UNIVERSITY OF THE PHILIPPINES

Master of Science in Environmental Science

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Evaluation of *Enhalus acoroides* as a potential biomonitor of heavy metal variations near mining areas

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Date of Submission

June 2019

Thesis Classification:

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Abstract

Biomonitors are often used to assess the heavy metal contamination in an area for they have been successful in exhibiting spatial and temporal variations in the bioavailabilities of contaminants (i.e., heavy metals) in the environment. Biomonitors offer time-integrated measurements that reflect portions of the total ambient metal load that are of direct ecotoxicological relevance. The use of seagrasses as biomonitors of heavy metals has been investigated in several studies but was only limited to species such as *Posidonia oceanica* and *Zostera marina*.

In this study, the potential of a tropical seagrass *Enhalus acoroides* (*E. acoroides)* as a biomonitor of heavy metals in an identified mining site is explored. Spatial and temporal variations of heavy metals (Cr, Mn, Co, Ni, Cu, Pb, As, Zn, Cd) in *E. acoroides* in Hinadkaban Bay, Claver, Surigao del Norte were investigated. Tissues samples from *E. acoroides*, water, and sediment samples were collected at various strategic sampling points representing an exposure gradient from the mine tailings. Using lepidochronology technique, the historical contamination trend of the area was reconstructed from the heavy metal concentrations in the rhizomes of *E. acoroides*. The variation of metal concentration between *E. acoroides* leaf and rhizome tissues were also examined. Several pollution indices were also calculated to assess the degree of contamination in the area. All heavy metal concentrations of *E. acoroides* (leaves and rhizomes), water, and sediment samples were quantified using Agilent 7500cx Inductively Coupled Plasma Mass Spectroscopy.

Analysis of variance (ANOVA) results showed significant variations ($p < 0.05$) in the metal concentrations in the tissues of *E. acoroides* (Mn, Co, As, Cd for leaf tissues while Cr, Mn, Cu, Zn for rhizome tissues) and the marine sediments (Cr, Mn, Co, Ni, As) across sites, with the highest concentrations usually found at sites with

closest distance from the metal sources. Post-hoc tests determined that significant differences in the metal concentrations were between the most probable contaminated sites and the least contaminated sites. Through lepidochronology technique, rhizomes were retroactively dated from age 1-7 (year 2009-20015). Heavy metal concentrations across this period were found to exhibit clear exponential trends for all metals except for Pb, Zn, and Cu. This could indicate the possible ability of the rhizomes to accumulate metal across time or to translocate metal across its rhizome sections. The more pronounced exponential trend is found in sites with greater proximity to metal sources, with more prominent metal concentration peaks between 2009-2011.These peaks coincided with the construction period (2009-2010) and the opening (2010) of an additional mining company in the study area. The metal concentrations across time was also found to be associated with nickel production in the area. Construction period and increased mining activities were reflected in the rhizome sections of *E.acoroides*. Calculated pollution indices were indicative of varying metal contamination in the study site with higher contamination found in sites that are closer to metal sources. Overall, the rhizomes of *E. acoroides* captures the spatio-temporal variations of the studied heavy metals (Cr, Ni, Mn, Co, As), that deem it fit as a biomonitor of pre and current mining activities.