



Plants with economic value along the anthropogenically disturbed Bigaan river

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Abstract

Anthropogenic activities release pollutants that are harmful to the aquatic ecosystem. Bigaan river stretches more than 20 kilometers from Bukidnon down to Cagayan de Oro City (Philippines) and is highly prone to various kinds of pollution. Identifying plant species with economic value could be a useful tool in developing strategies for environmental conservation. Four sampling sites were used covering upper, middle and lower streams of the river and as well as the area close to a tailing pond. The study found 9 species having economic value: *Paspalum conjugatum*, *Saccharum spontaneum*, *Hylodesmum repandum*, *Imperata cylindrica*, *Celosia argentea*, *Homonoia riparia*, *Urochloa maxima*, *Colocasia esculenta* and *Mikania cordata*. Therefore, immediate mitigation strategies must be implemented not only to protect the plants but also to preserve the ecosystem surrounding Bigaan river. Applying sustainable conservation programs to such ecosystem will definitely improve biodiversity and increase productivity.

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Introduction

River ecologists have long understood the important connections between rivers and their floodplains (Stanford *et al.*, 1996). The inflows of water, nutrients, and sediments from surrounding watersheds are heavily influenced by conditions within the floodplain. Inland aquatic and terrestrial environments do not exist in isolation (National Academies of Sciences, Engineering, and Medicine, 2005). The abiotic environment in the surrounding watershed will impact the productivity of a water body (Allan, 2004), and in certain cases the abiotic conditions of a water body have been shown to affect the productivity of the surrounding terrestrial landscape (Bayley, 1995). In addition, the abiotic characteristics of terrestrial and inland aquatic landscapes are also known to influence biodiversity directly (Kärnä *et al.*, 2019).

However, countless anthropogenic activities constantly release pollutants that can cause adverse effects to the terrestrial and aquatic ecosystems. Along the Bigaan river, there are industries (i.e. agriculture, mining, construction, etc.) and a number of communities that produce wastes which are simply discharged to the river. These wastes can be heavy metals, detergents, microfibers, plastic or non-plastic origin, and contribute to aquatic pollution problems (Hampel *et al.*, 2015). Oil spills are also present as well as other wastes that are organic in nature like animal manures that contain pathogens. Aquatic environments are pickers for contaminants and industrial wastes and leaks, whether chemicals or solid pollutants (Bhat *et al.*, 2017).

But even with such threats, Bigaan river is actually rich in aquatic resources like fish and gastropods which are consumed by the locals. It is also used by the communities for washing, bathing and as drinking water for their agricultural animals. It is clear that Bigaan river has been a source of life that provides not only food and water but also a lot of services to the people and to the environment in general. The problem is, as population continues to increase in the coming years, the amount of waste will also increase

and in effect, higher volume of pollutants can be expected to contaminate the river if no policies are implemented or no measures are taken. To come up with present information about the kinds of plants that grow along the Bigaan river could be a relevant tool that can be used as foundation in developing strategies for the protection and conservation of the ecosystem surrounding the river.

Therefore, the aim of this study was to identify plant species that have economic value (source of food, medicine or animal feeds) along the Bigaan river.

Materials and methods

Establishing sampling sites

Actual ocular area inspection was conducted. The sampling sites were located starting from the area close to the tailing pond in Gango, Libona, Bukidnon including the areas along the Bigaan river in different elevations: upper stream at 181 meter above sea level (masl), middle stream at 136 masl and lower stream at 40 masl. Gango tailing pond has the following GPS coordinates 8°24'19"N-124°40'33"E while the coordinates of the other sampling sites are found below:

Plant survey

In every sampling site, a 50 meter transect line was established randomly. In every 10 meter along the line, a quadrant was established. Sampling was done using a wooden frame (1 meter x 1 meter) with 100 sub-plots (with equal size) formed by strings. In each sampling point, the wooden frame was placed and all the plants found within were identified.

Plant identification

Plants were initially identified using local names with the help of local counterparts. Initial identification for plants was done using photographic guide by Nyarko and De Datta (1991) and by Moody *et al.* (1984). Plants were photographed using a Canon DSLR camera and photos were used to validate the initially identified species. A plant expert was consulted for plant identification and only those plants with economic value were included.

Results and discussion

The main purpose of this work was to identify the kind of plant species with economic value that grow along the Bigaan river from the upper to the downstream areas. From the 4 sampling sites, a total of 9 plant species were identified to have economic value. *P. conjugatum*, *S. spontaneum* and *H. repandum* are common in all the sites. The lower

stream has the most number of the identified plants while the area close to Gango tailing pond has the least number. *I. cylindrica* and *C. argentea* were only present in the area close to the tailing pond while *H. riparia* was found to be available only in the lower stream. *U. maxima*, *C. esculenta* and *M. cordata* are present in all sites except in the area close to the tailing pond.

Table 1. GPS coordinates of sampling sites.

Sampling sites	GPS coordinates		
	Sub-site 1	Sub-site 2	Sub-site 3
Along Bigaan river			
Upper stream	8°24'36.8"N 124°40'29.72"E	8°24'34.88"N 124°40'30.08" E	8°24'46.95"N 124°40'29.22" E
Middle stream	8°24'42"N 124°41'6" E	8°24'54" N 124°40'30" E	8°25'05.60"N 124°40'26.48" E
Lower stream	8°26'42"N 124°41'6" E	8°27'18" N 124°41'6" E	8°27'10.79"N 124°40'59.58" E

I. cylindrica is well known as invasive species able to adapt in poor soils (MacDonald, 2004) such as the area close to the tailing pond. It may persist in such condition because of its extensive root and rhizome systems and tolerance to drought. *C. argentea* on the other hand may have been adapted to the soil condition in the area close to the tailing pond with low salinity at 135 and 167 parts per million during wet and dry seasons respectively. (Salinity was measured by the other component of this project.) *C. argentea* can also thrive up in a high saline condition which indicates that this plant has wide salinity tolerance (Shrivastava and Kumar, 2015).

H. riparia species was the only one found in the middle of the Bigaan river in the lower stream. It is a shrub which is adapted to the condition of the area that is sometimes flooded during heavy rainfall, and dry during summer season.

This is a native species in the Philippines common in river banks and used by the Ati tribe as medicinal plant (Cordero *et al.*, 2022). *C. esculenta* is cultivated by the locals as source of food while the majority of the identified plant species in this study are consumed as food by the local livestock animals.

Variation in the occurrences of the plant species could be attributed to several factors. Species distributions and population sizes are dependent on interactions among physical, chemical, and biological factors (Westgate *et al.*, 2014). Abiotic factors that regulate species distribution include climatic features such as temperature, moisture and availability of macro- and micronutrients (Guisan and Thuiller, 2005). Climatic factors such as temperature and precipitation are key drivers to control species distribution directly when they exceed the ecophysiological tolerances of species and affect photosynthetic activity and biological processes directly (Rowe, 2009). Topographic features such as slope, aspect, and elevation can impact local climate as well as soil conditions that in turn have varied effects on vegetation structure (Zhang *et al.*, 2016).

However, these natural environmental factors could not provide enough protection for the plants against external influences brought about by anthropogenic activities. The presence of industries and communities in the areas along the Bigaan river as mentioned above will continue to cause disturbances on the river's physical and biological nature.

Table 2. Plant species with economic value.

Scientific and common names	Sampling sites			
	Around Gango tailing pond	Along Bigaan river		
		Upper stream	Middle stream	Lower stream
<i>Paspalum conjugatum</i> (Carabao grass)	x	x	x	x
<i>Imperata cylindrica</i> (Cogon grass)	x			
<i>Saccharum spontaneum</i> (Bogang)	x	x	x	x
<i>Urochloa maxima</i> (Guinea grass)		x	x	x
<i>Colocasia esculenta</i> (Gabi)		x	x	x
<i>Homonoia riparia</i> (Miyagos)				x
<i>Mikania cordata</i> (Bikas/Muti-muti)		x	x	x
<i>Hylodesmum repandum</i> (Desmodium)	x	x	x	x
<i>Celosia argentea</i> (Kudiapa)	x			

The river itself is simply helpless when it comes to the prevention of any kind of destructive substance or material that enters into its surrounding. The lack of action in implementing existing environmental laws that regulate waste discharges to rivers will place the fate of Bigaan river in jeopardy. In effect, the ecosystem along Bigaan river which includes varieties of plant species will slowly deteriorate if nothing is done to the present situation.

Conclusion

Bigaan river is rich with plant species that have economic importance. The conservation of the plant species requires immediate mitigation strategies with multi-disciplinary and holistic approaches not only to conserve the species but more importantly to provide mechanisms for the preservation of the entire ecosystem that surrounds the Bigaan river. It is therefore necessary to take urgent steps to minimize and control any kind of pollution discharges to the Bigaan river.

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