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Species composition and abundance of gastropods in the Bigaan River

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Abstract

Bigaan river is around 19 kilometers (km) from Gango, Libona, Bukidnon down to Cagayan de Oro City (Philippines) and ends up in the Macajalar Bay. This study investigated species composition and abundance of gastropods along the river's stretch during wet and dry seasons. Sampling areas differ in elevation. Three species were found to be relatively abundant: *N. porcata*>*M. tuberculata*>*P. canaliculata*. Two sepcies - *P. canaliculata* and *M. tuberculata* were considered to be site-specific while *N. porcata* was present in all sampling areas. Abundance differs between seasons. Except for *N. porcata*, the 2 other species have small, medium and large sizes. With various kinds of pollutants discharged to Bigaan river, abundance of species faces huge threat. Therefore, measures in implementing programs for environmental protection need urgent and serious attention.

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Introduction

The Philippines is host to about 22,000 mollusk species (Cabrera, 1987) and gastropods are the largest group in the phylum Mollusca. For many years they have been known as a major source of protein for humans and other macroorganisms. Gastropods are unique from an ecological perspective because they are inhabiting extremely contrasting habitats (Marshall *et al.*, 2015) such as marine, freshwater, and terrestrial environments. They are distributed in a wide array performing various ecological functions particularly at maintaining the balance in the environment (Echem, 2017). For example, in the mangrove ecosystem, gastropods play a significant ecological role in nutrient dynamics because they form an essential link within the food web as predators, herbivores, detritivores, and filter feeders (Pawar, 2012; Suresh *et al.*, 2012). Freshwater gastropods are herbivores or detritivores that feed on detritus and algae. They are grazing omnivores that consume primarily periphyton or macrophytes (Dillon, 2000). In fact, gastropods often controls the amount and composition of periphyton in both lotic and lentic environments but occasionally ingest carrion (Bovbjerg, 1968) or small invertebrates associated with periphyton (Cuker, 1983).

Mollusks have had the highest number of documented extinctions among the major taxonomic groups in the world (Lydeard *et al.*, 2004). It is evident that losses to populations and biodiversity of these animals would have impacts on the ecology and economy of a country like the Philippines (Ramos *et al.*, 2018). Data documented on mollusks in the Philippines is only 31% (22,000 out of 70,000 species) which means that a huge number has remained undiscovered and undocumented (Sularte and Jumawan, 2016). Measuring species richness and diversity across different habitats are a useful tool for planning actions to conserve biodiversity (Rahmawati *et al.*, 2021).

A number of communities along Bigaan River are using the river for domestic purposes like washing, bathing and even as drinking water for their agricultural animals. On the other hand, countless anthropogenic activities from industries (i.e. agriculture, mining, construction, etc.) and the communities themselves are responsible for waste discharges to the river (Factura and Apuan, 2022). The aim of this study was to provide data on species composition, abundance and sizes of gastropods present in Bigaan River.

Materials and methods

Entry protocol

The study proposal was first presented to the local government units to seek permission. The Gratuitous permit which allows the conduct of sampling in target areas was secured from the Department of Environment and Natural Resources.

Establishment of sampling sites

Ocular area inspection was conducted to establish sampling sites located in barangays Gango, Indahag and Cugman (Table 1). A 500 meter transect was established in each sampling area. (*Barangay is the smallest administrative division in the Philippines.*).

Collection of gastropods

Collection was done during wet and dry seasons (November 2018 to January 2019 for wet and March to May 2019 for dry). Random sampling used grab or hand pick method. Collected samples were sorted as edible or not as identified by the locals. Non-edible species were returned to where they were collected.

Determination of size and abundance

Collected gastropods were manually counted to determine the number of individuals per species. Size was determined by weighing each collected sample and segregating them as small (0.000-2.000 gram), medium (2.001-4.000 gram) and large (4.001 gram and above).

Identification of specimen

Gastropods were initially identified using local names with the help of the locals and also by using photographic field guides. Samples per species were photographed and the photos were used for

validation. Experts were consulted to confirm the identification of each species.

Results and discussion

Abundance and distribution

After thorough assessment, only 3 species of gastropods, as shown in Table 2 and Figure 1, were found to be relatively abundant in Bigaan River. Species with relatively low abundance were not included in this study. In terms of distribution, *P. canaliculata* and *M. tuberculata* are considered to be site-specific as they were found only in Gango and Cugman respectively. *N. porcata* was present in all sampling areas but only during wet season. During dry season, *N. porcata* was only present in Cugman but not in Gango and Indahag. *N. porcata* is the most abundant while *P. canaliculata* is the least abundant and can only be found in Gango.

It is also quite obvious to see that the abundance of *P. canaliculata* is higher during dry season while the abundance of *M. tuberculata* is comparatively the same in both seasons. The location of where the samples were found is also an indicator of how a gastropod is fit enough for the level of environment conditions they are exposed with (Echem, 2017).

Table 1. Location of sampling sites**.**

Sampling sites	Elevation (masl)	Distance from Gango (km)	GPS Coordinates		
			Sub-site 1	Sub-site 2	Sub-site 3
Gango	181	0.0	8°24'36.8" N and 124°40'29.72" E	8°24'34.88" N and 124°40'30.08" E	8°24'46.95" N and 124°40'29.22" E
Indahag	136	6.6	8°24'42" N and 124°41'6" E	8°24'54" N and 124°40'30" E	8°25'05.60" N and 124°40'26.48" E
Cugman	40	21.0	8°26'42" N and 124°41'6" E	8°27'18" N and 124°41'6" E	8°27'10.79" N and 124°40'59.58" E

Note: meter above sea level (masl), Global Positioning System (GPS).

P. canaliculata is an aquatic gastropod that inhabits in freshwater like swamps, ditches, ponds, lakes, creek, river, streams and irrigation systems (Cowie, 2005) and feed on living invertebrates including worms, micro crustaceans, bryozoans and other snails (Wood *et al.*, 2006; Horgan *et al.*, 2014). They even feed on vegetal and animal material floating at the surface by pedal surface collection (Saveanu and Martin, 2013). *P. canaliculata* are omnivorous animals that feed on a great variety of plants, detritus, periphyton and animal matter in both native and invaded habitats (Hayes *et al.*, 2012).

Table 2. Number of individual gastropods in different areas and season**.**

Family	Scientific Name	Wet Season			Dry Season		
		Gango	Indahag	Cugman	Gango	Indahag	Cugman
Ampullariidae	*Pomacea canaliculata*	45			82		
Neritidae	*Neritina sp.*	135	302	594			471
Thiaridae	*Melanoides tuberculata*			468			476

N. porcata is a member of the family of Neritidae that inhabits in rocky substrates near streams, intertidal and supratidal rock and mangroves, brackish water and fresh water, on temperate to tropical water bodies. *N. porcata* are herbivores or detritivores, they feed on detritus, graze on the periphyton and feed on algae. *M. tuberculata* is a polyphagous species and aquatic herbivorous snail that feeds on periphyton, fine detritus, diatoms, epiphytic algae and decaying plants (Madsen, 1992).

It inhabits in freshwater and can be found in shallow slow running water like coastal lakes, pans, spring, streams and rivers (Raw *et al.*, 2016).

Table 3. Size of gastropods according to area and season.

Gastropod Species	Size	Wet Season			Dry Season		
		Gango	Indahag	Cugman	Gango	Indahag	Cugman
P. canaliculata	Small	✓			✓		
	Medium	✓					
	Large	✓					
N. porcata	Small			✓			✓
	Medium		✓				✓
M. tuberculata	Small			✓			✓
	Medium			✓			✓
	Large						✓

Species abundance relative to season

Except for *N. porcata*, the other 2 species appeared to be higher during dry season. Accordingly, the abundance of gastropods could be attributed to the high rates of biological activities during dry season and high precipitation rate during the wet season (Ndifon and Ukoli, 1989; Priawandiputra *et al.*, 2017). Increased water volume during rainy season could lead to dispersion of gastropods to other areas resulting to changes in their population structure. Food availability is another factor. Since most gastropods are considered herbivores, their population could increase during dry season when vegetation and algae are abundant in their habitat. However, the higher abundance of *N. porcata* during wet season suggested that this species is not greatly affected by the factors mentioned. This exceptional case might be due to the habitat preference and feeding behavior of *N. porcata*. Nerites such as *N. porcata* are mostly found attached firmly to rocks or stones which make them able to withstand strong water current during rainy season.

Additionally, *N. porcata* feed by scraping algae and other food particles that are attached on the medium like rocks. So even during rainy season when other food sources are washed out, *N. porcata* could survive. Gastropod diversity and abundance were lower in water bodies with sandy sediments compared to the ponds with a coal shale bottom (Strzelec *et al.*, 2014). Siltation and human consumption could also limit abundance of gastropods.

Size differences

Table 3 shows that the size of gastropods vary within the same species and also among the different species. *P. canaliculata* and *M. tuberculata* were found to have the small, medium and large sizes but all the sizes were not all the time present in the same areas and seasons. On the other hand, *N. porcata* only had the small and medium sizes which are present in both seasons but not in the same areas.

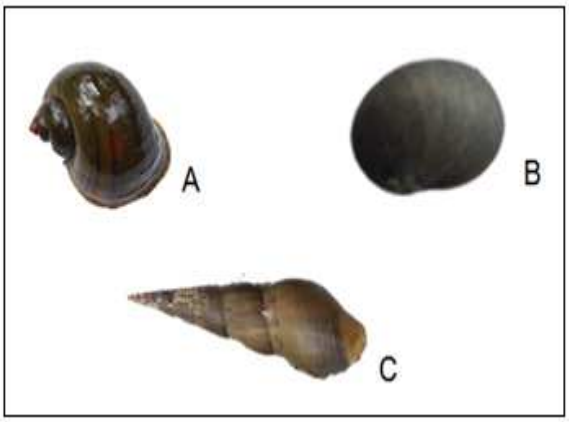

Fig. 1. A: *Pomacea canaliculata,* B: *Nertina sp.,* C: *Melanoides tuberculate.*

Size variation generally has a large genetic component (Goodfriend, 1986). Fresh weight of gastropods showed high correlation with the shell length (Echem, 2017). Shell mass increases with proportion with the body size which means that larger gastropods have larger body size. There are a variety of environmental factors that are known to influence shell morphology

and the relative proportions of many gastropod species (Gaspar *et al.*, 2002) thereby also affecting size in terms of weight. Snails may attain smaller adult sizes at higher population densities, apparently through the effects of pheromones on growth rate (Goodfriend, 1986).

Lacang *et al.* (2021) described in details the physico-chemical characteristics of the exact sampling areas in the Bigaan River during the same time periods. The results showed statistical significant differences in total dissolved solids and turbidity. Total dissolved solids is used to describe inorganic salts and small amounts of organic matter present in water which are directly proportional to the water's salinity and electrical conductivity that include cations of calcium, magnesium, sodium, potassium and anions like carbonates, chlorides, sulfates and nitrates (Lacang *et al.*, 2021). Turbidity is directly proportional to the presence of suspended particulates in water which differ in particle shape, size and amount of surface (Atwebembeire *et al.,* 2018). Total dissolved solids and turbidity might have caused some effects on the differences found in the results of this study in terms of abundance, distribution and sizes of gastropods species.

Conclusion

Bigaan River is rich in gastropod species. Environmental factors play a role in the distribution and adaptation of gastropods. Therefore, it is highly necessary that concrete measures are urgently undertaken to protect the river from becoming severely polluted and contaminated by any form of pollutant. Protecting and preserving the Bigaan River will have a huge positive impact not only for the freshwater organisms but more importantly to the health of the people along the river's neighboring communities and also for the future generations. This must be seriously considered by the authorities.

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