of benthic macroinvertebrates with cumulative total number of 702 organisms. . Although Simpson (1-D), Shannon (H) diversity was higher at site B and C with values of 0.79 and 1.92 respectively, evenness was higher at site D with a value of 0.62 (Table 2). Dominance was higher at site E with a value of 0.24, followed by site A and B with a value of 0.21. Species richness as revealed by the Margaleff and Menhinick index was higher at site C with values of 2.26 and 0.49 respectively and lowest at site E with values of 1.64 and 0.42 respectively (Table 2).

More macrobenthic invertebrates were recorded in the dry season than in the wet season in Nasarawa reservoir (Table 3). Mollusca and Diptera are the only groups that recorded more organisms during the rainy season.

Species diversity, Simpson (1-D), Shannon (H) and evenness were higher during the dry season with values of 0.85 and 2.22 respectively than in the wet season which has the values of 0.78 and 1.96 respectively but dominance was higher in the wet season with a value of 0.22 (Table 3). Species richness as revealed by the Margaleff and Menhinick index was higher during the wet season with values of 2.07 and 0.36 respectively than in the dry season with values of 1.95 and 0.34 respectively (Table 3).

Table 1: Benthic macroinvertebbrate Composition, relative abundance in Nasarawa reservoir

Taxon	Site A	Site B	Site C	Site D	Site E	Total	R. Abundance (%)
Coleoptera (11.77%)							
Onychohydrus sp	0	0	74	86	0	160	3.59%
Hydrophylus sp	36	0	68	72	0	176	3.95%
Diptera(11.77%)							0.00%
Chironomus sp	54	52	64	59	56	285	6.39%
Tanytarsus sp	34	28	45	40	38	185	4.15%
Ephemeroptera(5.89%)							0.00%
Caenis sp	4	0	6	0	3	13	0.29%
Mullusca(41.18%)							0.00%
Anadonta anatine	0	24	32	14	0	70	1.57%
Anadonta cygnea	0	25	31	10	0	66	1.48%
Bulinus sp	44	28	43	36	49	200	4.48%
Cleopatra bulimoides	8	4	13	12	10	47	1.05%
Lymanea natalensis	142	165	182	160	174	823	18.45%
Melanoides tubaculata	268	284	386	286	348	1572	35.25%
Physa sp	8	6	9	7	4	34	0.76%
Odonata(5.89%)							0.00%
Lestes sp	2	0.00	4	0.00	0.00	6	0.13%
Oligochaetae(23.53%)							0.00%
Diplogaster sp	0	0	8	6	4	18	0.40%
Eisenniella sp.	28	18	68	30	31	175	3.92%
Lumbriculus sp	32	46	64	68	30	240	5.38%
Tubifex sp	42	98	92	76	82	390	8.74%
Total	702	778	1189	962	829	4460	100.00%

Table 2: Community Structure Indices for the Benthic Macroinvertebrates of Nasarawa Reservoir

Diversity Index	Site A	Site B	Site C	Site D	Site E
Taxa_S	13.00	12.00	17.00	15.00	12.00
Dominance_D	0.21	0.21	0.16	0.15	0.24
Simpson_1-D	0.79	0.79	0.84	0.85	0.76
Shannon_H	1.95	1.92	2.27	2.22	1.78
Evenness_e^H/S	0.54	0.57	0.57	0.62	0.49
Menhinick	0.49	0.43	0.49	0.48	0.42
Margalef	1.83	1.65	2.26	2.04	1.64

Table 3: Benthic macroinvertebrate Composition and community structure during Wet and Dry season in Nasarawa Reservoir

Species Composition	Dry season (%)	Wet season (%)	Total
Taxon			
Coleoptera			
Onychohydrus sp	110 (5.1)	50 (2.17)	160
Hydrophylus sp	121 (5.61)	55 (2.39)	176
Diptera			
Chironomus sp	105 (4.87)	180 (7.82)	285
Tanytarsus sp	75 (3.48)	110 (4.78)	185
Ephemeroptera			
Caenis sp	0	13 (0.56)	13
Mullusca			
Anadonta anatina	46 (2.13)	24 (1.04)	70
Anadonta cygnea	38 (1.76)	28 (1.22)	66
Bulinus sp	88 (4.08)	112 (4.87)	200
Cleopatra bulimoides	12 (0.56)	35 (1.52)	47
Lymanea natalensis	303 (14.04)	520 (22.59)	823
Melanoides tubaculata	672 (31.14)	900 39.10)	1572
Physa sp	15 (0.70)	19(0.83)	34
Odonata			
Lestes sp	4 (0.19)	2 (0.09)	6
Oligochaetae			
Diplogaster sp	15 (0.70)	3 (0.13)	18
Eisenniella sp.	115 (5.33)	60 (2.61)	175
Lumbriculus sp	144 (6.67)	96 (4.17)	240
Tubifex sp	295 (13.67)	95 (4.13)	390
Taxa_S	16	17.00	
Dominance_D	0.1545	0.22	
Simpson_1-D	0.8455	0.7778	
Shannon_H	2.218	1.96	
Evenness_e^H/S	0.5744	0.42	
Menhinick	0.3444	0.36	
Margalef	1.954	2.07	
Total			4460

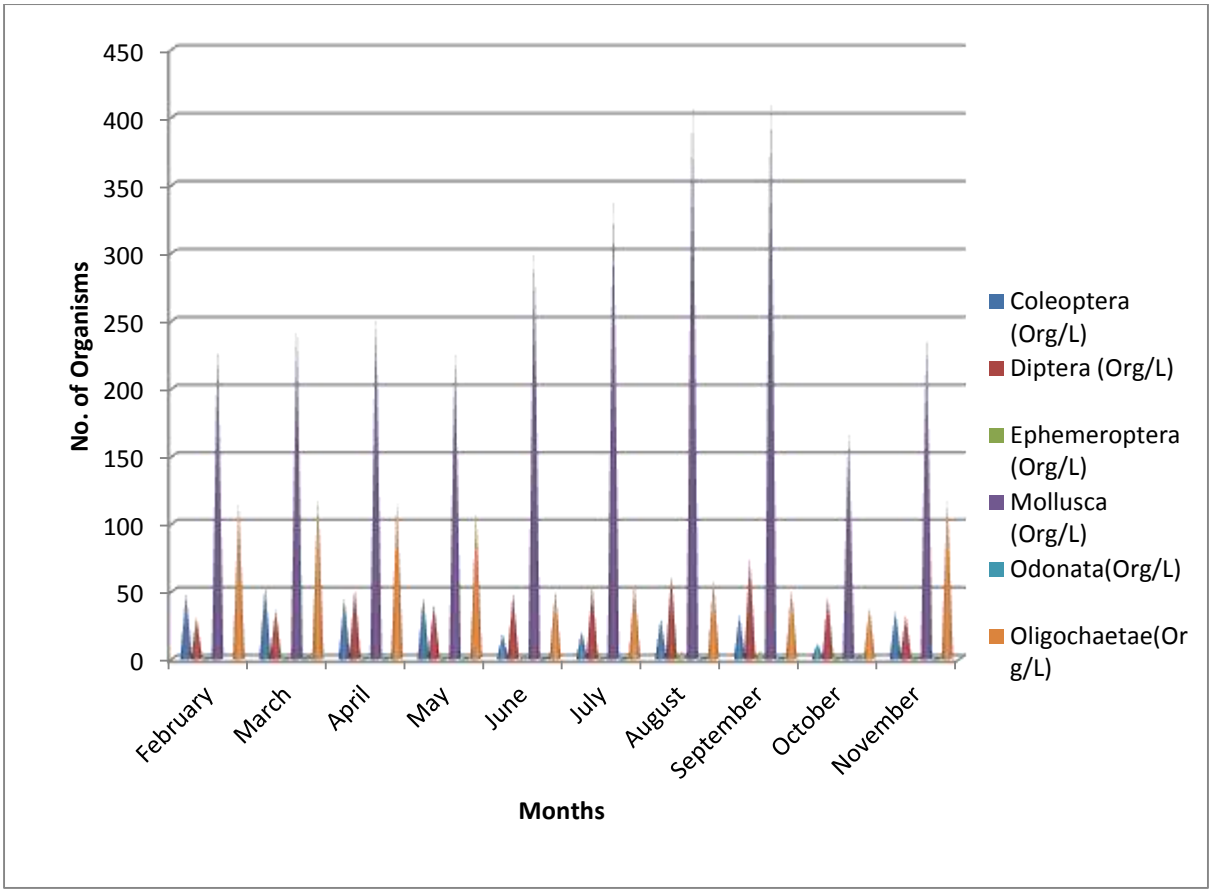

Fig. 2: Monthly Variation of the families of benthic macroinvertebrates of Nasarawa reservoir

DISCUSSION

In this study, it was observed that the maximum numbers of species were recorded during dry season when temperature is usually low and the amount of dissolved oxygen is more. This finding is similar to the reports of Negi and She et al (2013). The decline in the density of benthic fauna during rainy season months may be due to increase load of suspended solids, reduced transparency and increased water flow. Similar findings have also been observed by many other authors (Duffield and Nelson, 1993). Their abundance might be as a result of the fact that there was no human activity recorded in the lake during the study period. Oligochaeta can also be described as deposit feeders, as such more tolerant to silting and decomposition than other groups of benthic organisms (Olumukoro and Victor, 2001). Oligochaetae were found to be dominating benthic macroinvertebrate assemblage because they can tolerate low dissolved oxygen due to their cutaneous respiration (Mandaville, 1999).

The findings from this study also revealed that Mollusc (*Melanoides tuberculata*) had the highest number of occurrence with 35.81 %. The relatively high percentage observed in *M. tuberculata* reflects their superior natural adaptation such as the presence of hard protective shell that can withstand harsh environmental conditions and also protect them against predators and drought.

Dipterans were found to be abundant in all the sampling sites. This coincides with report of Mbah and Vijime, (1989) that the dominance of dipterans in the system as in other aquatic ecosystems may be attributed to their morphological and physiological adaptations to the various habitats, availability of food and sustained reproduction. The recorded seasonal and spatial variation in community structure could be related to seasonal differences in habitat characteristics with respect to physicochemical and biotic influences. The variations could directly or indirectly affect the sediment stability through sediment mixing, exposure to water level fluctuations and changes in the sediment chemistry. Factors which influenced the abundance and distribution of invertebrates includes; nature of the water body, habitat richness and stability, immediate substrate, tropic condition, resource partitioning and predation (Olomukoro and Oviojie, 2015). These factors, coupled with habitat differences observed in this study, acted singly or in combination to influence the variation in abundance of macro invertebrate of Nasarawa Reservoir. The present study indicates that benthic community structure and diversity of Nasarawa reservoir depends upon seasonal changes in both abiotic and biotic components of the reservoir. The rocky nature of site A might be the reason for the low species diversity and richness recorded in the site.

CONCLUSION

Factors which influenced the abundance and distribution of invertebrates are: the nature of the water body, habitat richness and stability, immediate substrate of occupation, tropic condition, resource partitioning and predation. These

factors are likely to influence the variation in abundance of benthic macroinvertebrate abundance and diversity of Nasarawa reservoir.

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