Biodiversity of Freshwater Snails and Sediment Analysis as Water Quality Indicators in Badiangon Spring, Gingoog City

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DOI: 10.29322/IJSRP.9.04.2019.p8833
http://dx.doi.org/10.29322/IJSRP.9.04.2019.p8833

Abstract: Water quality is the basis to determine as to how a certain body of water can be use and if it is sufficient for supporting species and ecosystem processes. Assessing water quality can be done through studying macrobenthic biodiversity- including the biodiversity of freshwater snails, and through sediment analysis. Freshwater snails are sediment-dwellers since they are benthic macroinvertebrates. Their abundance in an area can determine water quality- either if it is good quality or poor quality. Biodiversity and chemical content in the sediments are correlated with the water quality of the stream. The study was conducted in order to determine the water quality of the stream through the biodiversity of freshwater snails and sediment analysis. A total of 201 individuals were collected from 6 3m x 3m stations- 3 downstream stations and 3 upstream stations, through scoop net sampling. This includes 9 species and 1 genus of freshwater snails under the class Gastropoda which are tolerant to poor water quality. The results of the sediment analysis showed that the heavy metal contents either exceeded or are below standard values. High availability of Cu and Fe was observed and can cause harm to the inhabitants in the wet land. Therefore, it is recommended that the water from the spring should undergo purification process and rehabilitation must take place in order to improve water quality and safety.

Keywords: Biodiversity, Freshwater snails, Sediments, Water quality, Gingoog City

INTRODUCTION

Water quality is the basis to determine as to how a certain body of water can be use and if it is sufficient for supporting species and ecosystem processes. Domestic and industrial waste can cause water pollution that will result to declining water quality (Benetti, et al., 2012). Thus, water quality monitoring is essential in identifying cases of water pollution and giving information for the government to give response for the improvement of water quality (Martinico-Perez, et al., 2016).

Assessment of water quality is conducted through physicochemical parameters. However, the use of bioindicators such as benthic macroinvertebrates is proven more effective in detecting long-term pollution since they adapt to a specific environment. Studying the biodiversity of these bioindicators- including the variations in the populations of species, can detect pollution (Benetti et al., 2012).

Benthic macroinvertebrates are species lacking the presence of a backbone, can be seen by naked eye, and are inhabited in river and lake bottoms and basically, bottom-dwelling organisms. These organisms are also involved in the processes and cycles of aquatic environment (Fajardo et al., 2015). One of these organisms are freshwater snails with 5000 species that inhabit streams, ponds, and lakes. The biology, distribution, and mostly, its abundance, had gained importance in the field of research- including the assessment of water quality (Oloyede, O. et al., 2016). Water clarity is said to be improved by freshwater snail present in the environment, through releasing substances that causes suspended particles to clot. On the other hand, snails can also cause resuspension of sediments and increase nutrient release to water, that worsens eutrophication. Therefore, the presence of snails has positive and negative effects on water quality (Mo, S. et al., 2017).

Sediments act as sinks of contaminants, like heavy metals. Thereby, chemicals found on water can be found on sediments. The assessment of sediments toxicity was conducted through chemical analyses and it can be correlated to water quality together with the biodiversity of benthic macroinvertebrates such as freshwater snails (Mazurova, E., et al., 2008).

Badiangon spring is a place where people go for leisure because of the sea breeze and its ice-cold water from the spring. Badiangon spring is located 3 km west of Poblacion of Gingoog City, in the province of Misamis Oriental. The spring and the stream became the sources of water for the residents' every day drinking and domestic use. There is visible trash in the place- including the streams, such as wrappers, fallen leaves and branches, and domestic wastes brought by the residents and visitors. The quality of water is affected. The assessment of water quality is required to ensure the safety of the water and for actions to be made.

Thus, this study was conducted to determine the biodiversity of freshwater snails in Badiangon spring and to determine the chemicals and organic matter present in the sediment through chemical analysis, and correlate it with the water quality of the stream.

MATERIALS AND METHODS

A. Protocol Entry

The researchers acquired permit from the local government unit of Barangay San Juan, Gingoog City for the conduct of the study. A Gratuitous permit was also acquired from DENR Region X for the collection of freshwater snails in the area.

B. Study Area

The study area was located in Badiangon Spring, located 3km west of Poblacion, Gingoog City. It is a source of water for drinking and domestic purposes of the nearby residence, and a place with high socio-economic activity due to visitors and residents.

C. Collection of Samples

Specimens were collected from the 6 sites- 3 downstream sites and 3 upstream sites- with a 3mx3m measurement using the scoop net with 30 scoops at each site. The sediments were sampled along with the snails collected (Corpuz, M.C. et al., 2016 .and Oloyede, O.O. et al., 2016).

D. Laboratory Analysis

The snails were sorted, counted, and placed in a container with 70% solution ethyl alcohol. Each container was labeled and brought to the Bureau of Fishery and Aquatic Resources in Cagayan de Oro for further identification of an expert (Corpuz, M.C. et al., 2016).

E. Sediment Analysis

The collected sediments at each site were placed in a container and were taken to the Taguibo Regional Soils Laboratory for the identification of mineral contents (Mazurováa, E. et al., 2008).

F. Statistical Analysis

Biodiversity indices were determined using Shannon-Weiner index in PAST Software (Corpuz, M.C. et al., 2016). On the other hand, sediment standard qualities were determined based on the standard mineral content for soils and sediments.

RESULTS

Table 1. Number of Individuals and Taxa

Class	Family	Scientific Name	Site US	Site DS	Taxa
Gastropoda	Neritidae	Vittina chrysocolla	6	0	3
		Neritina pulligera (Dusky nerite snail)	51	88	3
		Septaria lineata (Lined Limpet-like Nerite	6	0	3
		Neripteron bicanaliculatum	1	0	3
		Clithon sp.	1	2	3
		Septaria taitana	4	6	3
		Clithon corona (Horned Nerite Snail)	2	16	3
		Clithon spinosum	0	11	3
		Neritina cornuta	0	1	3
		Septaria porcellana	0	6	3

Table 1 shows the number of freshwater snail individuals in both downstream and upstream sites and their corresponding taxa. 9 species and 1 genus of *Clithon sp.* were collected from all sites. Higher numbers of individual can be observed downstream compared to upstream.

Highest number of freshwater snail individuals collected from both sites belongs to the species *Neritina pulligera* (Dusky nerite snail). *Neripteron bicanaliculatum* and *Neritina cornuta* species have the least number collected on both sites.

Table 2. Biodiversity indices of Freshwater Snails

Indices	Site Upstream	Site Downstream
Taxa_S	7	7
Individuals	71	130
Dominance_D	0.5346	0.4851
Simpson_1-D	0.4654	0.5149
Shannon_H	1.038	1.117
Evenness_e^H/S	0.4033	0.4363

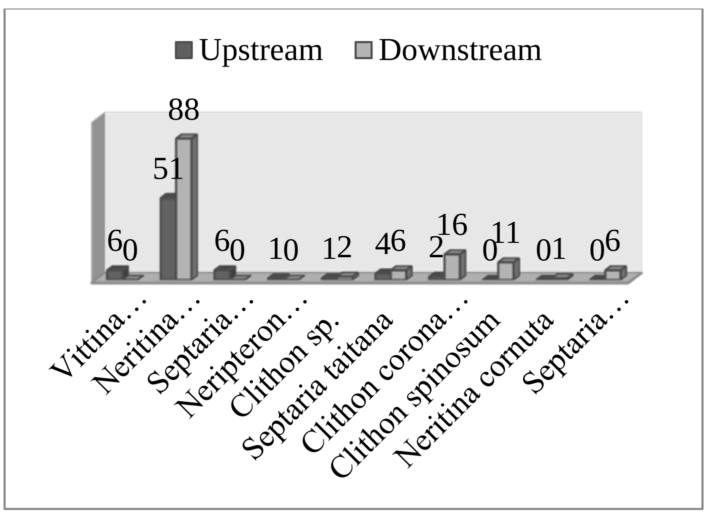
Biodiversity indices are shown and the values do not differ with each sites (Table 2). The numbers of individuals collected from each site differ. However, the values for the Dominance and Simpson index do not differ in great values. The values for the Shannon index were more than zero (0) indicating that the community has many taxa with few individuals under each taxa.

Table 3. Sediment Analysis

Contents (ppm)	Site		Reference Value (ppm)
	US	DS	
Zinc (Zn)	20	19	92-233
Iron (Fe)	32,916	65,153	30,020-43,858
Copper (Cu)	86	44	15-61
Nickel (Ni)	25	31	15-43

Chemical contents in the sediment were presented and compared to the reference value of chemicals in sediments (Table 3). Zinc (19 ppm and 20 ppm) was below reference value while Iron (Fe) content in downstream site (65,153 ppm) and Copper (Cu) in the upstream site (86 ppm) have values that exceeded the reference value. Moderate contents of Nickel (Ni) in the sediments were detected.

Figure 1. Graph on the number of individuals in upstream and downstream sites



Number of freshwater snail individuals in both upstream and downstream sites. The abundance of *Neritina pulligera* in the sites can be observed. It is shown that downstream sites have higher number of freshwater snail individuals compared to upstream sites (Figure 1).

DISCUSSION

A total of 201 individuals were collected from both upstream and downstream sites. There were 10 species from the class Gastropoda and all species belong to Taxa 3. According to Fajardo et al. (2015), Taxa 3 species are tolerant to average and highly polluted water. The abundance of gastropods in Badiangon Spring implies that the waters are slightly polluted or polluted. Oloyode (2016) also stated in his study that the abundance of gastropods in the area without any bivalve indicates pollution for bivalves are sensitive to water quality compared to gastropods. Gastropods, on the other hand, are tolerant to polluted waters.

A total of 130 individuals were collected from the downstream sites and there were 71 individuals from the upstream sites. Higher number of gastropods was collected from downstream sites implying that the site is more polluted compared to the upstream.

Meanwhile, identifying the chemicals, specifically heavy metals, on sediments can help determine the toxicity of water (Hallare et al., 2009; Singare et al., 2011; Kumar et al., 2011). The sediments collected from the upstream and downstream sites were presented and compared to the recommended reference values in Table 3 as a basis for comparison in order to determine contamination risk on the water.

The upstream site contains 20 ppm, 32916 ppm, 86 ppm, and 25 pmm of Zn, Fe, Cu, and Ni respectively. Comparing to the recommended reference values Zn, Fe, and Ni did not exceed the standard values and exist in moderate values in contrast to the Cu contents. While on the downstream sites it contains Zn, Fe, Cu, and Ni with 19 ppm, 65, 153 ppm, 44 ppm, and 31 ppm respectively. It can be observe that Fe contents in the sediments exceeded the recommended reference value dissimilar to the values of Zn, Cu, and Ni. Kumar et al., (2011) opined that a high availability of such heavy metals means a high contamination risk for the water. High availability of Cu and Fe can cause harm to the inhabitants in the wet land.

The availability heavy metals have different contamination risk and the presence of gastropods implies present pollution of the stream. Pollution is caused by the activities of the residents and visitors of Badiangon spring, Gingoog City.

CONCLUSION

All the freshwater snails collected from Badiangon Spring are under the class Gastropoda which are highly tolerant to poor water quality. The value for the sites' biodiversity indices do not differ from each other. In addition, the heavy metal contents in the sediment, presents that the amount of Zn, Fe, and Ni in the upstream site does not exceed the recommended reference values dissimilar to the amount of Cu. While on the downstream site, only two (2) chemicals did not exceed the standard values; the Zn and Ni. It can be concluded that Badiangon spring has poor water quality due to the abundance of Gastropods and the high availability of Cu and Fe in the sediments.

Therefore, it is recommended that rehabilitation must take place in order to improve water quality and safety.

ACKNOWLEDGMENT

The researchers would like to extend their warmest gratitude and appreciation to the following person who have contributed and assisted in the completion of this research study.

We give thanks and praises to our Almighty God for the endurance, guidance, wisdom, blessings, and love He had showered us. The motivation to give Him glory, kept us going. We are nothing without His grace and mercy.

To our family and friends who are our support system, and who showered us support- in all aspects, for the understanding and motivation you have given us.

The researchers would like to express our gratitude to our adviser and research teacher, Mrs. Hazel R. Balan, who has been a great help and supporter to us. Without her guidance and expertise, this research will not be a possibility.

To Mr. Rejomar Galleros and BFAR personnel for lending us a helping hand in identifying the snail species.

To the panelists who critiqued our paper.

To our fellow researchers who shared the same endeavor and for the encouragement they gave that fueled us to keep going.

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