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# Correlation between water quality and seagrass distribution along intertidal zone in Sarangani Province, Philippines

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**Key words:** Pearson's correlation, Salinity, pH, Turbidity, Temperature.

**Abstract**

This study aimed to determine the correlation between certain properties of water quality and the distribution of seagrasses in the coastal areas of Glan and Maasim, Sarangani Province. Both sites have no previous correlation studies. At each site, three 50m transects were laid perpendicular to the shore with each transect having 11 quadrats at 5m intervals. Six species of seagrass were identified throughout the study. The most dominant species in Glan was *Halodule pinifolia* while in Maasim, the most dominant was *Enhalus acoroides*. Water samples were taken in each quadrat using vials. Salinity was measured using Atago refractometer. Temperature and pH were simultaneously measured using a HM Digital pH meter. Turbidity was observed visually. Correlation was analyzed using the statistic tool Pearson's correlation through PAST software. The correlation analysis in Glan yielded a negative correlation of -0.99915 between salinity and seagrass distribution, implying an unhealthy fluctuation of salinity in the area which can harm seagrass. pH resulted in 0.99916 and temperature in 0.76758. In Maasim, the analysis yielded positive correlations in all physicochemical properties. 0.4342 for pH, 0.4342 for temperature, and 0.93193 for salinity. Overall, the results indicate generally healthy seagrass beds which means they are in a generally healthy marine environment. Researchers strongly recommend a more extensive study on the correlation of physicochemical properties with seagrasses along Sarangani Bay.

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## Introduction

Seagrasses are marine flowering plants widely distributed along temperate and tropical coastlines of the world (Short *et al*, 2007) that evolved from terrestrial plants. They are classified into four unrelated families of 50 to 60 species. Philippines is the second highest in seagrass diversity in the whole world, Australia being the first. Nineteen species or about fifty-five percent of the number of East Asian species can be found in the Philippines, seven of which are in Ulugan Bay, Palawan.

Seagrass communities are considered the most important shallow marine ecosystems to humans (Green *et al*, 2003). In fact, people have utilized seagrasses for over 10,000 years now. Potentially, they can be used as bio-filters for sewage, coastal stabilizers, for paper manufacturing, as source of useful chemical fertilizer and fodder, and even as food and medicine for people (Fortes, 1990). Aside from these, seagrasses play key ecological roles in coastal ecosystems. They also form extensive meadows that can support high biodiversity. Also, seagrass productivity is as high as the best agricultural crops (Fortes, 1990). They are an important food source for many marine animals such as sea cows (dugong) and sea turtles (Green *et al*, 2003). They also serve as habitats and nurseries of many invertebrates, fishes, and mammals. Seagrasses also contribute to the stabilizaton of the ocean bottom, like how grasses stabilize the soil to prevent soil erosion. They also improve water quality by trapping fine sediments in the water (Green *et al*, 2003).

One of the great importance of seagrass communities is their being useful indicators of environmental health as they are generally susceptible to changes in water quality and environmental quality and they respond in a manner that allows them to be measured and monitored. The vital factors for maintaining seagrass community health are sediment quality and depth, water quality (temperature, salinity, clarity), current and hydrodynamic processes, and species interactions (McKenzie, 2007). This study aimed to assess the health of the marine environment along Sarangani Bay through the assessment of the health of its seagrass communities by determining the correlation or association between water quality and the seagrass distribution or cover.

## Material and methods

### *Study sites*

The study was conducted on the first two weeks of November 2015 in two sites: 1) Morales Beach, Binoni, Glan, Sarangani Province, Philippines and 2) Susan's Beach, Tinoto, Maasim, Sarangani Province, Philippines located between 05◦46'66.1"N and 125◦11'17.2"E, and 05◦52'43.79" and 125◦05'04.58", respectively. The areas, shown in Figure 1, are popular sites of study among seagrass researchers due to their abundance and diversity in these areas.

### *Establishment of sampling sites*

At each site, three 50 m (perpendicular to the shore) transects were laid. Each transect was distanced 25 m from another. Eleven 1m × 1m quadrats were laid in every five meters of each transect.

### *Assessment of water quality*

Water samples were collected in each quadrat in each transect using a vial. Salinity was measured using an Atago refractometer. Temperature and pH were simultaneously measured using HM Digital pH meter. Turbidity was visually observed.

### *Estimation of seagrass percent cover and identification of seagrass species*

Seagrass percent cover was estimated and species were identified using a guide provided by the Environment Conservation and Protection Center Alabel. The percent cover of each species identified in situ in each quadrat was also estimated using the same guide. Other organisms such as macroalgae, sea cucumbers, molluscs, and et cetera found in the quadrats were also noted. Photographs were taken using a digital camera, Nikon CoolPix AW130, for documentation.

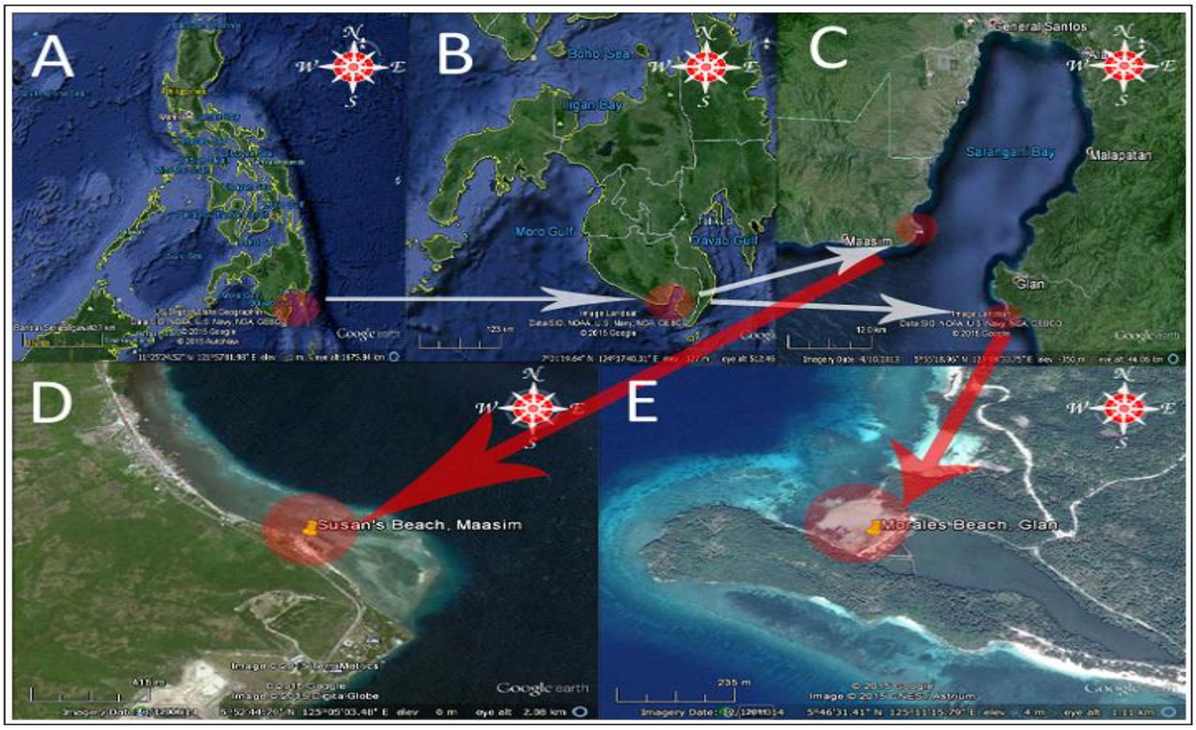


**Fig. 1.** Location of study sites Morales Beach, Benoni, Glan and Susan's Beach, Tinoto, Maasim, Sarangani Province, Philippines. (Fig. 1A. Philippines; Fig. 1B. Mindanao; Fig. 1C. Sarangani Bay; Fig. 1D. Susan's Beach, Maasim; Fig. 1E. Morales Beach, Glan).

*Correlation analysis*

The correlation between water quality and the distribution of seagrasses was analysed using the statistical tool Pearson's correlation through the PAST software.

## Results and discussion

Table 1 shows the results of the assessment of the water quality and Table 2 shows the average percent cover of seagrasses in Glan and Maasim.

Results of the assessment of the water quality show values that fall within the range of the standard values provided by the DENR Region XII. Seagrasses can tolerate considerable short-term salinity fluctuations. Although seagrasses may tolerate lowered salinities, the photosynthetic rate in seagrasses is affected by changes in salinity. A decrease in salinity carries a corresponding decrease in the photosynthetic rate (Thomas *et al*, 1961). Glan and Maasim are both in an optimum salinity range thus the presence of seagrasses in these areas.

Turbidity has always been found to affect seagrasses. Elevated turbidity limits light from reaching the leaves for photosynthetic processes which will decrease seagrass productivity. In addition, the decline of seagrass populations during increased turbidity event can also be explained by the shedding of old shoots (resulting in reduced percentage cover) (Ahmad-Kamil *et al*, 2013).

Maasim has very clear waters and thus has higher seagrass percent cover than Glan which had waters with many suspended solids. Factors that may have contributed to this increase in turbidity are siltation (de Jesus *et al*, 2001) and algal bloom.

pH also affects seagrass photosynthesis. Lowered seawater pH will increase seagrass production. Maasim with pH of 6.4 had an average percent cover of 25.15% and Glan with pH of 7.9 had an average percent cover of 16.12%. Maasim has far lower pH compared to Glan and thus has far greater cover of seagrass.

**Table 1.** Physicochemical properties (average) of intertidal zone in Glan (Morales Beach) and Maasim (Susan's Beach), Sarangani Province.

| Physicochemical Property | Results | | DENR Region XII Standard |
|---|---|---|---|
| | Glan | Maasim | |
| pH | 7.9 | 6.4 | 6.0-8.5 |
| Temperature | 31.3◦C | 31.9◦C | Maximum rise of 3◦C |
| Turbidity | Clear but with many suspended particles | Very clear; very few suspended particles | |
| Salinity | 35 ppt | 38 ppt | |

**Table 2.** Seagrass average percent cover in Glan (Morales Beach) and Maasim (Susan's Beach), Sarangani Province. T = transect (consists 11 quadrats).

| Sampling Site | T1 | T2 | T3 | Average percent cover |
|---|---|---|---|---|
| Glan | 39.5% | 3.6% | 5.27% | 16.12% |
| Maasim | 23.18% | 23.63% | 28.63% | 25.15% |

The result of this study that Maasim has greater seagrass cover than Glan is in harmony with the results of a recent study regarding the abundance of seagrasses in these coastal areas (Alima *et al*, 2014). However, Glan showed greater diversity. There was a greater number of species identified in Glan compared to the number of those in Maasim. The total of 6 species identified in both sites are listed in Table 3, including those identified outside the transects. In the sampling site in Glan, the most dominant species was *Halodule pinifolia*, followed by *Cymodocea rotundata*. In Maasim, *Enhalus acoroides* was the most dominant, followed by *Cymodocea rotundata*.

**Table 3.** Species of seagrass identified in Glan and Maasim.

| | Glan | Maasim |
|---|---|---|
| Family *Cymodoceaceae* | | |
| *Cymodocea rotundata* | ✓ | ✓ |
| *Halodule pinifolia* | ✓ | ✓ |
| *Halodule uninervis* | ✓ | |
| *Thalassodendron ciliatum* | ✓* | |
| Family *Hydrocharitaceae* | | |
| *Enhalus acoroides* | ✓* | ✓ |
| *Halophila ovalis* | ✓* | |

*species identified outside transects.

**Table 4.** Correlation (Pearson) between seagrass cover and physicochemical properties in Morales Beach, Glan.

| Glan | pH | Temperature | Salinity |
|---|---|---|---|
| Seagrass Cover | 0.99916 | 0.76758 | -0.99915 |

Tables 4 and 5 show the results of Pearson's correlation analyses on the data gathered in each study site. A Pearson's correlation coefficient above 0.25 indicates significance. Pearson coefficient values nearer 1 indicate greater significance. Positive values indicate increase in both variables, whereas negative values show decrease in one variable while the other increases.

**Table 5.** Correlation (Pearson) between seagrass cover in Susan's Beach Maasim and physicochemical properties.

| Maasim | pH | Temperature | Salinity |
|---|---|---|---|
| Seagrass Cover | 0.4342 | 0.4342 | 0.93193 |

Table 4 shows the results of Pearson's correlation analysis for the data gathered in Glan. All physicochemical properties included in this study showed significant correlation with the presence and distribution of seagrasses. However, there is a negative correlation between salinity and the distribution of seagrasses. This result implies unhealthy fluctuations of salinity which can harm seagrasses. One factor that the researches have observed to possibly contribute to unhealthy fluctuations in salinity is a large basin of mostly fresh water but mixed with saline water only approximately 50 m away from the shore.

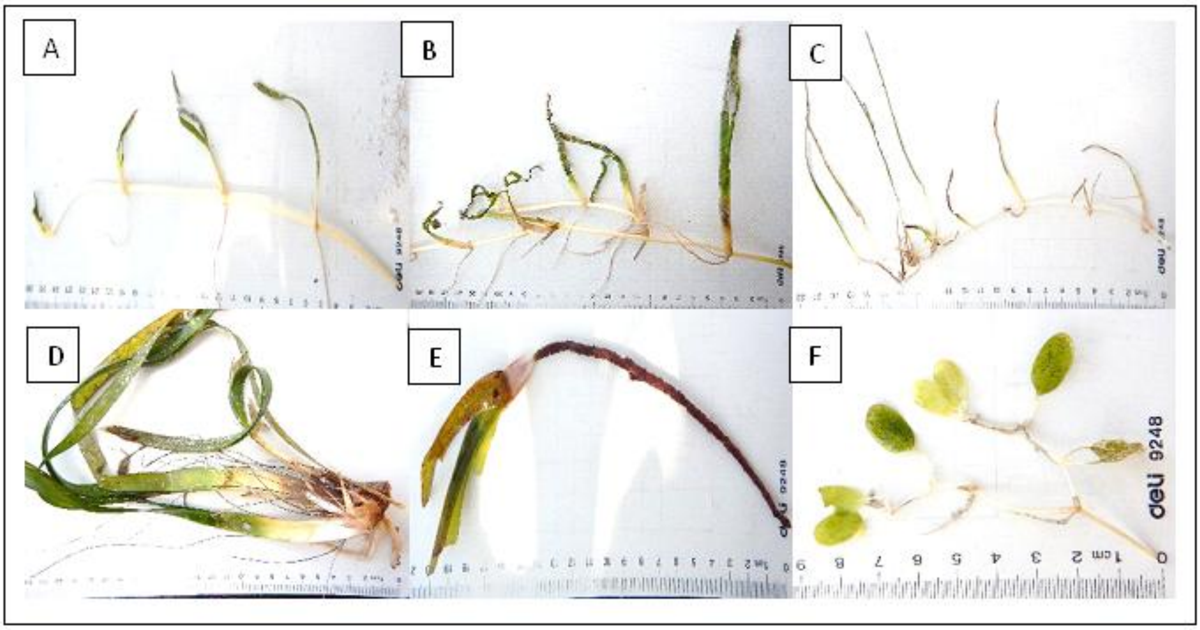


**Fig. 2.** Photos of actual seagrass species collected. (Fig. 2A. *Cymodocea rotundata*; Fig. 2B. *Halodule uninervis*; Fig. 2C. *Halodule pinifolia*; Fig. 2D. *Enhalus acoroides*; Fig. 2E. *Thalassodendron ciliatum*; Fig. 2F. *Halophila ovalis*.).

Table 5 shows the correlation analysis results for the data gathered in Maasim. All physicochemical properties also showed significant correlation with seagrass distribution. However, compared to Glan, pH and temperature are less significantly correlated and salinity is positively correlated with the distribution of seagrasses.

## Conclusion

In this study, the results of the correlation analyses showed a healthy, dynamic association between seagrass species found in the study areas and the physicochemical properties: salinity, pH, temperature, and turbidity. This indicates generally healthy seagrass beds and thus a generally healthy marine environment.

## Recommendations

The researchers strongly recommend a more extensive study on the correlation of physicochemical properties with seagrasses along Sarangani Bay, as well as nutrient supply and substrate type and a study of the interactions between light availability and wave action and how these interactions affect seagrass distribution.

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