

# Diversity of Gastropods in the Selected Rivers and Lakes in Bukidnon

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**Abstract**—Diversity and abundance of Gastropods were determined in seven sampling sites in Bukidnon, Philippines: Maapag, Matay, and Tigua rivers and Lakes Napalit, Apo, and Pulangui for a period of one year from June 2011-May 2012. Pulangui Lake is a manmade impoundment while all the other sites are natural formations. Sampling was done in a 100m × 3m belt transect and gastropods were collected within the belt transect by hand picking and sieving. Seven species representing 5 families were collected. Shannon-Weiner index shows that the highest diversity is in Tigua river ( $H' = 0.518$ ) and lowest is in Pulangui lake ( $H' = 0.144$ ). Tigua River has also the most abundant gastropod species.

**Index Terms**—Diversity, gastropods, lakes, rivers, Philippines.

## I. RATIONALE

Gastropods are single-valve, soft-bodied class of animals in phylum Mollusca.

It is the largest, extremely diverse taxa that includes over 40,000 species of which 5,000 are fresh water snails found in wetlands like lakes, ponds and streams worldwide [1]. Snails, slugs, and limpets, either marine, fresh water or terrestrial belong to this class. Also included in it are the pulmonates and some prosobranch [2].

Bukidnon is one of the provinces in Mindanao endowed abundantly with rivers, lakes and other water impoundments. These bodies of water are significant resources that meet the daily protein dietary needs of the communities living nearby. This protein need is supplied in part by the gastropods or snails gleaned by fisher folks and cooked at home. Some also harvest the gastropods to augment livelihood by marketing or processing them into feeds of poultry and aquaculture. The *Melanoides* spp., *Thiara granifera* and *Vivipara costata* are the species usually harvested and cooked with coconut milk. For *Pomacea canaliculata* some reports indicate that the species is cooked as escargot in urban areas in the Philippines and abroad.

Gastropods are also good water quality indicators and the abundance of some species may reveal the current status of

any water impoundment. In Bukidnon, Philippines, the wetlands in addition to their basic ecological functions, also serve as source of water for irrigation and domestic consumption, as laundry sites and bathing places not only of people but also for domestic animals like carabaos (water buffalo); as duck rearing areas in the rural communities as well as local tourist and recreation spots. Along with these activities, there is also quarrying particularly in Pulangui Lake and Tigua River. Compounded by the unpredictable climate change these activities may have adverse impact on species diversity specifically on gastropod fauna of these wetlands. This habitat loss or degradation together with the introduction of exotic species as well as the unsustainable use of water resources are the identified threats to many of the sensitive wetland wildlife [3], [4]. This survey could thus provide part of the baseline data that might be useful for future use.

## II. METHODOLOGY

Entry protocol was observed after which quarterly samplings were done in 4 selected rivers and 3 lakes in Bukidnon from June 2011-May 2012 with a sampling effort of 8 hours per sampling site. These sites were given specific sampling designations. Also, these sites except for Tigua and Matay rivers are in close proximity to agricultural lands or human settlements.

### A. Sampling Site 1: Tigua River

The river is found in barangay Comawas, San Fernando, Bukidnon. This is a large river, with shallow and deep portions and variable current flow. Small pebbles and stones form part of its muddy clayish bed. Grasses and weeds line the river bank. Taro plants were also seen.

### B. Sampling Site 2: Maapag River

This is considered as the biggest river of the barangay and serves as the primary source of water for the crops. Grasses, herbs and trees line the deep river bank. The river bed is also muddy.

### C. Sampling Site 3: Pulangui Lake

Pulangui Lake has a wide range of area with turbid water, muddy to clayish substrate and surrounded by trees, shrubs, grasses and macrophytes. It is known for fishing, bathing and laundry area among the nearby communities, some of its islets are used as grazing spots and some as agricultural land.

The sampling site was established along the bank of Barangay Panadtalan, Maramag, Bukidnon. Trees, shrubs and grasses were submerged in the water due to the high level of water during the sampling trip.

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D. Sampling Site 4: Sawaga River

The sampling site established for the Sawaga River bank was in Barangay Kalasungay, Malaybalay City. Big stones and boulders line the river bank and bed, though some pebbles were also observed. The sides are lined with tall grasses and shrubs.

E. Sampling Site 5: Lake Apo

Lake Apo is considered as a deep lake. The bank is lined with trees, shrubs, grasses and some macrophytes. A privately owned tourist inn occupies a portion of the shoreline. Some households were also seen nearby. Substrate was also muddy.

F. Sampling Site 6: Napalit Lake

Napalit Lake is in Pigtauranan, Pangantucan, Bukidnon. The lake bank is also lined with trees, shrubs, grasses and macrophytes with muddy substrate. However, a little farther from the shoreline landward were sugarcane and root crops plantations and cornfields. There are also few households nearby on one side of the lake. The lake is a favorite spot for anthropogenic activities like bathing, washing of clothes and wallowing pond for carabaos (water buffalo).

G. Sampling Site 7: Matay River

Matay River is in Mabuhay, San Fernando, Bukidnon. It is a narrow river with rocky to sandy substrate and the bank is lined with grasses.

Three belt transects (100m × 3m) were set in suitable areas in these sampling sites. Gastropods collected were subsequently processed for proper identification. Data were analyzed in the BIOPRO software to get alpha and beta type of diversity indices which were useful in evaluating diversity within individual sampling units as well as measuring how diversity differs among the study areas. Richness and evenness of gastropod species were also obtained.

The physico-chemical parameters determined were temperature, water depth, and pH.

III. RESULTS AND DISCUSSION



Fig. 1. Representative gastropod species in selected rivers and lakes in Bukidnon 1-2. *Lymnaea natalensis* 3-4. *Melanioides tuberculata* 5-6. *Melanioides turriculus* 7-8. *Planorbis* sp.

Seven gastropod species were collected from the different sites: *P. canaliculata*, *Vivipara costata*, *Lymnaea natalensis*, *Melanioides tuberculata*, *Melanioides turricula*, *Thiara granifera* and *Planorbis* sp. (Table I, Fig. 1, Fig. 2). These represent 5 families: Ampullariidae, Viviparidae, Lymnaeidae and Planorbidae, and 6 genera: *Pomacea*, *Lymnaea*, *Melanioides*, *Thiara* and *Planorbis*. Among the species, *P. canaliculata* was always most abundant and occurred in all sampling sites.



Fig. 2. Representative gastropod species in selected rivers and lakes in Bukidnon 9-10. *Pomacea canaliculata* 11-12. *Thiara granifera* 13-14. *Vivipara costata*.

TABLE I: CLASSIFICATION OF GASTROPODS COLLECTED IN SEVEN SELECTED SITES IN BUKIDNON FROM JUNE 2011-MAY 2012

FAMILY	GENUS	SPECIES	COMMON NAME
Ampullariidae	<i>Pomacea</i>	<i>Pomacea canaliculata</i>	Kuhol/ Golden Apple Snail
Viviparidae	<i>Vivipara</i>	<i>Vivipara costata</i>	Kuhol/ege
Lymnaeidae	<i>Lymnaea</i>	<i>Lymnaea natalensis</i>	Crib Physa
Thiariidae	<i>Melanioides</i>	<i>Melanioides tuberculata</i>	Suso/Red-rimmed Melania
		<i>Melanioides turricula</i>	Suso/Fawn Melania
	<i>Thiara</i>	<i>Thiara granifera</i>	Suso/Quilted Melania
Planorbidae	<i>Planorbis</i>	<i>Planorbis</i> sp.	Rams horn

The peak of the species accumulation curve (Fig. 3) was attained in Tigua, Matay rivers as well as Lake Apo in this study.

Gastropod abundance (Tables II, III and Fig. 4) was highest in Tigua river with 638 individuals (6 species), followed by Matay River with 600 individuals (4 species), Lake Apo with 276 individuals (4 species), Pulangui Lake with 160 individuals (2 species), Maapag River with 100 individuals (2 species), Napalit Lake with 76 individuals (2 species) and Sawaga River with 36 individuals (3 species). Moreover, among the species, *P.canaliculata* appears to be most widely distributed among the sampling sites confirming earlier observation on the invasive nature of the species [4], [5]. *Melanioides tuberculata* and *Thiara granifera* and *Planorbis* sp. appear only in the lotic sampling site and not in the lakes. The occurrence of *Melanioides tuberculata* in this type of habitat was similarly noted in literature [6].

Shannon-Weiner index of diversity (Fig. 5 and Table IV)

is also highest in Tigua River ( $H'=0.518$ ), followed by River ( $H'=0.361$ ), Maapag River ( $H'=0.292$ ), Napalit Lake ( $H'=0.426$ ), Lake Apo ( $H'=0.41$ ), Matay ( $H'=0.291$ ) and the lowest was Pulangui Lake ( $H'=0.141$ ).

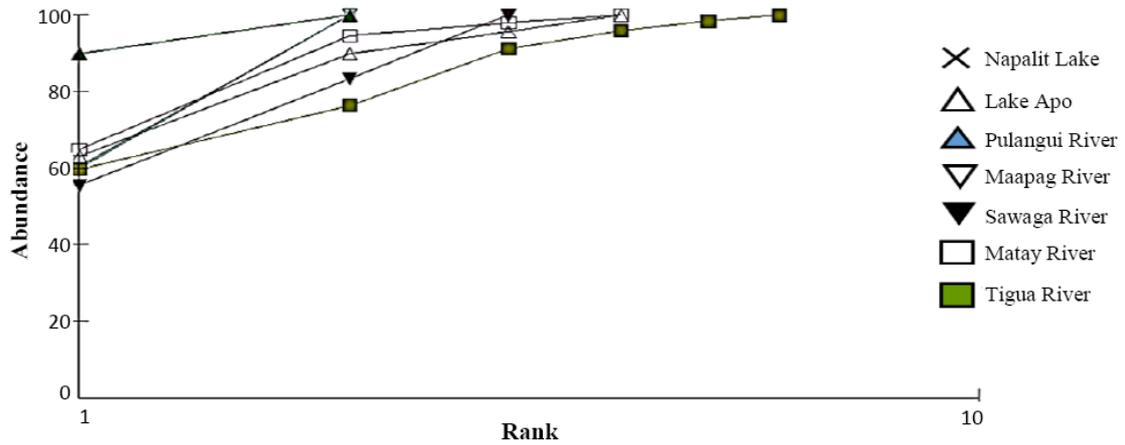


Fig. 3. Species accumulation curve of gastropods in seven selected sampling sites in Bukidnon.

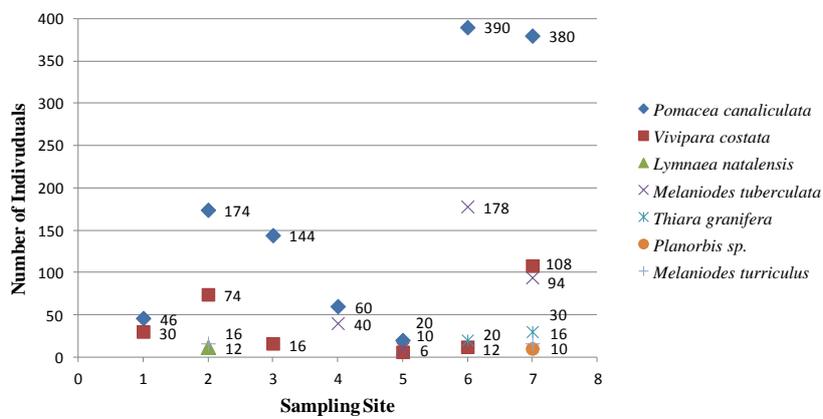


Fig. 4. Graph analysis of gastropod occurrence in different sampling sites.

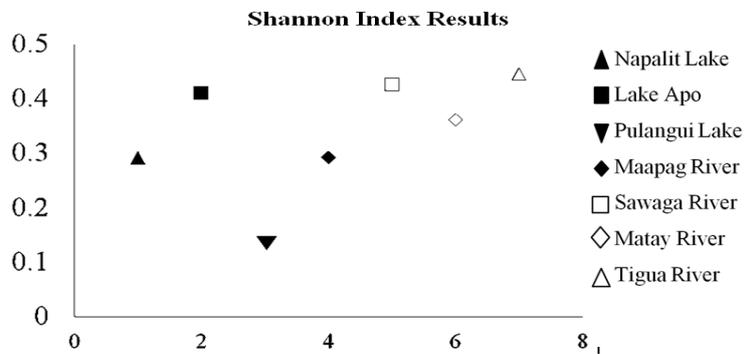


Fig. 5. Shannon-Weiner index plot of gastropods in seven selected sampling sites in Bukidnon.

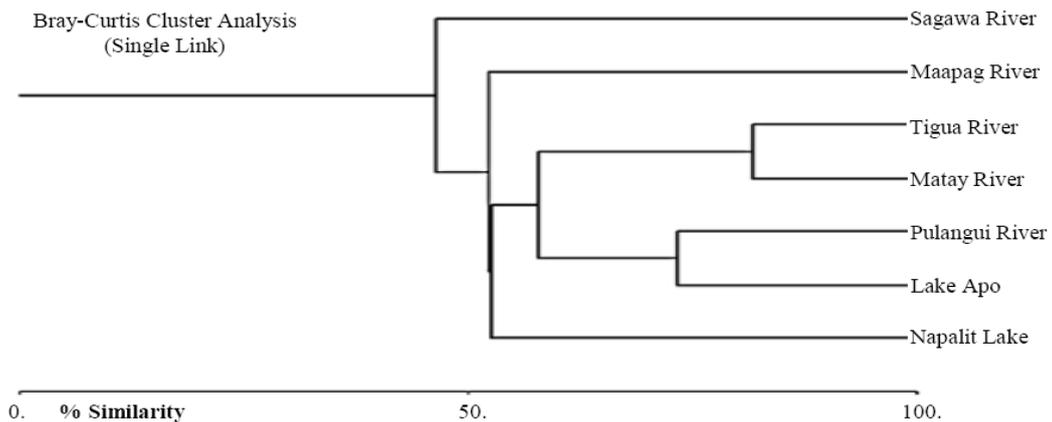


Fig. 6. Dendrogram of species composition of gastropods in seven selected sampling sites in Bukidnon.

TABLE II: TOTAL NUMBER OF INDIVIDUALS OF GASTROPOD SPECIES IN SELECTED SAMPLING SITES IN BUKIDNON

Species	Sampling Area							Total
	Napalit Lake	Lake Apo	Pulangui Lake	Maapag River	Sawaga River	Matay River	Tigua River	
<i>Pomacea canaliculata</i>	46	174	144	60	20	390	380	1214
<i>Vivipara costata</i>	30	74	16		6	12	108	246
<i>Lymnaea natalensis</i>		12						12
<i>Melaniodes tuberculata</i>				40	10	178	94	322
<i>Thiara granifera</i>						20	30	50
<i>Planorbis</i> sp.							10	10
<i>Melaniodes turiculus</i>		16					16	32
<b>Total</b>	76	276	160	100	36	600	638	1886

Bray-Curtis cluster analysis (Fig. 6) shows three unique clusters of habitat: Cluster 1-Sawaga river, Cluster 2-Maapag River, Cluster 3-Tigua River, Matay River, Pulangui Lake and Lake Apo. Sawaga River appears to be the most unique habitat of all sampling sites. This is probably due to its substrate. Sawaga River has more boulder rocks and less soil substrate and grasses along the bank that could serve as favourable habitat to gastropods.

High species diversity in Tigua River is probably attributed to its location and substrate. Its muddy clay substrate could be favourable for burrows as snails crawl to escape from possible predators like crustaceans, leeches, fishes, ducks and birds. The riverbank of Tigua River is likewise lined with grasses and weeds which serve as depository of egg masses and food. The submerged rocks and pebbles in the shallower water are favourable for the accumulation freshwater algae which is food to these

grazers. The substrate is also a possible hibernating place during dry seasons. On top of these, Tigua River cuts through the highlands of San Fernando, Bukidnon where agricultural activities are not yet intensive. However, the occurrence of *P. canaliculata* in the site may signify a probable threat to the other extant species in the area.

TABLE III: SUMMARY OF GASTROPOD MEAN DATA AND TOTAL INDIVIDUAL IN SEVEN SELECTED SAMPLING SITES IN BUKIDNON

Sample	Mean Individuals	Total Individuals	Total Species
Napalit lake	10.857	76	2
Lake apo	39.429	276	4
Pulangui lake	22.857	160	2
Maapag river	14.286	100	2
Sawaga river	5.143	36	3
Matay river	85.714	600	4
Tigua river	91.143	638	6

TABLE IV: SHANNON-WEINER INDEX FOR GASTROPODS IN SEVEN SELECTED SITES IN BUKIDNON

Index	Napalit Lake	Lake Apo	Pulangui Lake	Maapag River	Sawaga River	Matay River	Tigua River
Shannon H' Log Base 10.	0.291	0.41	0.141	0.292	0.426	0.361	0.518
Shannon Hmax Log Base 10.	0.301	0.602	0.301	0.301	0.477	0.602	0.778
Shannon J'	0.968	0.682	0.469	0.971	0.893	0.6	0.666

#### IV. CONCLUSION

This study shows the apparent dominance of the introduced and invasive species *P. canaliculata* in sampled wetlands. The results further indicate that gastropod diversity in the wetlands of Bukidnon's highlands are vulnerable to the species.

#### V. RECOMMENDATION

It is recommended therefore that monitoring activities should be done.

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