Article

Self-purification in tropical upland rivers as affected by environmental factors: the case of Balili River in Benguet, Philippines

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Abstract

A major data gap in tropical river ecology is the limited documentation of natural water purification of upstream rivers. This study documented the improvement of water quality of downstream Balili River as affected by environmental factors and macrophyte diversity using a mixed-method approach (water quality assessment, plant inventory, field observation, canonical correspondence analysis, community interview). Results showed that the distance from pollution plays a significant role in the self-purification of the river while the floral diversity maintains the riparian from further contaminating the water and at the same time absorbing air pollutants. Generally, the pollution reduction and %change is exponential at 2 and 3 km from point source then taper at 4 and 5 km. At 3 km from the point source, 30% improvement in TDS, BOD and salinity, 25% for EC, 20% in TSS, 35% in WQI, 36% in CPI, and 50% for DO were noted. Key factors that influence the self-purification process in the river were distance from pollution source, elevation, human disturbance (as indicated by %tree canopy) and temperature. These findings highlight the importance of distance from pollution sources and floral diversity in driving water quality improvements, with implications for sustainable water resource management in tropical regions. NOVELTY STATEMENT This study documented the improvement of water quality of downstream Balili River as affected by environmental factors and macrophyte diversity-as contribution to the major data gap in tropical river ecology which currently has limited documentation on natural water purification of upstream rivers. The study also shows the mosaic interplay of water quality, plant diversity, distance from pollution, human disturbance, and air quality in understudied tropical river. Further, this study is unique in documenting the downstream of Balili River since majority of the previous studies were concentrated in the upstream portion of the river.

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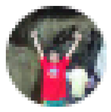
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LEAD AND MERCURY UPTAKE IN DOMINANT MACROPHYTES OF BALILI RIVER, BENGUET, PHILIPPINES

November 2020

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Abstract and Figures

Lead and mercury contamination have been reported in several sites in the Philippines including Balili River, the drainage of Baguio City and La Trinidad, Benguet. Amidst this, the river is still vital to the community as irrigation source, thus the immediate need for its rehabilitation. The study has assessed the potential of common macrophytes growing along the riparian such as Alternanthera sessilis, Cynodon dactylon, Solanum americanum and Tithonia diversifolia for lead and mercury uptake. Cynodon dactylon and Solanum americanum registered the highest Pb concentrations in all plant organs but they differ in their translocation (TF) capabilities. Cynodon dactylon has higher Pb in its stem qualifying it as phytoextractor while Solanum americanum has low translocation in its shoots qualifying it only as a phytostabilizer. Alternanthera sessilis and Tithonia diversifolia have much lower Pb uptake showing the metal excluding capacity of these plants for lead. In terms of Hg uptake, Alternanthera sessilis and Solanum americanum have higher absorption in their roots while T. diversifolia and Cynodon dactylon have higher values in their shoot organs, particularly in leaf. Consequently, Tithonia diversifolia and C. dactylon qualify as phytoextractor for Hg having a bioaccumulation factor (BCF) and TF values > 1. On the hand, Alternanthera sessilis and Solanum americanum at BCF > 1 and TF < 1 qualify as phytostabilizers for Hg. These results show that macrophytes in Balili River, even if they differ in their heavy metal uptake, could be tapped for the phytoremediation of its heavy metal contamination.

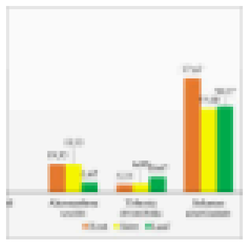


Figure no. 1 Lead concentration in…

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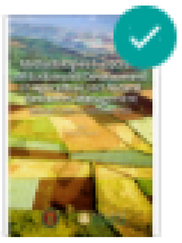
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Rehabilitation of Eutrophic Rivers Through Phytoremediation in Constructed Wetland: The Case of Balili River in Benguet, Philippines



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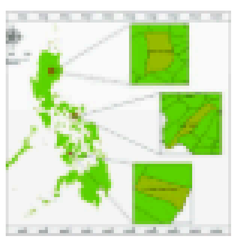
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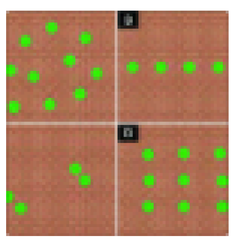
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Abstract and Figures

Balili River in Benguet, northern Philippines remains polluted despite more than a decade of rehabilitation efforts; thus, an alternative clean-up method, such as phytoremediation, is timely and worth investigating. This chapter describes the phytoremediation potentials of selected local dominant aquatic macrophytes of the river, namely; Amaranthus spinosus, Eichhornia crassipes, Eleusine indica and Pennisetum purpureum in pilot-scale constructed wetlands and subjected to varying hydraulic retention time (HRT) treatments. Results showed significant improvement of the wastewater quality in almost all parameters of water assessment. At optimal HRT, total suspended solids, dissolved oxygen, nitrate, and mercury were significantly lowered at values passing the particular minimum water quality standard, while biological oxygen demand, phosphate, and lead were slightly above the minimum standards. Against these reduction rates, total and fecal coliform still did not pass the water quality standard for class A water. The pollution reduction efficiencies of the aquatic macrophytes were significantly affected by HRT. Significant pollution reduction was observed as early as day 1, while optimal reduction was recorded at 3-4 days HRT. Among the macrophytes, P. purpueum, generally, had the best pollution reduction efficiency. Results of the study showed that local dominant aquatic macrophytes are promising phytoremediators and provide a good template for coming up with a full-scale constructed wetland for the rehabilitation of Balili River as well as for other eutrophic rivers in the country.



Location of the study sites



Spatial sampling patterns



Rhizosphere soil on mungbean...



Microbial community DNA...



Aerial photo of a farm in Quezon...

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FLORAL DIVERSITY ASSESSMENT OF BALILI RIVER AS POTENTIAL PHYTOREMEDIATORS

January 2017

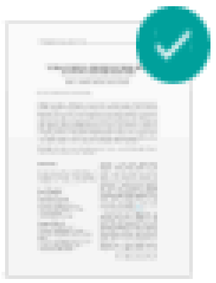
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Abstract and Figures

Local floras of Balili River were inventoried to determine plants with phytoremediation potential using line intercept method. Common weeds namely Alternanthera sessilis, Pennisetum purpureum, Eleusine indica, Cyperus distans, Amaranthus spinosus dominated the littoral zones of Balili River. Only nine species were documented in the area and thus, expectantly, registered low values in diversity indices such as Shannon-Wiener's, Margalef's and Simpson's index. The upstream, midstream and downstream sampling stations in the littoral zone have high index of similarity but differ significantly with the nearby upper riparian zone in terms of diversity and species composition. This could be attributed to the prevailing environmental conditions in the two zones-the littoral zone has waterlogged sandy soil while clayey loam and mesophytic condition prevail in the upper riparian zone. Literature reviews showed that these local flora have phytoremediation potential, albeit mostly in soil conditions, and thus worthy to be explored for the clean-up of the river's pollutants.



Figure no. 5 Upper riparian samplin...

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Regression Analysis of the Balili River's Biological to Physio-Chemical Characteristics

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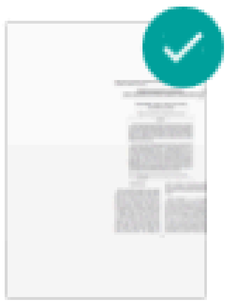
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Abstract

The study determined the interrelated physico-chemical characteristics of the Balili River water system and the regression analysis of the dissolved oxygen and biological oxygen demand with the derived interrelated physico-chemical factors of the Balili river water system. Secondary data regularly monitored by the Environmental Management Bureau of the Department of Environment and Natural Resources, Cordillera Administrative Region was used in the Study. Factor and Regression analyses were the statistical tools used in the study. There were four derived interrelated physico-chemical factor of the Balili River water system. These factors are the following: F1: Physico-chemical Factor; F2: pHConductivity- cadmium-phosphate Factor; F3: Temperature-Coliform Factor; and F4: Lead-TSS Factor. The Dissolved Oxygen (DO) of the Balili River water system was correlated to the four factors derived as shown by the equation: DO = 8.242 – 0.26F1 + 0.18F2 + 0.084F3 – 0.069F4, but not significantly correlated. The Biological Oxygen Demand is correlated with the four derived factors shown in the following equation: BOD = 51.643 + 0.74 F1 – 0.122F2 + 0.143F3 + 0.16F4. The first factor was significantly interrelated with oxygen demand while the other three factors were not. It is recommended that water treatment procedures should be undertaken to improve the dissolved oxygen and oxygen demand of the Balili River water system.

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