SURVEY OF THE DISTRIBUTION AND ABUNDANCE OF BENTHIC MACRO-INVERTEBRATES IN NASARAWA STATE UNIVERSITY MAIN STREAM, KEFFI, NIGERIA

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Abstract: This study aimed to survey the distribution and abundance of benthic macroinvertebrates conducted at Nasarawa State University Keffi, main stream between January and June 2019. The stream was divided into three sampling points A, B and C at a distance of 50 m apart. Samples were collected from each point using hoe, transferred into a plastic container and transported to the laboratory in a cooler for analysis. A total of 2,365 benthic macroinvertebrates comprising Chiromomid larvae 2015 (85%), Dragon Fly Nymphs 120 (5.1%**)**, May Fly Nymphs 111 (4.7%), Molluscs 89 (3.7%) and Annelidworms 30 (1.2%**)** were recorded. The highest number of benthos was recorded at point B (30.5%) and the lowest in point C (30.2%).Water parameters was found to have an effect on the abundance and distribution pattern of the benthic macro-invertebrates. ANOVA results did not evidence significant differences on the distribution and abundance of benthic macroinvertebrates between the sampling points at $P > 0.05$.

Keywords: Distribution, abundance, benthic macro invertebrates, stream

Introduction

Streams, rivers and lakes support a diverse community of small animals living on or in the stream bed or sediment (sand, mud, litter). They are made up of species which crawl or borrow along the bottom of water such as immature stages of many flies, beetles (adults and immature), mayflies, caddisflies, stoneflies, dragonflies, and aquatic worms, mollucs aquatic worms generally called benthic macroinvertebrates or benthos. They have special adaptations that allow them to live in aquatic environment such adaptations include possession of flattened bodies that allow them to hide between boulders and cobbles, thus limiting the stress of fast-moving water and allowing them to avoid some predators. Others have sharp claws, suction cups, or other grasping mechanisms on their bodies to prevent them from being swept away in the swift-flowing current.

The benthic macroinvertebrate fauna are important link in the energy flow from the deep compartment to the aquatic environment which serve as a modern tool frequently used for the monitoring of freshwater aquatic ecosystems (Baptista, 2008). Their distribution may be influenced by some physical or chemical disturbance (Abel, 1989; Milesi *et al*., 2009), and are significant within the food chain of aquatic environments as they serve as primary food source for many fish species, amphibians and other aquatic animals (Voshell and Reese, 2002).

Benthic macroinvertebrates are sensitive to different chemical and physical conditions meaning that if there is a change in the water quality, perhaps because of a pollutant entering the water, or a change in the flow downstream of a dam, then the macroinvertebrate community may also change. The complex interactions between benthic fauna and the environment make these organisms useful tools in the evaluation of water quality and the development of biological indices (Nijboer *et al.*, 2005; Roche *et al*., 2010). By contributing to nutrient cycling, pollutant and sediment removal, benthos are directly responsible for maintaining healthy water quality.

This study is important because benthic macroinvertebrates play vital roles in aquatic ecosystems; from a food source to a monitoring tool to evaluate a catastrophic environmental event such as a spill or explosion from an environmental standpoint and to track the acute and chronic effects of a system's recovery over time using quantitative stream assessment analysis, such as the invertebrate community index (ICI). The key aim of the present study was to survey the distribution and abundance of benthic macroinvertebrates in Nasarawa State University main stream.

Materials and Methods

Study area

The research was conducted in Nasarawa State University main stream Keffi. Keffi is about 50 km away from Abuja, the Federal capital of Nigeria and lies between latitude 8 50' 55"N and longitude 7°52' 25"E south of the equator with estimated population of about 96,664 (N PC, 2006). The water is mainly used for irrigation in the surroundings near to the sampled stretch.

Field sampling

Benthic sampling was undertaken monthly usually between the hours of 7am – 10am. At each sampling point, muddy sediments were scooped up 3-4 times using a hoeto ensure the greatest range of macroinvertebrates. The samples collected were placed into labeled polythene bags and transported in a cooler to the laboratory for processing and analysis.

Laboratory analysis

The benthicsediments were mixed thoroughly with water in the bucket to ensure that the contents are evenly distributed and the animals were segregated from the mud in living state through a 0.250 mm mesh size sieve to retain most benthic organisms. The entire samples were emptied into a white tray, stained with Rose Benger solution and sorted using fine-tipped forceps and magnifying glass following the same protocol of Kaboré *et al*. (2016) and preserved in 70% ethanol labeled storage vials to prevent desiccation during identification. The preserved specimens were examined, identified, and counted under compound microscope using dichotomic micronvertebrates keys manuals of Tachet (2003), Merrit and Cummins (1984), Lévêque and Durand (1981) and Moisan and Pelletier (2008) and with direct assistance of laboratory technologist.

Analysis of physicochemical parameters

Surface water physico-chemical parameters viz; temperature, pH, and dissolved oxygen, were determined by using methods described by UNEP, (2004); APHA (2005) and Panday *et al*. (2005) to evaluate water quality.

Determination of temperature (ºC)

Temperature (ºC) of the water was measured *in situ* for every collection using a mercury thermometer. The thermometer was inserted into the stream and left for about 3 – 4 min to allow for stabilization before final reading was taken (APHA, 2005).

Determination of dissolved oxygen (DO)

Winkler method was used to determine the dissolved oxygen content in the water sample. A 60 mL BOD bottle was filled completely with water in the stream and taken to the laboratory for analysis. The dissolved oxygen in the sample was then "fixed" by adding a series of reagents that form an acid compound which was then titrated with a neutralizing compound that results in a color change using Winkler titration technique. The point of color change is called the "endpoint," which is equivalent with the dissolved oxygen concentration in the water sample. The Winkler's titrimetric method for the determination of dissolved in the sample is shown in the following formula:

$$\text{Dissolved oxygen (mg/L)} = \frac{v\,(D)\ x\ N\ (D)\ x\ 8}{Volume\ of\ the\ sample}$$

Where: D = Sodium thiosulphate ($XLa_2\ S_20_3$); v = volume of $Na_2S_2O_3$ used in the titration; N = Molarity of $Na_2S_2O_3$ used = 0.0124N; v × 0.0124 × 8 mg oxygen per 100 mL water sample

Determination of pH

It is the concentrations of hydrogen ions (H^+) present in water and is a measure of acidity or alkalinity. Most of the aquatic organisms are very sensitive to pH change and can alter various metabolic activities of aquatic organisms. The pH of the streams was measured using a Beckman electric pH meter, model – H_3 in-situ and the results were recorded (APHA, 2005).

Statistical analysis

Thedata obtained were subjected to Analysis of Variance (ANOVA) and mean was calculated using percentage with SPSS 22.0 software. The mean values were separated using post-hoc TURKEY.

Results and Discussion

A total number of 2365 specimens of benthic macroinvertebrates comprising of Chironomids larvae 2015(85%), May fly nymphs 111(43.75%), Dragon fly nymphs 120 (5.1%), Annelid worms 30(2.3%) and Molluscs 29(3.8%) were recorded as shown in (Table 1). The highest abundance occurred at point B, where 846 individual were recorded. At point A 804 individual were counted while at point C, 715 benthic animals were recorded. The results indicated that Chironomid larvae was the dominant organisms recorded during the period of the study.

Table 1: Abundance of Benthic macroinvertebrates in NSUK stream (January – June, 2019)

S/N	Benthic organisms	Sampling points			%composition
		A	B	C	
1	Chironomidlarvae	687(29%)	735(31%)	593(25%)	2015(85%)
2	May fly nymphs	29(1.2%)	40(1.7%)	43(1.8%)	111(4.7%)
3	Dragon fly nymphs	40(1.7%)	31(1.3%)	49(2.1%)	120(5.1%)
4	Annelid worms	13(0.5%)	11(0.4%)	6(0.3%)	30(1.2%)
5	Molluscs	36(1.5%)	29(1.2%)	24(1.0%)	89(3.7%)
	Total	**804(33.9%)**	**846 (35.6%)**	**715(30.2%)**	**2365(100)**

The result obtained in water temperature, dissolved oxygen and pH varied among the sampling points (Table 2). The observed differences in the abundance and distribution pattern of benthic macroinvertebrates during the study could be attributed to the environmental factors. Higher concentration of dissolved oxygen was recorded in all the sampling points which indicates the overall health of a water body that typically support the most diverse biological communities.

Table 2: Water quality parameters in NSUK stream (January – June, 2019)

Parameters	Sampling points		
	A	B	C
Dissolved Oxygen (mg/L)	7.6	7.8	7.3
pH	7.3	6.5	7.0
Temperature (^{0}C)	27.8	28.8	28.7

The pH of water is important for the biotic communities as most of the plant and animal species can survive within tolerable range of pH from slightly acidic to slightly alkaline condition (Goher, 2002). To that effect, the pH value was slightly alkaline suitable for the survival of benthic organisms in the study area.

Conclusion

The results of the study revealed that Chironomid larvae were the dominant species of the macroinvertebrate communities recorded at all the sampling points. Habitat structure and environmental parameters at different sampling points govern the distribution and composition of benthic invertebrates. Thus, it is important to protect the diversity of benthic communities in a water body because they can be used to provide an estimate of fresh water ecosystem health.

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Conflict of Interest

Authors declare that there is no conflict of interest related to this work.

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