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Macrobenthic Assemblages in the Riverine Systems in Kauswagan, Lanao del Norte, Philippines

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ABSTRACT Determining the composition of taxa and diversity of benthic macrobenthos could serve as reference in understanding the structure and function of riverine ecosystems. In this study, temporal and spatial variations in the distribution of macrobenthos were determined in dry and wet seasons in four sampling stations in the river and creek systems in Kauswagan, Lanao del Norte. A total of 272 specimens/m^{-2} benthic macrobenthos belonging to 6 taxa were identified, namely, Nematoda (42.28%), Oligochaeta (22.06%), Annelida (11.40%), Amphipoda (9.19%), Rotifera (8.46%), and Polychaeta (6.62%). Diversity index analyses indicated that Simpson index varied from 0.65 to 0.78, Shannon diversity values ranged from 1.21 to 1.62, while Dominance index ranged from 0.22 to 0.35, respectively, for all sampling stations during wet and dry seasons. Composition and diversity of taxa in all sampling stations for both wet and dry seasons were not significantly different (p>0.05). This means that macrobenthos population did not thoroughly changed through time and space. Thus, this study can be used in determining patterns and dynamics of biodiversity in ecosystem**s** and try to manage their main aspects.

KEY WORDS Macrobenthos; Northern Mindanao; riverine ecosystem.

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INTRODUCTION

Biodiversity study poses high relevance in dealing with environmental changes in aquatic ecosystems. For instance, coastal sediment habitats contained much assemblages of macrobenthic taxa. These taxa play key important ecological roles such as recycling of nutrients, detoxifying pollutants, dispersion and burial, and secondary production (Madhushankha et al., 2014). Hence, data that can be obtained are imperative in various biomonitoring activities to ascribe ecological health and status. In some cases, there are taxa of organisms that are tolerant to pollution and other changes in the environmental systems (Lamptey, 2015) like most of the nematodes. Analysis of data demands appropriate index to associate the number of species within a community and the abundance of individual taxa relative to all taxa accounted for. Spatial and temporal patterns of taxa as observed in the study sites could relate in the much-needed relevance to monitoring of ecological health especially in studies dealing with management and conservation of ecosystems (Morris et al., 2014). Some information promoted is useful in understanding of diversity indices, richness, and evenness of the species in the community (Shah & Pandit, 2013) and various indices of diversity were considered to depict its significant benthic community study (Guerold, 2000). Thus, describing the macrobenthic communities in the freshwater systems in Kauswagan, Lanao del Norte could serve as an input in monitoring changes in these aquatic ecosystems related to various resource utilization in the area.

Sustaining biological diversity is a priority for nature conservation (Brooks et al., 2006) and freshwater biodiversity is an example of such conservation priority (Dudgeon, 2000). Hence, the assessment of biological diversity in freshwater ecosystem plays a very significant role as the basis for nature protection, particularly on its structures and functions (Uwadiae, 2009; Magurran, 1988; Dash, 2003). Therefore, diversity of taxa as quantified could describe the spatial distribution of individuals and the communities and environment (Morris et al., 2014; Lamptey, 2015). Another information could point to the concept of biodiversity threat especially in water pollution (Dudgeon, 2000; Ravera, 2001). However, interpretation should be carefully assessed to avoid confusions and other related problems (Shah & Pandit, 2013; Guerold, 2000).

The influencing factors among macrobenthos had encompassed both geographic and climatic (Magurran 1988; Dudgeon, 2000). For instance, there are notable differences in composition and diversity of benthic assemblages between New Zealand and Palearctic springs (Barquin & Death 2006). Some had findings related to spring stability and productivity, stream-benthos diversity and oxygen concentration in water (Scheffer et al., 2006; Shulman & Chase, 2007; Koperski, 2010).

In line to the concepts and information on macrobenthic composition and diversity, a study was conducted in the freshwater ecosystems within the vicinity of GN Power Plant. These were considered as monitoring sites that potentially depict changes in some environmental conditions particularly on the benthic population. These informations, henceforth, could be used to manage and protect the resources of these environments

MATERIAL AND METHODS

Three replicate sediment samples were collected per sampling station. Hence, a total of 12 sediment samples were collected in four sampling stations located in the creek and river systems in Kauswagan, Lanao del Norte. Macrobenthic specimen collections were done twice in a year, representing the dry and wet seasons. A modified 1x1 m^2 square sieve sampler was used with a mesh measuring 1 mm. in collecting the microbenthic specimens, decantation method was used wherein the organisms retained in the 1 mm sieve were collected. Identification of specimens was done using taxonomic keys and illustration guides (Haynes, 2001) as references. Total number of speciemns per taxa were determined and expressed as number of spec./m^2. Taxa composition, number of individuals, and diversity indices were analyzed using descriptive statistics. Significant variations among macrobenthic counts were analyzed using Kruskal-Wallis test. PAST version 4.03 statistical software was used for data analysis.

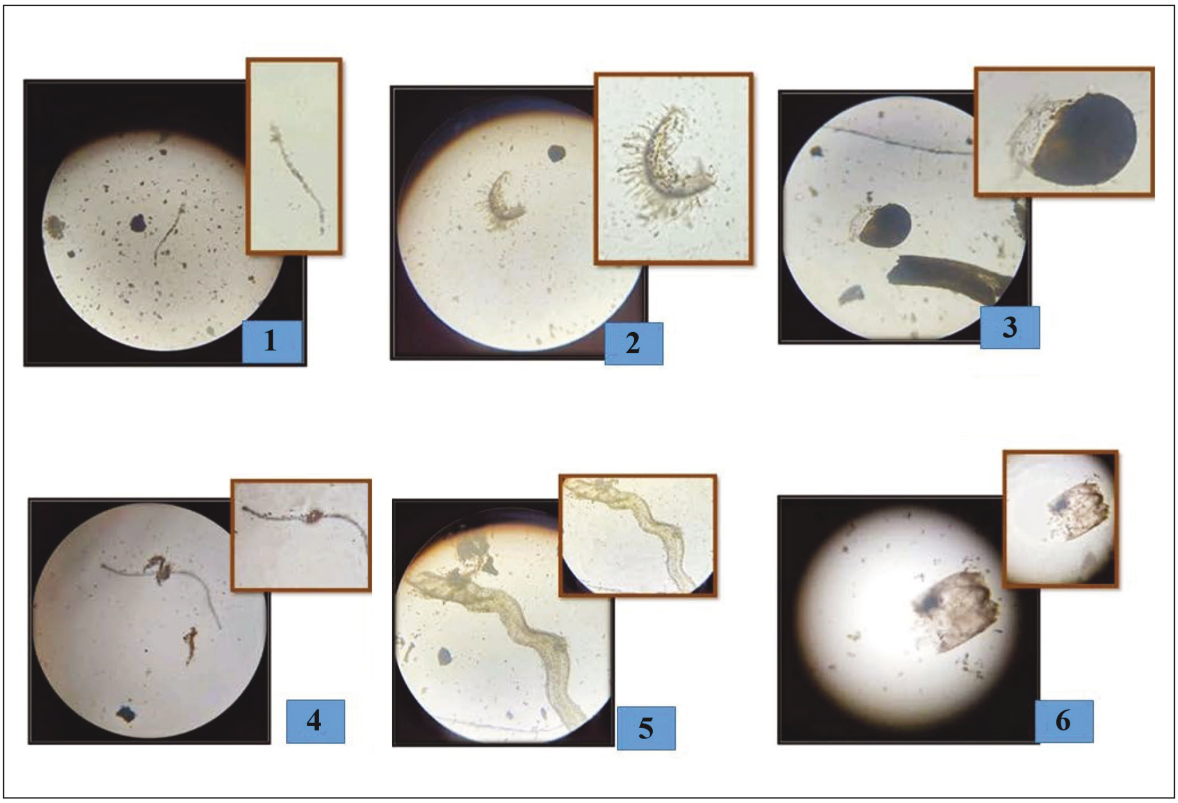
RESULTS AND DISCUSSION

Six major microscopic macrobenthic taxa were recorded in these established freshwater sampling stations in both wet and dry seasons. It has a total of 177 and 95 specimens/m^2, respectively, for wet and dry seasons, for all taxa. For both seasons and freshwater systems, Nematoda (42.28%) was the most dominant, and was followed by Oligochaeta (22.06%), Annelida (11.40%), Amphipoda (9.19%), Rotifera (8.46%), and Polychaeta (6.62%). Other benthic organisms, although not quantified, were also observed on the substrates like the freshwater crablets, juvenile shrimps, and golden snails, in relatively lesser abundance. All taxa were present in FW1 and FW2, while only 4 and 5 taxa were present in FW3 and FW4 stations, respectively. In terms of density, FW1 had the highest density at 154 spec./m^2 or 56.61%, followed by FW2 (47 spec./m^2 or 17.29%), FW4 (29 spec./m^2 or 10.61%), and FW3 (42 spec./m^2 or 15.44%) (Table 1, Figs. 1–6).

In terms of diversity indices, which were analyzed using PAST (ver 4.03) statistical software, all stations had more than 1 Shannon's Diversity Index values ranging from 1.21 to 1.62. This means that all sampling stations had a relatively

Taxa	FW1		FW2		FW3		FW4		Total Density	Relative Density
	dry	wet	dry	wet	dry	wet	dry	wet		
Annelida	8	2	4	1	3	6	4	3	31	11.40
Oligochaeta	23	12	7	3	4	4	4	3	60	22.06
Nematoda	47	21	13	3	7	3	14	7	115	42.28
Rotifera	10	2	2	6	0	0	2	1	23	8.46
Polychaeta	6	4	2	3	1	1	0	1	18	6.62
Amphipoda	12	7	2	1	0	0	2	1	25	9.19
Total No. of Ind.	106	48	30	17	15	14	26	16	272	100.00
Mean	18	8	5	3	2	2	4	3	45	16.54
SD	5.55	7.40	4.38	1.83	2.74	2.42	4.97	2.34	4.64	5.31
Total No. of Taxa	6	6	6	6	4	4	5	6		

Table 1. Total number of specimens (spec./m^{-2}) of macrobenthos recorded in all sampling stations (Riverine Systems in Kauswagan, Lanao del Norte, Philippines). Kruskal-Wallis test p-value = 0.061. Note: dry = dry sampling period, wet = wet sampling period, FW= Freshwater Sampling Station.



Figures 1–6. Macrobenthos recorded in all sampling stations in the two river systems within the vicinity of GN Power in Kauswagan, Lanao del Norte. Fig. 1: Annelida. Fig. 2: Polychaeta. Fig. 3: Amphipoda. Fig. 4: Nematoda. Fig. 5: Oligochaeta. Fig. 6: Rotifera.

low index of species diversity. All stations had a relatively even distribution of all taxa ranging from 0.74 to 0.86, Simpson index varied from 0.65 to 0.78, while Dominance index ranged from 0.22 to 0.35, respectively, for all sampling stations during wet and dry seasons. However, number of individuals for all taxa, its distribution and diversity of taxa in all sampling stations for both wet and dry seasons were not significantly different ($p>0.05$). This means that macrobenthos population did not thoroughly change through time and space (Table 2).

The observed population density of macrobenthos might have some bearing on the environmental factors of the river and creek systems. This could serve as useful indicators of the water and habitat quality. The abundance and similarity of macrobenthos would indicate availability of food sources and similar tolerance of the water quality. Absence of pollution-sensitive taxa of macrobenthos like copepods might indicate that they were not capable of inhabiting the river and creek systems given its current water quality and habitat conditions. Dominance of nematodes were very likely due to its substrate composition which is mainly a mixed of mud and sand. This substrate also favored the existence of other taxa like oligochaetes and polychaetes. The governing factors for this habitat preference could be due to water quality, immediate substrates for occupation and food availability (Andem et al., 2012). While there were observed fluctuations in the abundance of taxa across stations and sampling periods, these were not statistically significant. Hence, changes of their population density might not be so relevant in the changes of environmental factors affecting them. The current resource utilization of the freshwater systems from various anthropogenic activities that in turn potentially influence the benthic population density might be within their tolerable limit.

CONCLUSIONS

This study provided some insights on the impacts of environmental factors (e.g. water quality and substrate) on the composition and diversity of macrobenthic communities in the freshwater systems of Kauswagan, Lanao del Norte. It turned out that macrobenthos had tolerated the current environmental conditions of the freshwater systems as a function of various resource uses of the area. It is therefore necessary that the initiatives of continuous monitoring of these freshwater systems must be undertaken to fully document should there be changes in their composition and diversity. This in turn, would suggest appropriate intervention programs should adverse conditions of the freshwater systems arise in the future.

Indices	FW1		FW2		FW3		FW4	
	dry	wet	dry	wet	dry	wet	dry	wet
Taxa S	6	6	6	6	4	4	5	6
Individuals	106	48	30	17	15	14	26	16
Dominance Index	0.27	0.29	0.27	0.22	0.33	0.32	0.35	0.27
Simpson's Diversity Index	0.73	0.71	0.73	0.78	0.67	0.68	0.65	0.73
Shannon Diversity Index	1.52	1.46	1.51	1.62	1.21	1.24	1.30	1.51
Evenness Index e^H/S	0.76	0.72	0.76	0.84	0.84	0.86	0.74	0.75
Equitability Index	0.85	0.82	0.84	0.90	0.87	0.89	0.81	0.84

Table 2. Diversity index values of the macrobenthos recorded in all sampling stations for wet and dry seasons. Kruskal-Wallis test p-value = 0.127. Note: dry = dry sampling period, wet = wet sampling period, FW= Freshwater Sampling Station.

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