

Original Research Article

Bioaccumulation Potential of Seagrass (*Halophila* sp.) for Mercury in the Selected Coastal Areas in Malita, Davao Occidental

ABSTRACT

This research aims to determine the potential of seagrass *Halophila* sp. in absorbing mercury in the selected coastal barangays in Malita, Davao Occidental. The study employs a quantitative type of research where strategies focus on quantifying the collection and analysis of data. The study was conducted from October 2020 to December 2021 in the three selected coastal Barangays in Malita, Davao Occidental namely Brgy. Culaman, Brgy. New Argao and Brgy. Tingolo. Transect line quadrat method was used to determine the percent cover and shoot density of seagrass. Using this method, the point of seagrass occurrence up to the outer limit where seagrasses disappears was determined. There were three (3) stations and three (3) transect lines were laid for each station with an interval of 50m. Five (5) quadrats were also laid in the seagrasses along the 50 meter transect line positioned perpendicular to the shoreline. The seagrasses were collected in each quadrat and the samples were transported to Davao Analytical Laboratories, Inc. for mercury analysis. The highest mean percent cover (10.27%), shoot density (128.91 shoots/m²) and Hg accumulation (572.9ppb) was recorded in Brgy. Tingolo, Malita, Davao Occidental while the lowest result was obtained by Brgy. Culaman, Malita, Davao Occidental. *Halophila* sp. has the capability to accumulate mercury content and exceeds the standard level of 20 ppb. There were no significant differences in the percent cover and Hg accumulation of seagrass *Halophila* sp. while significant difference is observed in the shoot density. However, there is a positive relationship (.664) between the shoot density and mercury concentration of *Halophila* sp.

Keywords: Bioaccumulation, seagrass, mercury, Malita

1. INTRODUCTION

Seagrass is a diversified ecosystem that supports a wide range of flora and fauna in seawater. It is the only group of flowering plants or angiosperms that live in temperate and tropical coastal and marine environments (Phang, 2000). Seagrass meadows are important as they provide habitat for fishes and larger vertebrate as feeding, breeding and nursery grounds (Alima et. al., 2014). There are eighteen seagrass species found in the Philippines (Fortes, 2013).

Seagrasses significantly contribute to the oxygenation of the sea and carbon sequestration, resulting in a decrease in the impacts of global warming (Phang, 2000). These aquatic plants have the ability to capture and store a significant quantity of carbon from the atmosphere. And

collect carbon from the water to create their leaves and roots in the same way as trees receive carbon from the air to construct their trunks. Parts of the seagrass plants and accompanying creatures are buried and trapped in the sediments when they die and degrade. It is projected that the world's seagrass meadows may trap up to 83 million metric tons of carbon per year in this manner (Reynolds et al., 2017). However, seagrass condition in the country is declining (Dedel et al, 2018) and threatened globally (Björk et al. 2008).

Seagrasses have a unique metal bioaccumulation capability because they interact directly with both water column and pore water as ionic absorption; hence, the results of the study can represent the entire health of coastal water (Llagostera et al. 2011). Seagrasses, like marine angiosperms, interact with sediments via their roots and rhizomes, as well as with the water column via their leaves (Romero et al., 2005). As a result, heavy metal accumulation and dispersion were discovered not only on the roots, but also on the rhizomes and leaves. Malita, Davao Occidental, features some of the most extensive seagrass meadows in the country, which sustain populations of dugong, turtles, and commercially and historically significant fisheries. However, once pollution levels approach fatal levels, the seagrasses will die off, and this intertidal environment will be gone for good because there is little potential for the ecosystem itself to relocate (Hadley, 2009). The purpose of this research is to find out how effective seagrass is in absorbing mercury in the seagrass meadows of Malita, Davao Occidental. Results of the study could help local governments and communities gain better understanding of seagrass condition and serves as guide in the implementation of coastal resource conservation and management.

2. MATERIAL AND METHODS

2.1 Study Site

This research was conducted in Malita, Davao Occidental. Malita is the capital of Davao Occidental, Philippines, and a first-class municipality. It is divided into 30 barangays. It is the main economic hub of Davao Occidental, with agriculture and fishing being the primary industries. Specifically, Brgy. Culaman (6°24'4"N 125°36'25"E), The towns of New Argao (6°22'33"N 125°36'38"E) and Brgy. Tingolo (6°21'37"N 125°37'25"E) are coastal barangays notable for dugong, sea turtles, and other marine life due to the richness of seagrass ecosystems and coral reefs. Furthermore, livestock and agricultural crops like as banana, coconut, and durian might be found in these coastal areas. The Davao San Miguel power station, commonly known as the Malita power station, is a 628-megawatt (MW) coal-fired power plant located in Brgy. Culaman (Fig 1).



Figure 1. Map of study areas in Malita, Davao Occidental

2.2 Collection of Seagrass Samples

The samples were taken in the subtidal zone of coastal barangays in Malita, Davao Occidental, especially in Bgry. Brgy. Culaman Brgy Tingolo and New Argao. Seagrass species were taken in their whole, including roots, rhizomes, and leaves. The samples were washed with saltwater to remove silt from the roots and rhizomes, as described by Sanchiz et al., (2000). The samples were then placed in clean plastic bags, sealed, and frozen at -20°C before being analyzed. The samples were then delivered to Davao Analytical Laboratories, Inc. in Matina, Davao City, for analysis. Species of seagrass identification The identification of seagrass species was done in the laboratory. Images and a dichotomous key to the species of Philippines Seagrass (Calumpung & Meñez, 1997) were employed.

2.3 Determination of Seagrass Percent Cover and Shoot Density

The transect line quadrat method was employed to assess the percent cover and shoot density of seagrass (Duarte & Kirkman, 2001). First, the point of seagrass occurrence up to the outer limit where seagrasses disappears was determined. Second, the quadrats were placed on the seagrasses along a 50-meter transect line parallel to the coastline. The percent cover of the seagrass species per quadrat was recorded using the categories proposed by Saito and Atobe (1970). The procedure was repeated for each of the quadrat. The criteria in categorizing the percentage cover of seagrass species at the three sample stations is shown in Table 1.

$$C = \frac{\sum M_1 \times F_1}{\sum f}$$

Where:

M1 = midpoint percentage of class (i)

F1 = Frequency (number of sectors with the class dominance)

f = number of frequency of the class

Table 1. Criteria in categorizing the percent cover of seagrass

CLASS	AMOUNT OF PERCENTAGE COVERED	COVERED	MEAN
5	½ to all	50 – 100	75
4	¼ to ½	25–50	37.5
3	1/8 to ¼	12.5 – 25	18.75
2	1/16 to 1/8	6.25 – 12.5	9.38
1	Less than 1/16	<6.25	3.13
0	Absent	0	0

As to seagrass' shoot density, the shoots were counted in each quadrat and the total number of shoots of *Halophila sp.* was recorded. The process was also repeated for each species in the quadrat. The formula given by Odum (1971) was adapted.

Where,

$$Density = \frac{\text{number of shoots of a species}}{\text{area}(m^2)}$$

2.4 Mercury Analysis in Seagrass Sample

As to mercury accumulation analysis, the samples were delivered at Davao Analytical Laboratories, Inc. Matina, Davao City. Cold vapor atomic absorption spectroscopy was used to analyse mercury.

2.5 Physico – Chemical Parameters

Physico – chemical parameters were determined in each sampling sites. Water temperature, salinity and pH were the selected parameters to be monitored in each station.

2.6 Statistical Analyses

Analysis of Variance (ANOVA) was used to determine the significant difference of the percent cover, shoot density and mercury accumulation level of seagrasses in the three sampling stations. Tukey's test was also employed to find out which specific groups' means compared with each other are different. Pearson's correlation coefficient of mercury concentration to the shoot density of seagrass and mercury concentration was determined using Statistical Package for the Social Science (SPSS version 17).

3. RESULTS AND DISCUSSION

3.1 Percent Cover of Seagrass *Halophila sp*

Seagrass *Halophila sp.* showed the highest mean percent cover of seagrass (10.27%) in Brgy. Tingolo, followed by Brgy. New Argao (7.84%) while Brgy. Culaman had the lowest mean percent cover of 5.46% (Fig 2). There was no significant difference ($P = .165$) in the mean percent cover of *Halophila sp.* among sampling stations (Table 2). This result supports the conducted research of Noel et. al (2012) in Davao Gulf, wherein *Halophila* species obtained high mean percentage of 31.67% along New Argao. Moreover, *Halophila sp.* is a common seagrass in tropical and moderate temperate environments, where it can be found in pure stands (Kou & Den Hartog, 2001).

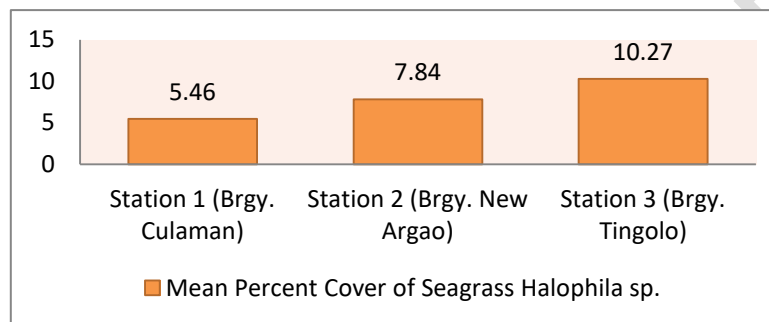


Figure 2. Mean Percent cover of Seagrass *Halophila sp.*

3.2 Shoot Density of *Halophila sp.*

Figure 3 shows that Brgy. Tingolo also got the highest mean shoot density of *Halophila sp.* with the number of 128.91 shoots/m² while the least value obtained by Brgy. Culaman with 45.13 shoots/m². The occurrence of *Halophila* species is favorable for the dugongs which are constantly seen in the area (Lucero, 2010). However, there was significant difference in the shoot density of *Halophila sp.* among sampling stations ($P = .006$) (Table 2). *Halophila sp.* density is also influenced by the type of substrate conditions, seasons, tides, wave energy strength, the content of organic matter in the sediment and other environmental factors same with other seagrass species (Short and Coles, 2001).

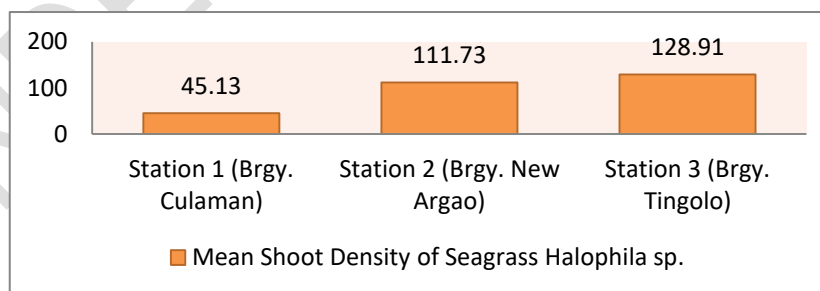


Figure 3. Mean Shoot Density of *Halophila sp.*

3.3 Mercury Analysis

Mercury poisoning has become a present concern as a result of worldwide environmental contamination, and its concentrations in plant stems and leaves are always higher when the metal is introduced in organic form (Patra et. al., 2000) and the amount of mercury accumulated in the plants should not exceed 20 ng/g (Guédron et.al., 2013). Figure 4 shows that the highest mercury accumulation in *Halophila sp.* is recorded in Brgy. Tingolo (572.9 ppb). It is also observed that Brgy. Culaman obtained the lowest concentration of mercury (19.13) ppb, however there were no significant differences in the levels of mercury (Table 2) among sampling stations ($P = 0.566$). This result confirms the preliminary study on the potential of seagrass *H. ovalis* in absorbing mercury where accumulation was also observed high in Brgy. Tingolo (41.9 ppb) (Tuba & Avenido, 2018). Mercury is most likely prevalent in the study area due to nearby coal-fired power plant operation (Ahmad, 2014). Mercury is a volatile metal that evaporates into the atmosphere via gases in incinerators then eliminated from the air by wet deposition and deposited in aquatic ecosystems before being methylated (Balogh & Nollet, 2008). Moreover, there was a positive large uphill relationship (.664) between mercury accumulation and shoot density of seagrass *Halophila sp.* (Table 3).

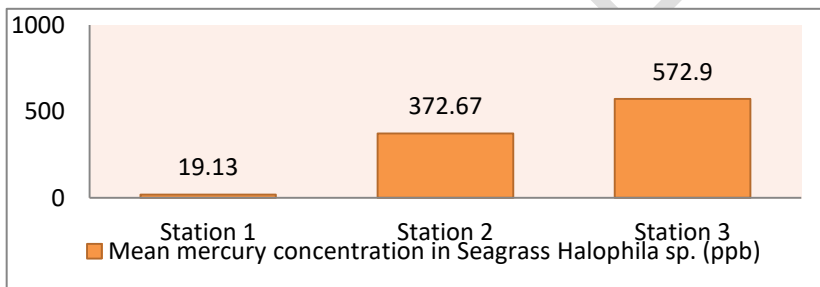


Figure 4. Mean Hg concentration in seagrass *Halophila sp.*

Table 2. Analysis of Variance for percent cover, mean shoot density and Hg concentration

Particulars		Sum of Squares	df	Mean Square	F	Sig.
Pcover	Between Groups	34.695	2	17.348	2.172	.195
	Within Groups	47.917	6	7.986		
	Total	82.612	8			
SDensity	Between Groups	12084.939	2	6042.470	13.314	.006
	Within Groups	2723.074	6	453.846		
	Total	14808.013	8			
HgCon	Between	55854.082	2	27927.041	.627	.566

Groups			
Within	267364.60	6	44560.767
Groups	0		
Total	323218.68	8	
	2		

Table 3. Pearson's r Correlation Test

Particulars	SDensity	HgCon
Pearson Correlation	1	.644
Sig. (2-tailed)		.061
N	9	9
Pearson Correlation	.644	1
Sig. (2-tailed)	.061	
N	9	9

3.4 Physico-chemical Parameters

During the conduct of the study, water temperature, pH and salinity were determined per transect. The mean results of the physico – chemical parameters for each station were observed to be at its normal level (Table 4).

3.4.1 Temperature

In this study, water temperature from different sampling sites ranged from 30 °C – 35 °C.

3.4.2 pH

The highest mean pH level was obtained in station 3 (7.86 ppm) followed by 7.04 ppm in station 1 whereas the lowest values was observed in station 2 of 7.02 ppm.

3.4.3 Salinity

The salinity of the seawater is normally 35 parts per thousand in most marine areas. In the study sites, water salinity varies from 34-35 ppt.

Table 4. Physico-chemical parameters in the study area

Parameters	Station 1	Station 2	Station 3
Temperature	35 °C	34 °C	30 °C
pH	7.02 ppm	7.04 ppm	7.86 ppm
Salinity	35ppt	34ppt	35ppt

4. CONCLUSION

The highest mean percent cover (10.27%), shoot density (128.91 shoots/m²) and Hg accumulation (572.9ppb) was obtained by Brgy. Tingolo, Malita, Davao Occidental. These signify that *Halophila* sp. has the capability to accumulate mercury content and exceeds the standard level of 20 ppb. There were no significant differences in the percent cover and Hg

accumulation of seagrass *Halophila* sp. while significant difference is observed in the shoot density. However, there is a positive relationship between the shoot density and mercury concentration of *Halophila* sp. Physico-chemical parameter results were in normal condition. Furthermore, determination of other heavy metals accumulation in seagrass is recommended as well as conducting preliminary study on the bioaccumulation potential of seawater and sediment for heavy metals.

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