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Soil Characterization and Nutrient Composition of Mangrove Vegetation in Carmen, Cebu

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ABSTRACT

Mangrove soils are estuarine and marine alluvium transported and deposited as sediments and nutrient particles through the influence of tidal inundation by rivers and seas. This study was conducted to characterize soil and quantify nutrient load to understand mangrove vegetation recruitment and structure. Using a 50 meter transect line, soil samples were collected, from the 6 coastal barangays of Carmen, Cebu, namely: Puente, Luyang, Dawis Norte, Dawis Sur, Cogon East and Poblacion. The soils were air dried, crushed and subjected to laboratory analyses. Other parameters were measured in situ within the study area. Results revealed that soil acidity, water temperature and water salinity in the area are desirable for the growth of mangroves. Low D.O was observed in all the sites which indicates high pollution level. Loam type of mangrove soil texture with high concentration of nutrients and organic matter were observed. Finding of the study suggest that soil characteristics and nutrient load could be an attribute to the abundance and diversity of mangrove vegetation.

Keywords: alluvium, mangrove soil, nutrient load, tidal inundation

INTRODUCTION

Mangroves play a significant role in the environment. The importance of mangroves can be summarized in ecological and economic aspects (Moreno and Calderon, 2011). Mangrove ecosystem in the six coastal barangays of Carmen, Cebu provides livelihood to fishermen, gleaners and nipa thatchers. It also protects the Carmen cove from excessive sedimentation. These ecosystems have already been assessed by the Department of Environment and Natural Resources (DENR) and Bureau of Fisheries and Aquatic Resources (BFAR) through the conduct of the Participatory Coastal Resource Assessment (PCRA). However, no substrate and nutrient status of these mangrove areas has been conducted. This study aims to determine the soil characteristics and nutrient status of the mangrove vegetation in Carmen, Cebu as a baseline data to help better understand mangrove structure as basis for the rehabilitation and conservation strategies towards a sustainable management of the mangrove ecosystem.

MATERIALS AND METHODS

The study was conducted in the six coastal barangays of Carmen, Cebu namely: Puente, Luyang, Dawis Norte, Dawis Sur, Poblacion and Cogon East. Three transect lines (50 meters long)

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were laid at 10 meters interval. Soil samples were collected to a depth of 15 cm using an improvised PVP pipe (50cm in length x 6cm in diameter). Five hundred grams of soil samples were collected from the front, middle and end portion of the transect line. The soil sample wassorted separating the macro fauna (which was later identified in a separate study), air dried, crushed, labelled and brought to the soil laboratory for analysis of the following: acidity (pH), organic carbon (%OC), organic matter (%OM), Phosphorus (P) and Potassium (K). Other parameters such as water temperature, D.O, pH and salinity within the study sites were measured in situ using a multi-parameter meter.

RESULTS AND DISCUSSION

Ambient Parameters and Soil Description

Mangroves soils are typically saline, anoxic, acidic and frequently waterlogged. Such properties affect the distribution and condition of mangrove forests (Dissanayake, N. and Upali, C., 2014).

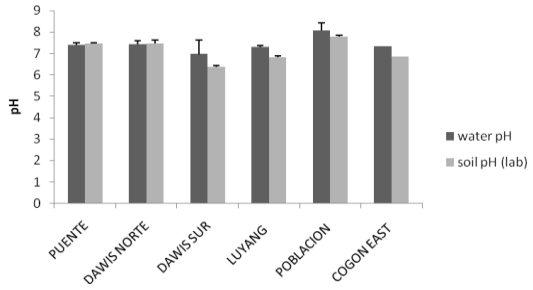

Figure 1. Mean pH within the study sites

Water pH within the mangrove areas are neutral to alkaline ranging from 7.35 to 8.08± 0.1.Soil pH analyzed in the soil laboratory ranging from 6.38 to 7.78 is slightly lower than the water pH measured in situ. The desirable pH range for fish production is 6.5 – 9.0 according to Lawson (1995), Tarazona and Munoz, (1995). This could be inferredthat mangrove soils of Carmen has the ideal pH for estuarine organisms to grow and survive.

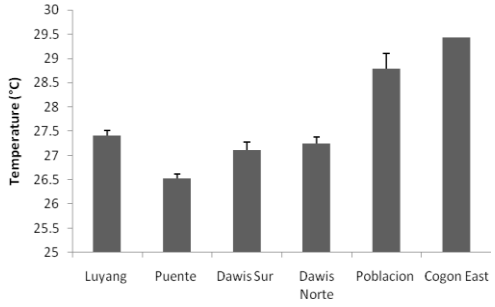

Figure 2. Mean temperature within the study sites

Water temperature among the study sites showed a little variation whichranged between

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26-29°C which is a desirable temperature for the growth of mangroves (temperature higher than 20°C-35°C).Water temperature by solar radiation, evaporation, insolation, freshwater influx, and cooling and mix up with ebb and flow from adjoining neritic waters (Govindasamy et al., 2000).

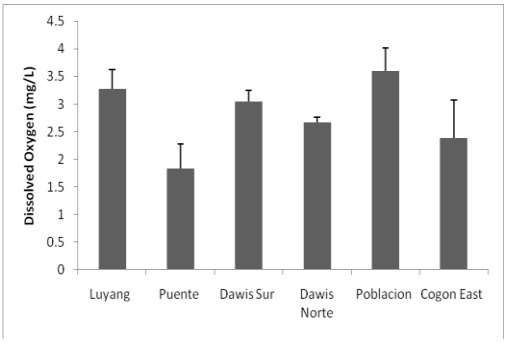

Figure 3. Mean D.O within the study sites

Dissolved oxygen in the study sites ranged from 1.83 mg/L to 3.6 mg/L where barangay Puente obtained the lowest D.O. Lower values of D.O were observed in all the sites which may indicate higher pollution level due to anthropogenic activities in the area.The presence of human feces, garbage and other domestic wastes may contribute to low D.O level.

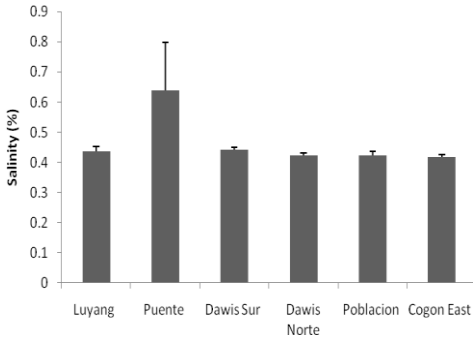

Figure 4. Mean salinity within the study sites

Mangrove soils are variable in terms of salinity since different mangrove species adapt to fresh and saline environment conditions. Mean salinity in the study sites ranged from 0.41% (4.1ppt) to 0.63% (6.3ppt) categorized as brackish water. Mangroves can still grow with salinity up to 90 ppt but salinity for the growth of mangroves are between 5 to 7 ppt(Krauss et al., 2008). Salinity accumulating in the roots of mangroves are caused by tides (Parida and Jha, 2010).

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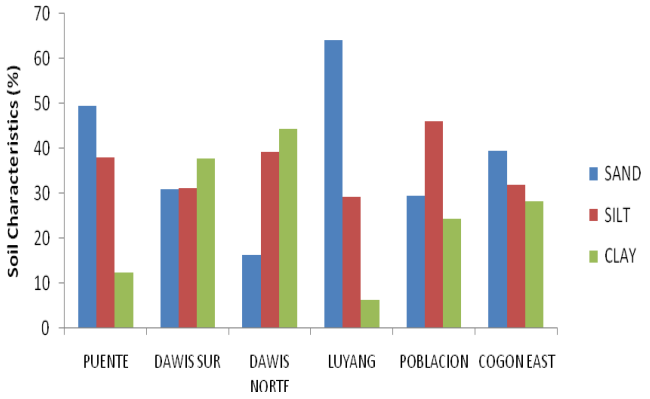

Figure 5. Soil characterization of mangrove in the study sites

Soil classification was based on USDA particle-size. The textures of mangrove soils in the study sites vary from loam, sandy loam, clay loam, and silty clay. Barangay Puente showed a mean percentage of 49.6% sand, 38% silt, 12.4% clay, classified as loam. Mangrove soil of Dawis Sur have 30.9% sand, 31.3% silt and 37.73% clay, classified as clay loam. Dawis Norte mangrove soil is composed of 16.26% sand, 39.3% silt, 44.4% clay, classified as silty clay. Mangrove soil of Luyang has 64.26% sand, 29.33% silt and 6.4% clay, classified as sandy loam. Mangrove soil of Poblacion has 29.6% sand, 46% silt, and 24.4% clay classified as loam. Finally, Cogon East has 39.6% sand, 32% silt and 28.4% clay classified as clay loam soil. Generally, soil texture of the study sites were mostly loam type of soils.

Inhabitants, canopy cover and tidal inundation influenced the variability of ambient parameters of these mangrove sites nevertheless it was in suitable range for estuarine organism to survive and flourish.

Nutrient Status

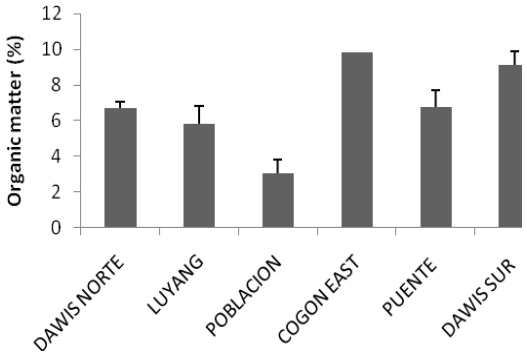

Figure 6. Percent Organic Matter

Organic matter is the breakdown of plants and animals. The presence of organic matters in mangrove soils varies in different mangrove areas.

Organic matter of mangrove soils in the sampling sites ranged from 3.0 percent± 0.75 to

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9.85 percent± 0. Highest was observed in Cogon East. There is no specific limit or measurement established for organic matter however based on Olsen et. al., (1954) a measure of more than 1.5% means the soil has improved water and nutrient capacity. Less than one per cent organic carbon reported by Sah *et al*. (1989) and Hossain *et al*. (2012) indicates the poor nutritional conditions of the soils of some mangrove forests.

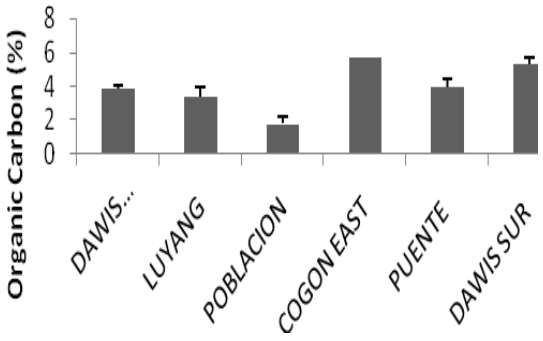

Figure 7. Percent Organic Carbon

Organic Carbon is the carbon deposited in organic matter that binds mineral particles together into micro aggregates and stabilized soil structure. Organic Carbon of mangroves in the study sites ranged from 1.78 percent±0.44 to 5.71 percent ±0.44 with highest observed in Cogon East and lowest in Poblacion. Based on limits established by Olsen et al., (1954) organic carbon concentration of more than 0.75% was interpreted as high in concentration.

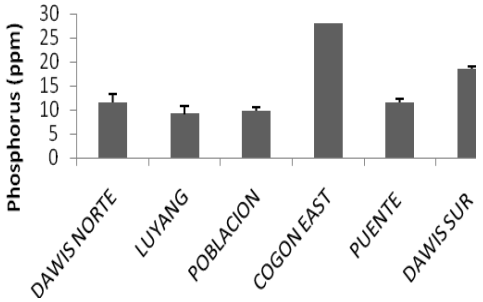

Figure 8. Available Phosphorus (P)

High concentration of Phosphorus was observed in Cogon East with a percentage of 9.8ppm ± 0.7. This might constitute the rapid proliferation of mangrove in this site. This nutrient regulates protein synthesis and other complex energy transformation in plants. It also helps in growth and development of plants. Generally Carmen mangrove soil has medium to high concentration of Phosphorus.

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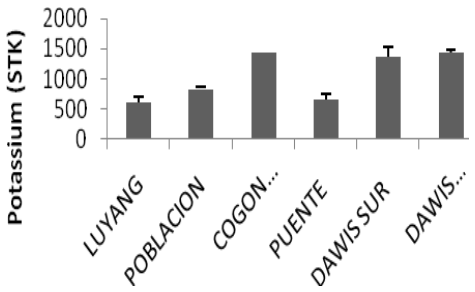

Figure 9. Available Potassium (K)

Available potassium in soil plays major role in the regulation of water in plants. It is known to improve drought resistance. High concentration was observed in Cogon East, Dawis Sur and Dawis Norte with 1425 $\pm$ 0, 1370 $\pm$ 163.45 and 1425 $\pm$ 59 respectively. This bulk concentration exceeds the limit for high concentration of 125.

Through to all sites, mangrove soil has high concentration level of nutrients. In could be inferred that these soil has strong nutrient and water holding capacity improving mangrove vegetations' drought resistance.

CONCLUSION

Generally, mangrove soils of the coastal barangays of Carmen, Cebu are fertile composed mostly of loam soil. Results of the nutrient analyses showed that mangrove soils in the study sites are rich in nutrients favorable for the growth of mangroves. However, it is important to note that high concentration of nutrients could lead to eutrophication and excessive sedimentation rate in Carmen cove and is likely to occur if the mangrove forest in the coastal barangays will be mismanaged. Therefore, continuous protection and management of the mangrove ecosystem is recommended.

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