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Diversity of aquatic macrophytes in Balili River, La Trinidad, Benguet, Philippines as potential phytoremediators

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Abstract. *Napaldet JT, Buot JR IE. 2019. Diversity of aquatic macrophytes in Balili River, La Trinidad, Benguet, Philippines as potential phytoremediators. Biodiversitas 20: 1048-1054.* Phytoremediation, an emerging, low-cost, aesthetically pleasing technology, is now being eyed for restoration of Balili River, Philippines. But first, there is a need to identify plants ideal for its phytoremediation. Macrophytes in the main stream, Bolo Creek and Mamaga Creek of Balili River were inventoried in this study with focus on determining macrophytes that were local, dominant (=fast growing), have high biomass and deep root systems – traits ideal for phytoremediation. A total of 38 species of macrophytes under 37 genera and 19 families were inventoried. This number is much higher than the previous inventory which recorded only 9 species. Consequently, diversity indices recorded in this study is much higher. The difference could be attributed to the time of sampling wherein the previous inventory was done in July, a rainy month, in contrast with this in April, the summer month at which the river is at its lowest level. At this period, much of the littoral zone is exposed for colonization of plants known to be easily dispersed and germinate such as Asteraceae species. In terms of species richness, family Asteraceae was the most represented with 11 species but in terms of dominance, the story was different. Dominant macrophytes of Balili River were species of family Poaceae (*Pennisetum purpureum*, *Eleusine indica* and *Cynodon dactylon*), Amaranthaceae (*Amaranthus spinosus* and *Alternanthera sessilis*), Solanaceae (*Solanum americanum*) and Commelinaceae (*Commelina diffusa*). Local macrophytes with potential for phytoremediation were *P. purpureum*, *E. indica*, *A. spinosus* and *S. americanum*.

Keywords: Balili River, diversity indices, macrophytes, phytoremediation

INTRODUCTION

Balili River is an important water resource of Baguio City and La Trinidad but like most urban rivers, it suffers from severe pollution due to indiscriminate waste dumping. It was classified as Class A by Environmental Management Bureau (EMB-CAR) but is practically a dead river during summer months. The excessive pollution of the river was usually blamed on the densely populated city of Baguio, with the river previously being tagged as “toilet bowl of Baguio City”. A study by the City Environment and Parks Management Office (CEPMO) of Baguio City showed that half of the city's population lives within the Balili watershed area, contributing the most waste. The river was included in the DENR's 2003 Pollution Report as one of the 15 "biologically dead" rivers among the 94 principal river basins in the country (Aro 2011; Palangchao 2015).

Several rehabilitation efforts had been conducted in Balili River as early as April 1999 with the launching of Balili River Summit, followed by several clean-up activities, information campaign, etc. until finally its designation as a Water Quality Management Area in 2015. But amidst all these efforts, the river still remains polluted up to present. Thus, alternative method of clean-up such as phytoremediation is timely and worth investigating. In fact, DENR-CAR was eyeing phytoremediation to revive the Balili River and other rivers in Cordillera (See 2014). But first, there is a need to identify plants in the area ideal for phytoremediation. Usual plants used in phytoremediation such as *Typha* spp. and *Phragmites autralis* (Coppini and Masi 2006; Akratos and Tsihrintzis 2007; Hoddinott 2006) do not occur in the river but other macrophytes were observed growing robustly in the river. These macrophytes were the aim of this study for inventory and documentation with special focus on plants with ideal traits for phytoremediation. According to Moffat (1995) and EPA (2000), traits for phytoremediation include local, dominant plants (=fast growing), with high biomass and deep root systems.

Results of this study would also contribute to the country’s effort of documenting its biodiversity. In a review conducted by Langenberger (2004), limited floral diversity had been conducted in the country and these primarily focus on tress and woody plants. He lamented the poor representation of Philippine vegetation in international research compared to other tropical rainforest areas. Smaller trees and other life forms were usually neglected although they account for the bulk of species richness. Moreover, ecosystems other than forest were not given much emphasis in floral assessment studies such as river ecosystems. Very few studies were conducted on macrophyte diversity amidst the importance of these plants. Aquatic macrophytes which include mosses, liverworts, larger algae and vascular aquatic plants, play an important role in structuring communities in aquatic environments by providing physical structure, increasing habitat complexity and heterogeneity and affecting various organisms like invertebrates, fishes and waterbirds (Thomaz and da Cunha 2010).

MATERIALS AND METHODS

Local plants growing along the riparian zone were assessed using quadrat method and harvest method from March to April 2018, the summer time at which the river is most polluted. The plants present at this time are the species most likely pollution-tolerant, a trait essential for phytoremediation. Quadrat method was used to identify the dominant plants while harvest method was used to identify species with high biomass, a trait ideal for phytoremediation. In the harvest method, the underground organs of the plant were also included. Three (3) sampling stations were established along the river; one in the mainstream and one each in two main tributaries of the river in La Trinidad side namely Bolo Creek and Mamaga Creek (refer to Figure 1). In each station, 5 quadrats measuring 1 m^2 each (1x1m) were used both for population counts and harvest method. Plants inventoried were identified using several taxonomic references (Pancho and Obien 1995; Pancho and Gruezo 1983, 2006, 2009, 2012; Co's Digital Flora), and voucher specimens were prepared.

Density, frequency and dry biomass were the major parameters measured. These were determined using the following formulas:

$$\text{Density} = \frac{\text{ni (number of individual of species i)}}{\text{Total area sampled (m}^2\text{)}}$$

$$\text{Frequency (\%)} = \frac{\text{Ji (number of quadrat where the species occur)}}{\text{K (Total number of quadrat)}} \times 100$$

$$\text{Relative Density} = \frac{\text{Di (Density of species i)}}{\text{Total D of all species}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{Fi (Frequency of species i)}}{\text{Total F of all species}} \times 100$$

$$\text{Relative Biomass} = \frac{\text{Biomass of Species i}}{\text{Total biomass of all species}} \times 100$$

$$\text{Importance Value} = \frac{\text{RDi + RFi + (2) RBi}}{4}$$

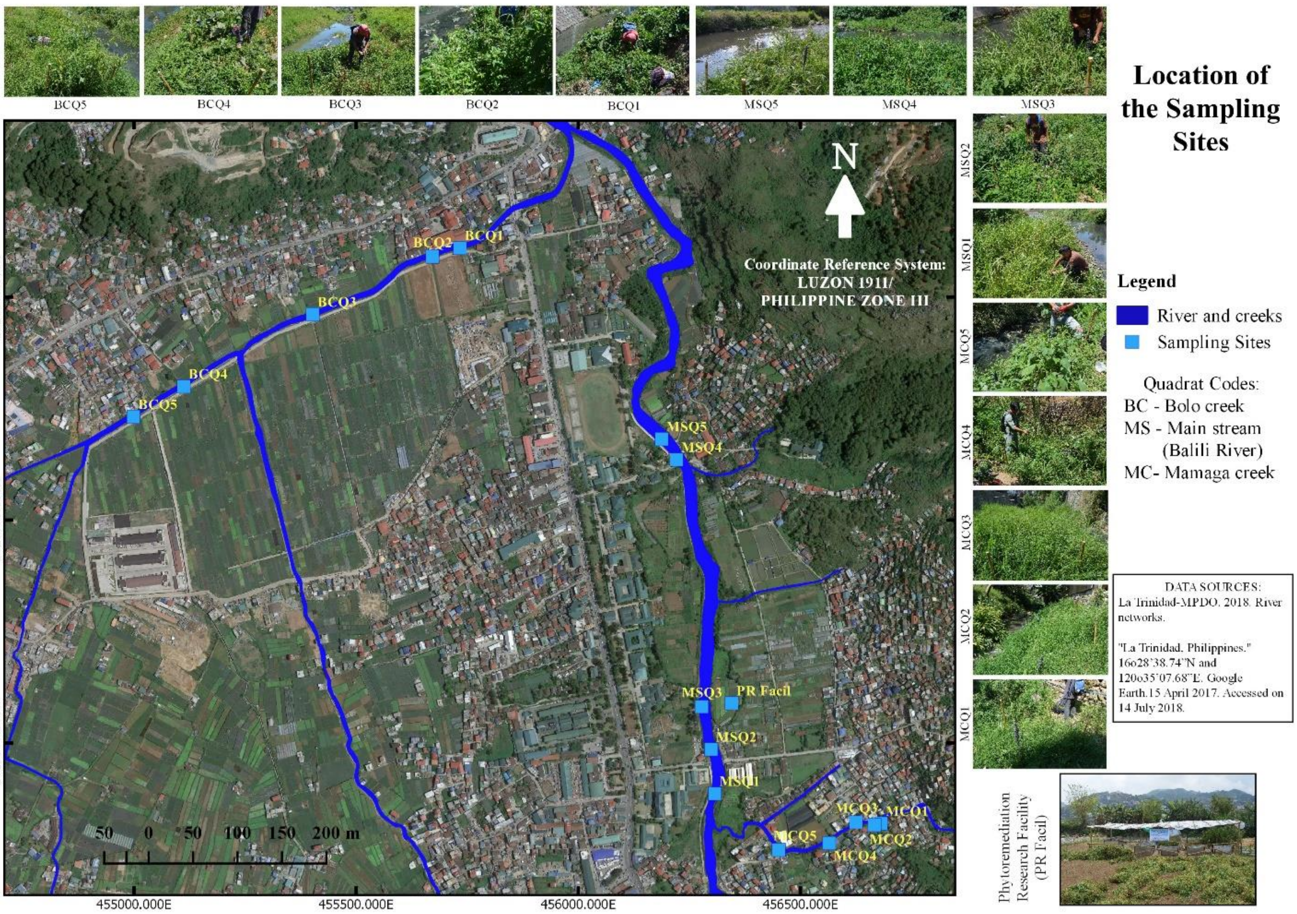

Figure 1. Close-up map of Balili River River, Philippines showing the sampling areas

Diversity indices such as Shannon–Wiener's, Margalef's and Simpson's were also computed and compared among the sampling stations. Shannon-Wiener diversity index takes into account species richness and the proportion of each species within the local community. It also accounts evenness or the distribution of individuals among the species. It was calculated as follows (Shannon-Wiener 1949):

$H = \sum p_i (\ln p_i)$

Where:
H : Shannon-Wiener diversity index
pi : Number of individuals of species i/ total number of samples
S : Number of species or species richness
E : H/H_{max}
E: Evenness
H_{max} (maximum diversity possible) : ln(N)

Simpson's index is the complimentary of evenness. It is the common measure of dominance and was computed as follows:

$$D : \frac{\sum n_i (n_i - 1)}{N (N-1)}$$

Where:
ni : total individual of species i
N : total number of individual of all species

On the other hand, Margalef's index is simpler. It was computed as:

$R = (S - 1) / \ln (N)$

Where:
R : richness
S : # of species
N : # of individuals (of all species)

To compare the diversity between sampling stations, Jaccard index of similarity was used. It was simply computed as:

$J = (Sc) / (Sa + Sb + Sc) \times 100$

Where:
Sc: number of species common to the two samples
Sa: number of species unique to station a
Sb: number of species unique to station b

RESULTS AND DISCUSSION

A total of 38 species of macrophytes under 37 genera and 19 families were inventoried in Balili River. In the main stream (Table 1), 26 species were determined while 12 in Mamaga Creek (Table 2) and 25 in Bolo Creek (Table 3). The low species richness in Mamaga could be attributed to highly disturbed state of the creek wherein much of the littoral zone is cemented at both sides; thus, discouraging growth of plants. Also, this could also be attributed to the dominance of *Cynodon dactylon* which cover much of the creek and thus preventing growth of other plants. The species richness in the main stream and Bolo Creek was much higher than the nine (9) species recently reported by Napaldet and Bout (2017) for Balili River. This discrepancy could be directly attributed to the time of sampling. The earlier sampling by Napaldet and Buot (2017) was done in July, a rainy month, while this study was conducted in April, the time at which the river is at its lowest level. At this period, much of the littoral zone was exposed for plant colonization and sure enough, the opportunistic plants known to be easily dispersed and germinate such as species from family, 'Asteraceae'. Much of these Asteraceae were absent during the sampling of Napaldet and Buot (2017) and as these were annual expected not to last long and be washed off during rainy season. This agree with the conclusion of Hughes et al. (2007) that in highly disturbed ecosystem like Balili River, species richness could vary significantly in different times.

In terms of species richness, family Asteraceae was the most represented with 11 species followed by Poaceae with 5, Amaranthaceae, Brassicaceae, Cucurbitaceae, Cyperaceae, Polygonaceae and Solanaceae with 2 species each while the rest of the families were represented by a single species (Figure 2). However, in terms of dominance, the story was different (Table 4). The dominant macrophytes of Balili River were species of family Poaceae (*Pennisetum purpureum*, *Eleusine indica* and *Cynodon dactylon*), Amaranthaceae (*Amaranthus spinosus* and *Alternanthera sessilis*), Solanaceae (*Solanum americanum*) and Commelinaceae (*Commelina diffusa*). All the plants inventoried were emergent plants in the littoral zone that can tolerate water-saturated soil and occasional flooding.

The main stream was dominated by *Pennisetum purpureum*, *Eleusine indica*, *Amaranthus spinosus*, *Alternanthera sessilis*, *Solanum nigrum* and *Cynodon dactylon*. On the other hand, the two tributaries, Bolo and Mamaga Creek, were dominated by 2 to 3 species only. Mamaga Creek was dominated by *C. dactylon* and *A. sessilis* while Bolo Creek by *C. dactylon*, *S. americanum* and *C. diffusa*. *Cynodon dactylon* usually forms a dense interwoven mat that prevents growth of other plants. Patches dominated by this grass often have very low diversity and were more evident in the two tributaries.

These results reflects habitat heterogeneity at the study sites. The dominance of fewer species in the tributaries could be attributed to the lesser degree of disturbance they experienced compared with the main stream. Greater fluctuation in water flow is readily apparent in the main stream which could change from a gentle riffle to a roaring rapid during heavy rains thus stripping away the vegetations. Another factor is the difference in edaphic condition. The two tributaries, Bolo and Mamaga Creek, predominantly have rocky loamy/clayey substrate that makes the rhizomatous condition of *C. dactylon* very hard to uproot. The main stream, on the other hand, have gravely/ sandy substrate that can be readily disturbed by strong water flow. This minimizes the establishment of a continuous mat of *C. dactylon* or *A. sessilis*, thereby allowing growth of other macrophytes and resulting to greater species richness.

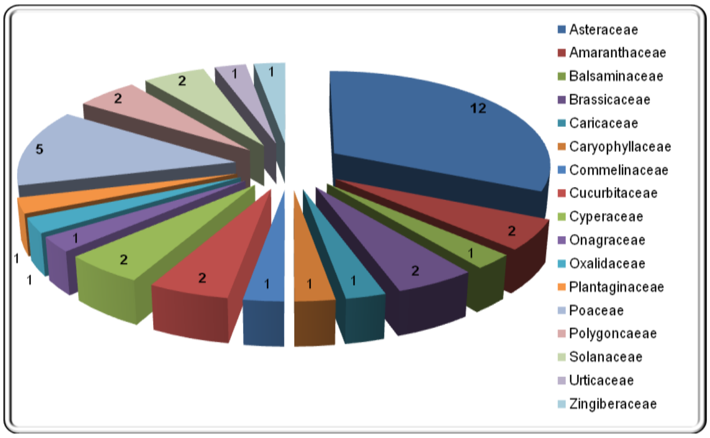

Figure 2. Distribution of aquatic macrophyte species by family

Table 1. The dominant aquatic macrophytes in the main strem, Bolo Creek and Mamaga Creek of Balili River River, Philippines

Main stream		Mamaga Creek		Bolo Creek	
Species	**IV**	**Species**	**IV**	**Species**	**IV**
Pennisetum purpureum	33.95	*Cynodon dactylon*	39.48	*Cynodon dactylon*	26.11
Eleusine indica	9.67	*Alternanthera sessilis*	26.69	*Solanum americanum*	14.18
Amaranthus spinosus	8.72	*Brugmansia versicolor*	8.69	*Commelina diffusa*	11.68
Alternanthera sessilis	8.51	*Crassocephalum crepidioides*	6.16	*Galinsoga parviflora*	6.96
Solanum americanum	8.39	*Tithonia diversifolia*	5.12	*Alternanthera sessilis*	5.75
Cynodon dactylon	5.40	*Cyperus involucratus*	2.97	*Bidens pilosa*	4.52
Galinsoga parviflora	5.16	*Pennisetum purpureum*	2.46	*Amaranthus spinosus*	4.16
Rorippa indica	5.09	*Paspalum conjugatum*	1.79	*Pennisetum purpureum*	3.76
Crassocephalum crepidioides	4.13	*Ageratina riparia*	1.74	*Persicaria glabra*	2.85
Ageratum conyzoides	3.37	*Setaria palmata*	1.72	*Crassocephalum crepidioides*	2.81

Table 2. Aquatic macrophytes in the main stream of Balili River River, Philippines

Species name	ni	Ji	ODW	Di	Fi	RDWi	RDi	RFi	IV
Ageratina riparia (Regel) R.M.King&H.Rob.	2	1	1	0.4	20	0.03	0.57	1.49	0.53
Ageratum conyzoides (L.) L.	11	5	45.9	2.2	100	1.45	3.12	7.46	3.37
Alternanthera sessilis (L.)R.Br. ex DC.	24	3	360	4.8	60	11.39	6.80	4.48	**8.51**
Amaranthus spinosus L.	14	5	370.9	2.8	100	11.73	3.97	7.46	**8.72**
Bidens pilosa L.	2	1	12.6	0.4	20	0.40	0.57	1.49	0.71
Crassocephalum crepidioides (Benth.) S.Moore	27	3	69.6	5.4	60	2.20	7.65	4.48	**4.13**
Cucurbita maxima Duchesne	1	1	5.8	0.2	20	0.18	0.28	1.49	0.54
Cynodon dactylon (L.) Pers.	16	1	246	3.2	20	7.78	4.53	1.49	**5.40**
Cyperus distans L.f.	7	3	6.9	1.4	60	0.22	1.98	4.48	1.72
Dichrocephala auriculata (Thunb.) Druce	3	3	1.2	0.6	60	0.04	0.85	4.48	1.35
Drymaria cordata (L.) Willd. exSchult.	1	1	0.7	0.2	20	0.02	0.28	1.49	0.46
Eleusine indica (L.) Gaertn.	26	4	400.6	5.2	80	12.67	7.37	5.97	**9.67**
Erechtites valerianifolius (Wolf) DC.	1	1	48.7	0.2	20	1.54	0.28	1.49	1.21
Galinsoga parviflora Cav.	20	4	142.3	4	80	4.50	5.67	5.97	**5.16**
Ludwigia perennis L.	1	1	5.9	0.2	20	0.19	0.28	1.49	0.54
Melothria pendula L.	2	1	3.3	0.4	20	0.10	0.57	1.49	0.57
Mikania cordata (Burm.f.) B.L.Rob.	25	2	8.2	5	40	0.26	7.08	2.99	2.65
Paspalum conjugatum P.J.Bergius	1	1	0.4	0.2	20	0.01	0.28	1.49	0.45
Pennisetum purpureum Schumach.	103	5	1567.4	20.6	100	49.59	29.18	7.46	**33.95**
Persicaria glabra (Willd.) M.Gómez	8	3	49.5	1.6	60	1.57	2.27	4.48	2.47
Pilea microphylla (L.) Liebm.	5	1	4.1	1	20	0.13	1.42	1.49	0.79
Plantago major L.	6	3	82.2	1.2	60	2.60	1.70	4.48	2.84
Pseudognaphalium hypoleucum (DC.) Hilliard &B.L.Burtt	1	1	1.2	0.2	20	0.04	0.28	1.49	0.46
Rorippa indica (L.) Hiern	32	5	60.8	6.4	100	1.92	9.07	7.46	**5.09**
Solanum americanum Mill.	41	5	228.8	8.2	100	7.24	11.61	7.46	**8.39**
Tithonia diversifolia (Hemsl.) A.Gray	8	3	16.8	1.6	60	0.53	2.27	4.48	1.95

Table 3. Aquatic macrophytes in Mamaga Creek of Balili River, Philippines

Species name	ni	Ji	ODW	Di	Fi	RDWi	RDi	RFi	IV
Ageratina riparia (Regel) R.M.King&H.Rob.	2	1	2.8	0.4	20	0.15	2.30	4.35	1.74
Alternanthera sessilis (L.) R.Br. ex DC.	19	5	586.7	3.8	100	31.60	21.84	21.74	26.69
Brugmansia versicolor Lagerh.	3	1	250.4	0.6	20	13.49	3.45	4.35	8.69
Crassocephalum crepidioides (Benth.) S.Moore	6	3	43.5	1.2	60	2.34	6.90	13.04	6.16
Cynodon dactylon (L.) Pers.	45	4	824.5	9	80	44.41	51.72	17.39	39.48
Cyperus involucratus Rottb.	2	2	8.3	0.4	40	0.45	2.30	8.70	2.97
Cyperus distans L.f.	2	1	0.9	0.4	20	0.05	2.30	4.35	1.69
Hedychium coronarium J.Koenig	1	1	4.4	0.2	20	0.24	1.15	4.35	1.49
Paspalum conjugatum P.J.Bergius	2	1	4.7	0.4	20	0.25	2.30	4.35	1.79
Pennisetum purpureum Schumach.	2	1	29.5	0.4	20	1.59	2.30	4.35	2.46
Setaria palmifolia (J.Koenig) Stapf	1	1	12.8	0.2	20	0.69	1.15	4.35	1.72
Tithonia diversifolia (Hemsl.) A.Gray	2	2	88.1	0.4	40	4.75	2.30	8.70	5.12

Table 4. Aquatic macrophytes in Bolo Creek of Balili River, Philippines

Species name	ni	Ji	ODW	Di	Fi	RDWi	RDi	RFi	IV
Ageratum conyzoides (L.) L.	2	1	3.5	0.4	20	0.16	0.66	1.96	0.74
Alternanthera sessilis (L.)R.Br. ex DC.	14	5	92.9	2.8	100	4.27	4.65	9.8	**5.75**
Amaranthus spinosus L.	8	4	66.6	1.6	80	3.06	2.66	7.84	**4.16**
Bidens pilosa L.	15	2	100	3	40	4.6	4.98	3.92	**4.52**
Brugmansia versicolor Lagerh.	1	1	3.1	0.2	20	0.14	0.33	1.96	0.64
Carica papaya L.	1	1	2.3	0.2	20	0.11	0.33	1.96	0.63
Commelina diffusa Burm.f.	44	5	242.5	8.8	100	11.15	14.62	9.8	**11.68**
Crassocephalum crepidioides (Benth.) S.Moore	6	3	36.5	1.2	60	1.68	1.99	5.88	**2.81**
Cynodon dactylon (L.) Pers.	40	3	927.4	8	60	42.64	13.29	5.88	**26.11**
Cyperus distans L.f.	1	1	4.2	0.2	20	0.19	0.33	1.96	0.67
Eleusine indica (L.) Gaertn.	5	2	13.6	1	40	0.63	1.66	3.92	1.71
Galinsoga parviflora Cav.	40	1	137	8	20	6.3	13.29	1.96	**6.96**
Impatiens balsamina L.	1	1	2.3	0.2	20	0.11	0.33	1.96	0.63
Melothria pendula L.	4	2	7.7	0.8	40	0.35	1.33	3.92	1.49
Nasturtium officinale R.Br.	6	2	17.1	1.2	40	0.79	1.99	3.92	1.87
Oxalis violacea L.	10	3	5	2	60	0.23	3.32	5.88	2.42
Pennisetum purpureum Schumach.	1	1	138.8	0.2	20	6.38	0.33	1.96	**3.76**
Persicaria glabra (Willd.) M.Gómez	8	2	52.3	1.6	40	2.4	2.66	3.92	**2.85**
Plantago major L.	1	1	23.7	0.2	20	1.09	0.33	1.96	1.12
Rorippa indica (L.) Hiern	5	2	1.6	1	40	0.07	1.66	3.92	1.43
Rumex obtusifolius L.	1	1	28.6	0.2	20	1.31	0.33	1.96	1.23
Setaria palmifolia (J.Koenig) Stapf	5	2	1.5	1	40	0.07	1.66	3.92	1.43
Solanum americanum Mill.	80	3	263.7	16	60	12.12	26.58	5.88	**14.18**
Sonchus oleraceus (L.) L.	1	1	2	0.2	20	0.09	0.33	1.96	0.62
Youngia japonica (L.) DC.	1	1	1.3	0.2	20	0.06	0.33	1.96	0.6

The dominant plants in the littoral zone of the river were noxious weeds. In fact, these plants were commonly included in several weed manuals (Pancho 1983; Pancho and Obien 1983, 1995) and *E. indica*, *P. purpureum, C. dactylon* and *C. diffusa* were named among the world's worst weeds (Holm et al. 1977). These plants were fast growing and have high tolerance to different environmental conditions including pollution. It could be generalized that these plants were not simply surviving in the littoral zone but are thriving as they were observably robust. The success of weeds in the area could be attributed to their stolon/rhizome which enables them to colonize exposed area rapidly. Also, the moist condition and occasional flooding favour rooting at their nodes thus hastening their reproduction asexually.

The plants inventoried in the study were very different from those documented by Aguilar & Buot (2003) and Vicencio & Buot (2017) in Laguna Bay where three forms of macrophytes in the lake were determined. In contrast, only one form of macrophytes, which is emergent, was documented in Balili River. Also, these emergent macrophytes are not permanently inundated but only during heavy rains of rainy season. Our inventory of macrophytes in Balili River was more comparable with the inventory of Molawin Creek, Laguna by Torrefiel and Buot (2017). Of the 38 species documented in the study, 10 of these also occur in Molawin Creek. This shows that freshwater ecosystems in the country are highly unique in terms of biodiversity.

Diversity indices such as Simpson's, Margalef's and Shannon-Wiener's were also computed in the three sampling stations (Figure 3). Margalef's indices were relatively high except in Mamaga Creek. However, Shannon-Wiener indices were low ranging from 0.85 to 2.39 with the lowest value recorded in Mamaga Creeek and highest value in Bolo Creek. Shannon-Wiener's index is generally between 1.5 and 3.5 in most ecological studies with higher number indicating greater species richness and evenness (Fernando 1988). The higher index of Bolo Creek could be attributed to its relatively even distribution of individuals per species. On the other hand, Simpson's index ranged from 0 to 1 with higher values indicating presence of a dominant species. Mamaga Creek registered the highest Simpson's index of 0.22 indicative of the dominance of *C. dactylon* in the creek. Overall, Balili River registered a Simpson's index of 0.054, Margalef's index of 5.56, Shannon-Wiener's index of 1.66 and evenness of 0.249. These values were comparable with the earlier diversity assessment in the same river by Napaldet and Bout (2017) except for Margalef's index which was much lower at 1.72. The difference could be directly attributed to the higher species richness recorded in this study.

On the other hand, Jaccard's index of similarity showed that the main stream was more alike with Bolo Creek in terms of species composition than with Mamaga Creek (Table 5). Macrophytes common in all three sites are *Alternanthera sessilis*, *Crassocephalum crepidioides*, *Cynodon dactylon*, *Cyperus distans* and *Pennisetum purpureum*. The greater similarity between the main stream and Bolo Creek is just a consequence of their higher species richness. Mamaga Creek is the smallest among the three with much lesser riparian area where macrophytes could grow.

The result of inventory showed wealth of available plants that can utilized for phytoremediation of Balili River. The diversity indices, on the other hand, showed the current state of the river biodiversity-wise. Further, these indices also hinted the presence of dominant and widely-distributed macrophytes which are traits of a prospective phytoremediator. The dominance of *Pennisetum purpureum*, *Eleusine indica* and *Amaranthus spinosus* in the river makes them ideal prospect for phytoremediation of Balili River. Their dominance was not just based on population counts but also on biomass. Furthermore, these weeds have deep and more extensive roots compared with the other dominant macrophytes like *C. dactylon* and *A. sessilis*. These two are also dominant particularly in the two tributaries but their root systems are observably shorter. These satisfy the recommended traits of an efficient phytoremediator namely local, dominant plant with high biomass and deep extensive root system (Moffat 1995 and EPA 2000).

Moreover, some studies have already documented the phytoremedation potential of the above-mentioned three macrophytes. *Pennisetum purpureum* was cited to be good phytoremediator of soils contaminated by Cd, Zn, Cs (Zhang et. al. 2010 & 2014), petroleum hydrocarbon (Ayotamuno et al. 2006) and P (Silveira et al. 2013). On the other hand, *Eleusine indica* was documented as phytostabilizer or good metal excluder at best (Merkl et al. 2005) but Lum et al. (2014) found the plant a good phytostabilizer for Cu. Lastly, *Amaranthus spinosus* was found suitable for Cu, Zn, Cr, Pb, and Cd accumulation and translocation (Chinmayee et al. 2012). It's now a matter of evaluating their performance in constructed wetland set-ups for phytoremedation of wastewaters like that of Balili River.

Table 5. Jaccard's index of similarity (%) among stations

	Main stream	Mamaga Creek
Mamaga Creek	26.67	
Bolo Creek	41.18	24.14

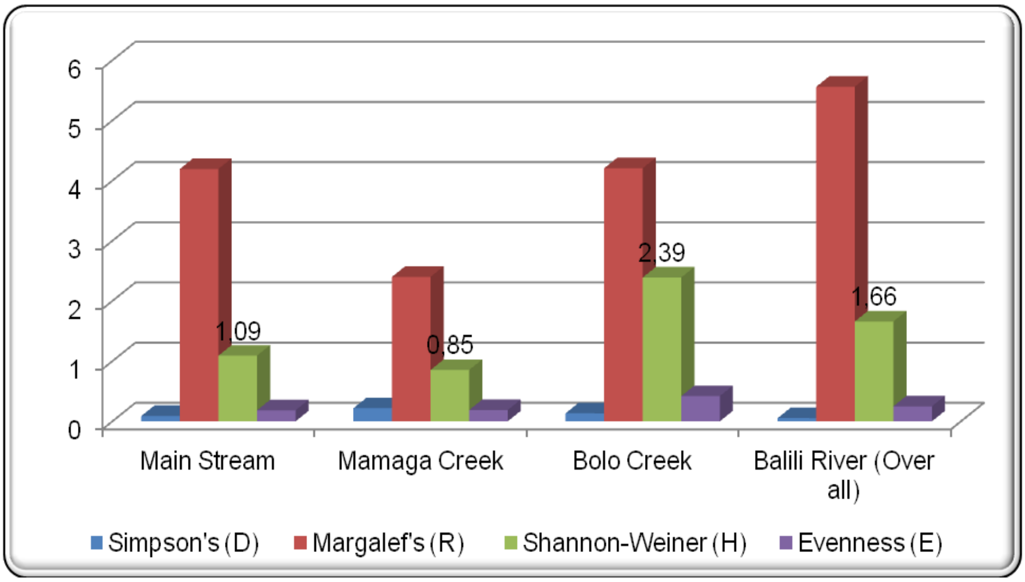

Figure 3. Diversity indices of Balili River, Philippines

A total of 38 species of macrophytes under 37 genera and 19 families were inventoried in Balili River. In the main stream, 26 species were determined while 12 in Mamaga Creek and 25 in Bolo Creek. The main stream was dominated by *Pennisetum purpureum*, *Eleusine indica*, *Amaranthus spinosus*, *Alternanthera sessilis*, *Solanum nigrum* and *Cynodon dactylon*. Mamaga Creek was dominated by *C. dactylon* and *A. sessilis* while Bolo Creek by *C. dactylon*, *S. nigrum* and *C. diffusa*. These shows that species composition and dominance could vary even in sites of close proximity. In terms of species richness, family Asteraceae was the most represented with 12 species followed by Poaceae with 5. However, in terms of dominance, the story is different. The dominant macrophytes of Balili River were species of family Poaceae (*Pennisetum purpureum*, *Eleusine indica* and *Cynodon dactylon*), Amaranthaceae (*Amaranthus spinosus* and *Alternanthera sessilis*), Solanaceae (*Solanum americanum*) and Commelinaceae (*Commelina diffusa*). Macrophytes inventoried in Balili River were very different than those documented by Aguilar and Buot (2003) in Laguna Bay which shows the high uniqueness of freshwater ecosystems of the country in terms of biodiversity. Thus, more biodiversity inventories are encouraged to better account for the country's biodiversity particularly in less prioritized areas.

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