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Assessment on the seagrass cover in Cabucan Island Hadji Panglima Tahil, Sulu Philippines

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Abstract

The importance of seagrasses for the sustainability of the fisheries resources to ensure food security, cannot be discounted. It played an important role in the marine ecosystem due to their productivity level that benefits any organism in the marine ecosystem. An assessment on the seagrass cover is essential to provide a baseline data for the conservation and protection of this ecosystem to maintain sustainability of this resources. The study investigated the status of seagrasses using three transect lines and ocular inspection. Three species of seagrass were identified on the area, namely *Enhalus acoroides, Thallasia hemprichii* and *Thallasia testudinum*. The condition of the seagrass beds were determined and identified to be generally under good condition, 51-75% coverage. Results showed that sediment nutrient availability, water flow and water level were significantly associated to the abundance of the seagrasses. The observed activities like blast fishing and placement of seagrass meadows into seaweeds farm threaten the seagrass ecosystems of the area. Thus, the importance of seagrass should not be overlooked in implementing policies, management and conservation in the area.

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Introduction

Seagrasses are marine flowering plants which grow in salty and brackish waters (Reynolds *et al.*, 2016) which are commonly found in shallow coastal marine locations, salt-marshes and estuaries. In the tropics they are often found associated with mangroves and often grown on soft sand or mud.

These marine flora play a vital part of the marine ecosystem due to their productivity level which can benefit any organism in the marine ecosystem (Heck and Valentine, 2006). Accordingly, seagrasses stabilize the sea bottom, provide food and habitat for other marine organims, maintain water quality and support local economies (Jackson *et al.*, 2001). Furthermore, seagrasses provide material for the detrital food chain and act in the nutrient cycling and primarily help in reducing the amount of carbon dioxide in the atmosphere and some species of seagrasses provide a habitat for juvenile fishes and shellfish, thus, providing essential habitat for fisheries (Duffy, 2006, Bostrom *et al.*, 2006).

However, even if they are crucial in maintaining the balance and sustainability of our environment and played a key ecological role in coastal ecosystem (Short *et al.,* 2007) their population had been greatly endangered. Many seagrass beds were left exposed to different threats that could potentially harm their population. They were also challenged with rapid environmental changes resulted from coastal human population pressures (Short *et al*, 2011; Orth *et al,* 2006, Duarte, 2002), coastal recreational activities, over exploitaion, overgrazing, and invasive species.

In the Philippines, coastal resources act as the main source of food products. However, less data were available on the diversity and richness of the seagrass ecosystem that maintained and sustained these resources. Specially in the Sulu archipelago, which are both limit for the Sulu (Southern) and Celebes Sea (Northern). Hence this paper was conceptualized, aiming to assess the seagrass species and cover in Cabucan Island Hadji Panglima Tahil, Sulu, Philippines. This study would provide a baseline data on the diversity of seagrass species in the area. This study would also seek information on the different activities that would likely threaten the seagrass beds in the area as well as activities that preserved, conserved and protected this ecosystem.

Materials and methods

Study area

The study was conducted in the coastal zone of Cabucan Island in the Municipality of Hadji Panglima Tahil, Sulu (6°10'5"N 120°58'27"E) Autonomous Region in Muslim (ARMM) Mindanao, Philippines (Fig. 1). The estimated terrain elevation above sea level is 1 meter (Google Map) and the sampling site is considered to be a catching area for the common fisher folks in the area and even from other neighboring municipalities like Jolo and Indanan.

Fig.1. Map showing the study.

Fig.2. Actual photo of the seagrass cover.

Methodology

A wide area survey was conducted through ocular inspection from a boat to determine the general distribution of the sea grasses as well as other species of aquatic flora and fauna. The observed flora and fauna were determined and identified with the help of the local fishermen and some were brought to the laboratory for further identification. Moreover, to further understand the common practices used in fishing, personal interviews were conducted to fishermen and local residence. There were three stations established in the study. Identification and selection of the areas were based on three criteria to wit: close proximity to human settlements, area accessibility and safety. Transect lines and quadrats were used at three different stations to assess the percentage cover of the seagrass in the area. Three transect line were laid at each sampling station at points where the habitat starts and ends with a distance of 5 meters between each transect. There were five quadrats measuring 50cm x 50cm set in every 5 meters in each transect and these served as representative samples. The quadrats were divided into squares for easy percentage estimation and data were analyzed by computing the average percentage cover of each transect by dividing the total number of species per transect by the number of quadrats. The averages from each transect were added and divided by the totals of the averages of each component by the number of transects in the survey. The condition of the seagrass beds were determined using the criteria set by Fortes (1989) as stated, excellent (76-100% coverage); good (51-75% coverage); fair (26-50% coverage) and poor (0-25% coverage).

Physico-chemical Analysis

Physico-chemical parameters were evaluated in each sampling station to correlate with the distribution and abundance of seagrass in the area. Standard protocols were observed in performing all the physico-chemical analysis.

Salinity

A Portable Refractometer (ATAGO-S10) was used to determine the salt content of the water and was read in parts per thousand (ppt). Sufficient amount of water sample was placed on the window of the device and was covered immediately before getting the final reading. Table 2 showed the averaged salinity level in each station.

Temperature and pH

A pH meter (Tester 30, waterproof pH and Temperature Tester Doubles Junction) was used in determining the pH and temperature of the seawater in different sampling stations. The device probe was dipped in the water surface for one minute and the following average results were obtained.

Table 1. Temperature and pH level result of the sampling stations.

Station	Temperature	pH
Station 1	29	8.125
Station 2	29.16	8.14
Station 3	29.14	8.08

Table 2. Salinity level of the sampling stations.

Station	Salinity (ppt)
Station 1	35.75
Station 2	36.25
Station 3	35.5

Total Suspended Solids

Analysis of TSS was partially done on the sampling site with the help of a wattman filter paper and were analyzed in situ. The filters that were used in the study were ordinary filters which had been oven dried for 1 hour at 100 to 105 °C and pre-weighed prior to the filtration of water samples. One (1) Liter of seawater samples was taken and the pre-weighed filter papers were used. The used filters were wrapped in Aluminum foil to avoid contamination and oven dried for 1 hour at 100 to 105°C. The difference of the final weight of the filter paper and its initial weight was divided to 1.025g/L, the average weight of seawater, and then multiplied to 100 to get the Total Suspended Solids (TSS).Three triplicates were done in each station to verify the result of the test. Table 3 showed the average result of the TSS in each station.

Table 3. Total Suspended Solids.

Station	Total Suspended Solid
Station 1	172.2
Station 2	147.2
Station 3	142

Sediment Grain size Analysis

Sediment grain size analysis was also taken from the samples of sediments from the sampling sites. Percentage of sand, silt and clay were determined using sieve analysis for sand percentage and pipetting method for silt-clay particle size. The average result was summarized in table 4.

Table 4. Sediment Grain Size per station.

Station	Sediment Grain Size	
	Sand (%)	Silt (%)
Station 1	95.89	4.11
Station 2	83.51	16.49
Station 3	85.93	14.07

Water level and Water flow

Water level was constantly measured at different sampling sites and water flow was estimated using clod cards. Clod cards were prepared according to the general instructions of Doty (1971). Calculation of water flow (cm-2) was done following the method of Anzai (2001). Data were presented as means ±SD of at least eight independent measurements.

Data Analysis

Statistical analysis was determined by Univariate Analysis of Variance. Pearson's correlation analysis was used to determine the correlation coefficients between environmental factors with seagrass cover.

Results and discussion

Seagrass played an important role in the livelihood and daily consumption of the locals in the area and even through other neighboring municipalities. It supported and played a vital role in coastal marine communities by enhancing the diversity of flora and fauna in the area.

The shoreline of the Cabucan Island is covered by widespread intertidal and subtidal *Enhalus acoroides* dominated seagrass meadows, while other seagrass species like *Thallasia testudinum* was also observed.

The surveyed seagrass communities were characterized and assessed by both continuous and patchy cover and meadows with had a cover ranging from 75% to 64% (Fig. 3). Survey results showed that the study area have a percent seagrass cover of 70% along the shoreline and also into its center. The condition of the seagrass beds were determined using the criteria set by Fortes (1989), and identified to be generally under good condition, 51-75% coverage. The result can be explained by the location of the area which is a far from the local communities of Sulu and experience minimal disturbances from human activities.

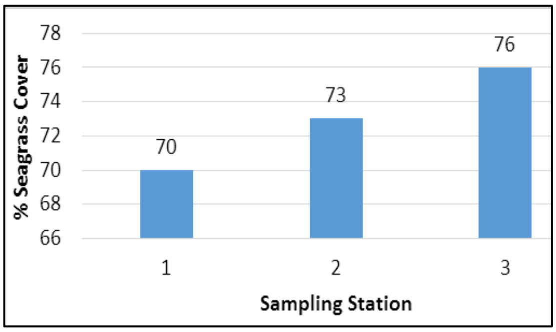

Fig. 3. Seagrass cover per station.

During the assessment, 3 species of seagrasses were identified, namely *Enhalus acoroides, Thallasia hemprichii* and *Thallasia testudinum* (Fig. 4). The existence of seagrass species ranged from a monospecific *E. acoroides* meadows to a two (2) species mixed communities. It was observed that species of *E. acoroides, T. hemprichii* and *T. testudinum* generally co-exist on a seagrass community.

Monospecific *E. acoroides* bed was observed in most of transect and in the study area (Fig. 2). This homogeneity is a result of, or at least promoted by a relatively high sedimentation brought about by allochthonous inputs from the adjacent mangrove community as well as from the opening up directly to the seagrass bed. The large, slow-growing *E. acoroides* is a climax species (Duarte, 1991) that has been demonstrated to be resilient to light reduction and enhanced sedimentation (Vermaat *et al.,* 1995). The pervasive co-occurrence of these two seagrass species compliments each other in such a way that *E. acoroides* was a climax species, while *T. testudinum* was pioneering. *E. acoroides* occupy space more permanently, and accumulate and retain resources for extended periods of time, while *T. testudinum* was best equipped to colonize new areas through rhizome expansion, or to wander from gap to gap within established beds (Vermaat *et al.,* 1995). This interaction between two species of seagrasses helped promoted the safeguard and balance of its ecosystem.

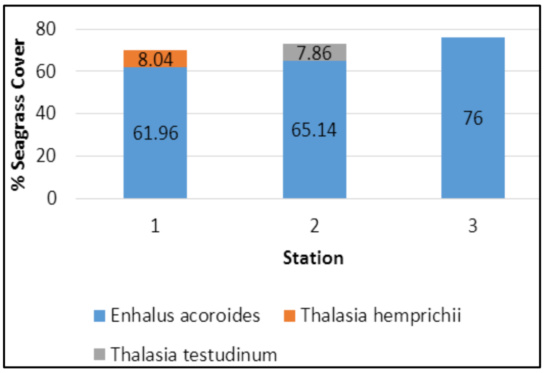

Fig. 4. Relative densities% of the 2 seagrass species.

The survival of the seagrass as well as their growth and production depends or influenced by lot of factors like, sediment nutrient availability, water flow, temperature, pH and salinity (Short *et al.*, 2011, Duarte, 1991, Masini, 1995, Short and Duarte, 2001, Walker and McComb, 1990).

Determination of Temperature and pH showed a constant result from all sampling stations. It was identified that temperature ranges from 29, 29.16, and 29.14 respective of each sampling station which showed no significant variation. This result is within the normal range of temperature especially it is located in the shallow water of the island and within the pacific region (Amad-Kamil *et al.*, 2013). The pH also was under normal condition with a value of 8.125, 8.14 and 8.08 respectively as shown in table 1.

Water salinity ranges between 35.5 to 36.25 ppt which falls within the preferred condition by the seagrass present in the area (Table 2). The slightly elevated salinity of water might be due to the high concentration of organic matter in the sediments attributed from the leaves of mangrove trees and seagrasses (Amad-Kamil et.al., 2013). Furthermore, considering that the area is far from the main island with no presence of freshwater bodies such as streams, these are some factors that contributed to the increase of water salinity. Data on seagrass distribution (Den Hartlog, 2003) have shown that seagrass meadows are absent in high-salinity bodies of water and in portions of estuaries were salinities fall below 16 ppt. The substrate properties of the area were also determined (Table 4). The results showed that the substrate is more likely sandy in nature. This is due to the fact that the study area is located in the island and far from the mainland where siltation occurred.

The amount of total suspended solids (TSS) were also determined (Table 3). It was also an indirect way for measuring the amount of nutrients available on the area. The result showed that amount of TSS differs from each station that also have a negative correlation with its seagrass cover (Table 6). Light and TSS were considered to be critical factors affecting seagrass distribution (Holland *et al*., 2013). It was observed that the occurrence of the seagrass cover decreases as TSS increases. It may be due to the decrease of light that affect the seagrass productivity and abundance.

Table 5. Water level and water flow in each sampling station.

Station	Water level (cm)	Water flow (cm/s)
Station 1	66.625	10.58
Station 2	77.29	9.45
Station 3	85	8.77

Table 6. Correlation coefficient between abundance and significant physico-chemical variables.

	Abundance	Water level	Water flow	TSS
Abundance	1			
Water level	0.995717	1		
Water flow	-0.98985	-0.99875	1	
TSS	-0.93524	0.96396	0.976051	1

Other significant variables that highly affect the seagrass abundance and cover are the water level and water flow. It has been observed that water level has a positive correlation with the abundance of seagrass while the water flow exhibited a negative correlation.

As the percent cover increases it reduces the flow of water in the area thus conforming to the correlation value (Table 6). Some other variables such as water pH, temperature and salinity did not show any significant correlation with other variables including the abundance of seagrass.

The zonation of seagrass species with respect to depth was most likely driven by their competitive requirements for light and nutrients (Den Hartlog, 2003, Masini *et al*., 1995). The abundant presence of climax species such as *E. acoroides* along the depth gradient an indication, not only of the stability of the seagrass beds, but of their morphological advantage to thrive without significant interference from the other seagrass species. While, *T. testudinum*, which was similarly small in sized, was best adapted near shore, as compensation for its relatively lower elongation rates (Vermaat *et. al*., 1995).

Subsequently Cabucan Island was adjacent to the main island of Jolo which was the main municipality of the province of Sulu, and on the coast north of the island was Sulu Sea. The coastline was fringed by intertidal and subtidal seagrass meadows connecting mangrove and coral ecosystems. The seagrass ecosystem support extensive subsistence fisheries that harvested lots of marine resources from invertebrates, fishes and even macro algae. Table 7 below showed the observed flora and fauna during the survey.

Table 7. Observed flora and fauna during the transect survey.

Flora		Fauna	
Scientific name	Common name	Scientific name	Common name
Enhalus acoroides	Broadblade seagrass	*Cassiopea frondosa*	Upside-down jelly
Thalasia testudinum	Turtle grass	*Diadema antillarum*	Long-spine urchin
Thalasia hemprichii		*Protoreaster nodosus*	Chocolate Chip sea star
Caulerpa racemosa	Sea grapes	*Echinus esculentus*	Common Sea urchin
Eucheuma denticulatum	Gelatinae		
Chlorodesmis fastigiata	Hair Algae		

Key informants interview revealed that seagrass meadows in Cabucan Island were fished using traps, spears, fishing bait, lines and even explosives (dynamite fishing) that involved variety of fish species eaten by locals. While expensive and more valuable shells and reef fishes were commonly sold to the main island of Jolo and even distributed to other city like Zamboanga City. Table 8 shows the list of the fishes that were usually caught in the area. It was also notified by the local residence that seagrass areas were also being used for the placement of seaweed farms. Seagrass were not only used by the locals as a ground for extracting marine resources, but also some of the species of seagrass were used as a herbal for treating paralyses, specifically the root part of the seagrass. In fact according to Newmaster *et al.* (2011), recent research on seagrass phyochemistry has shown that they are an important source of antioxidants, antibacterial agents, minerals and possibly anticancer compounds.

Table 8. List of fishes that were usually caught in the seagrass area of Cabucan Island.

Scientific name	Common name	Local name
Lethrinus lentjan	Emperor Fish	Kutambak
Siganus javus	Rabbit fish	Danggit
Leiopotherapon plumbeus	Silver perch	Bomg
Family Scaridae	Parrot fish	Bukaan
Epinephelus fuscoguttatus	Brown Marbled Grouper	Kulapu Kubing
Plectropomus leopardus	Red Grouper	Kulapu
Cephalopholis miniata	Coral Hind	Kulapu

There was no proper implementation of activities by the government or other agencies to protect seagrass on their area. This can be manifested by the unsustainable practices of the people that can greatly affect and destroyed the abundance of seagrasses. Most of the intervention activities on the area were focused on enhancing their livelihood and way of living.

Conclusion

Assessment of seagrass beds in Cabucan Island Hadji Panglima Tahil, Sulu, showed a multi-specific but mostly dominated by *E. acoroides* meadows that were sparse to moderate in cover. Seagrass cover observed in the area was in good condition (70%), and was comparable to other seagrass beds surveyed in other sites in the country. The observed activities like blast fishing and placement of seagrass meadows into seaweeds farm pose the greatest threat to the seagrass ecosystems of the area. Seagrass meadows were one of the most frequent fishing sites in the area having an advantage in terms of access, saving energy, time, fuel and also stability in catches.

Therefore, the importance of seagrass should not be overlooked in implementing policies, management and conservation.

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