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Growth And Survival of Sea Hare (*Dolabella auricularia*) Fed with Seaweeds under Cage Condition in Guang-Guang, Mati City, Davao Oriental

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Abstract

Growth and survival of sea hare (*Dolabella auricularia*) fed with seaweeds under cage condition in Guang-guang, Mati, Davao Oriental was studied through measuring the weight of 120 samples which ranged from 50-120 for three months (November 2006-January 2007). cages were set-up using (RCBD) Random Complete Block Design, four treatments with three replications, T1 control (no feeding), T2 feed with green algae (*Caulerpa racemosa*), T3 fed with brown algae (*Sargassum polycystum*), and T4 fed with red algae (*Gracilaria* sp.). Feeding was done weekly, and weight measurement was done every two weeks. Environmental parameters such as water temperature, pH, salinity, turbidity were also determined every two weeks. Growth was measured by calculating the variance (S^2). Survival was determined by actual count of every individual. Data showed that growth of sea hare in T4 exhibited faster growth (0.28 gram per day fed with red algae *Gracilaria* sp.) compared to other treatments. Survival of sea hare ranged from 80%-86%. Average mean temperature ranged from 31.89 °C-31.28 °C, salinity ranged from 33.42-33.83 ppt, pH ranged from 7.93-7.95, and turbidity of water is very clear. During gut analysis, there were undigested part of algae found in T4 and T2 specimens, while in T1 and 13 specimens no remains of algae was found.

Keywords: Salinity, Seaweeds, Specimen, Treatment, Turbidity

Introduction

Sea hare (*Dolabella auricularia*) is a kind of sea slug that vaguely resembles a sitting hare. Sea hare is a soft bodied animal. With two car-like extensions called tentacles with the eyes at the base. They are defenseless, move like slugs not like hares. Sea hare releases chemical stuffs to the predators as their defense mechanism. Those chemicals are from the algae they ate. Sea hares usually graze on seaweeds. They prefer red and green algae (Rudman, 1999). Sea hare lay eggs the so-called “lukot” or egg strings. Which is cosidered and its egg to be a great delicacy. The egg strings are known for its high protein content.

Mati coastal areas have abundantly distributed sea hare resources. People nearby these areas are fond of gleaning sea hares and its egg strings. Egg strings are sold to the market as

their additional income. Over collection of sea hares can cause mass depletion of the species and production of egg string will become lesser. Nowadays, a threat on sea hare resources depletion is one of the issues that should be restrained. Department of Environment of Natural Resources (DENR) personnel strictly prohibits the fishermen in gleaning sea hares.

However, mariculture is another resolution to the threatened depletion of sea hares. This was introduced to cultivate marine organisms under controlled conditions, which are then harvested and sold. Mariculture of sea hare aimed to differentiate the different growth of sea hares fed with different types of seaweeds and to identify which feeding had a rapid growth. With this mariculture technique, species are easy to harvest without depleting the natural sea hare stock.

The study would contribute new information to this field of study which would serve as baseline information for basis in protection and conservation of sea hare resources. This study aimed to determine the growth and survival of sea hares (*Dolabella auricularia*) fed with different seaweeds under cage conditions by assessing their growth and survival when fed various macroalgae, namely red algae (*Gracilaria* sp.), green algae (*Caulerpa racemosa*), and brown algae (*Sargassum polycystum*), and by monitoring selected environmental parameters such as salinity, water temperature, pH, and turbidity prevailing in the study area.

Methodology

Study Area

The study was conducted in Sitio Guang-guang of Barangay Dahican, which is approximately 1.3 km away from DOSCST campus. Figure 2 shows the map of Guang-guang. Cages were placed inside the strictly prohibited area. Cages were installed in sandy muddy substrate with the absence of seagrass. Guang-guang is within the protected area. The government preserved this area because mangroves, seagrass and fisheries resources, including sea hares are abundant in this area.

Construction of cage set-up

The cage set-up was placed in Guang-guang protected area where the low tide is not below 1 meter. Twelve cages measuring 1m x 1m constructed of nylon, net and bamboo were installed burrowed in the sandy substrate at 1.5 m apart from each other. The cages were arranged based on RCBD (Randomized Complete Block Design) in order to minimize biases in the arrangement of treatment and replication. Each cage was labeled with marked plastics (Figure 3).

Collection and Stocking of Sea hares

Ten *Dolabella auricularia* individuals with an average size of less than 120 g were stocked in each cage. Sea hares used in the experiment were collected in the same area. Collected sea hares were weighed using the weighing scale with a 500 g capacity (5 g calibration) to get the desired size before placing them inside the cage.

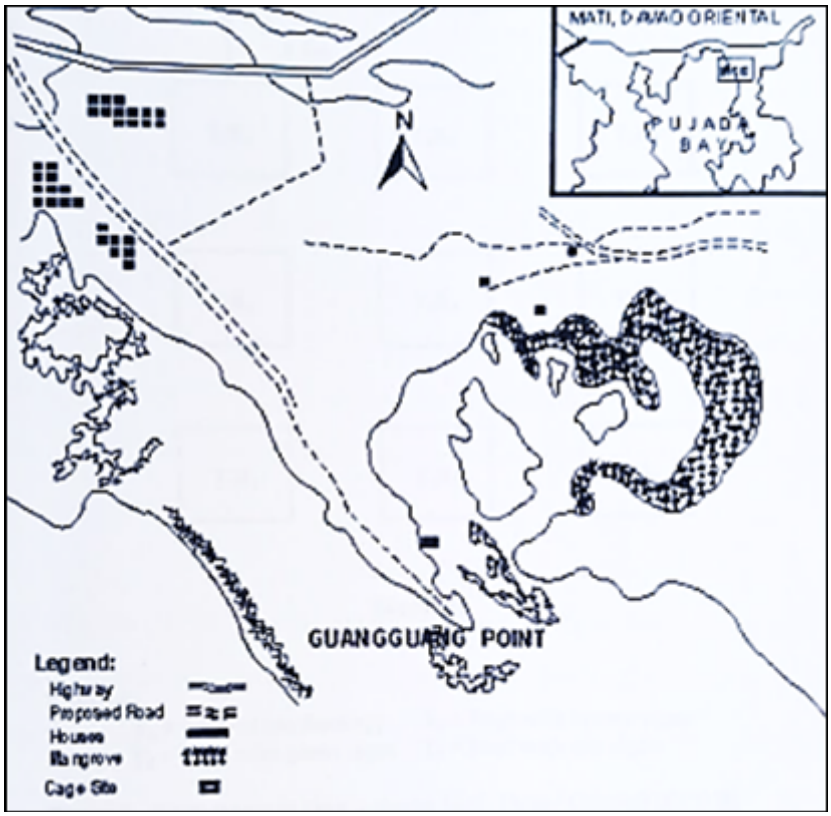

Figure 1. Map of the study area.

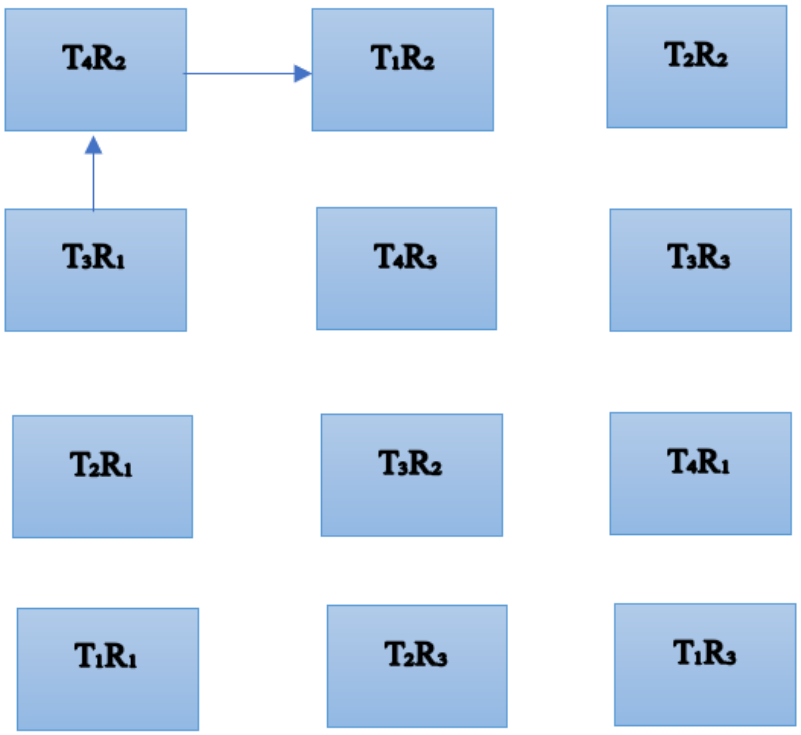

Figure 2. Arrangement of the twelve cages in following the RCBD protocol.

Cage management and maintenance

Cage set-up was monitored daily with proper maintenance of the cage set-up which was done in order to prevent any factors that may influence the experiment. While the cages must always be in proper position, they must be free from unwanted substances. Furthermore, there is a need to check torn and damaged nets to avoid and prevent sea hares to escape.

Collection of seaweeds

The different types of seaweeds were collected in Guang-guang. Three species of seaweeds, a red algae the *Gracilaria* sp., brown algae *Sargassum polycystum*, and the green algae *Caulerpa racemosa* were utilized as feeds for the sea hare in this study.

Feeding scheme

Twelve cages fed with three groups of macroalgae were set-up. Three cages served as the control, while the remaining nine cages were fed with different seaweeds. Feeding was done every seven days. During the first month period, the weight of the food is 8% of the body weight of the specimen, second month is 7%, and third month is 6%. During feeding time seaweeds were removed first, before a new batch of food were given.

Gut analysis

After the last sampling one, sea hare sample was collected for each treatment for the examination of gut. The dorsal portion of the sea hare was cut to reveal the internal organs. The internal organs were separated and preserved with 5% formalin. Afterwards, the intestinal part was cut and stained with lugol's solution. The internal contents were then examined with the aid of a hand lense or viewed under the microscope.

Data collection

The body size measurement of sea hare was measured every two weeks starting November to January 2007 weighing scale of 500 g capacity and (5 g calibration) was used in measuring the specimen. The measured specimen was placed in an empty pail to avoid mix-ups and the measured weight was recorded in the plastic slate. After measuring all the specimens in one cage, specimens were placed back in the designated cage. In each cage, specimens were being counted individually, to determine the survival rate.

Environmental parameters

Temperature was monitored using two alcohol thermometers. This was done by submerging the two thermometers in the seawater near the cage, around 3 to 5 mins or until the temperature is stable before it is read. In every sampling period, turbidity was measured in each cage, by using Secchi disk. These were done by lowering the Secchi disk into the water and get its reading. Water samples were collected every fourteen days. In each cage, two samples of seawater were collected inside the cage, top and bottom. Thereafter, water samples were situated in a cold place, to prevent any changes in the water. This was analyzed in the laboratory. In the laboratory analysis, Atago hand refractometer was used in measuring salinity. Using a dropper, little amount of water was collected from the water sample, and placed in the refractometer. Salinity reading was recorded in the plastic slate. pH was measured using pH meter The water sample was placed in a 200 ml beaker The pH indicator was suspended into the beaker of seawater sample. pH was read after 5 mins of suspending the pH indicator to the beaker of seawater or until the reading is stable.

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Statistical analysis

Growth

The following formula was used to determine the growth rate of sea hares per cage.

$$\text{Growth} = \frac{\text{Final weight - Initial Weight}}{\text{Number of Days}}$$

Percentage survival

The percentage survival of sea hares was determined by actual count of every individual until the study period ends. Percentage survival in each cage was determined using the formula.

$$\text{Percentage Survival} = \frac{\text{Final of Individual x 100}}{\text{Initial number of individuals}}$$

Analysis of variance

One way Analysis of Variance (ANOVA) without replication was used in testing the difference in growth and survival of sea hares in different feeding, testing the difference among means (Walpole, 1992).

Results and Discussion

Growth rate

The results on growth rate measurement of *Dolabella auricularia* fed with seaweeds showed that all cages had minimal variation with a range from 0.20-0.28 g per day. Cages T3R1 and T4R3 had a highest growth rate with a total mean of 0.28 g per day. T3R1 was fed with brown algae (*Sargassum polycystum*) while T4R3 was fed with red algae (*Gracilaria* sp.). In contrast, TIR1 and TIR3 (control no feeding) had the lowest growth rate of 0.20 gram per day (Figure 3). Otherwise, T2R1 and T2R2 exhibited the second to the highest growth rate which were fed with green algae. The growth of *Dolabella auricularia* in this study showed minimal weight interval because of environmental factors that affects the natural growth. Stocking of sea hare in a cage enabled them to move in a limited space. It can also change natural behaviors. Sea hares are all herbivores which are dependent on selected species of macroalgae (Rudman, 2000). In the study of Pennings (1993) they preferred mix diet rather than on single diet for faster growth. The growth of sea hare in gram per day was lower as compared from the previous study being conducted by Mailwas (2006, Unpublished). Figure 4 showed the variation of weight in continuous sampling until the end of the sampling. The growth of sea hare was very slow in every sampling, and growth was minimal. TI the control treatment, T2 fed with green algae, T3 fed with brown algae, and T4 fed with red algae. T4 treatment had the highest growth in the study. This conformed to the statement of Rudman (2001) that sea hares are mainly feed on red or green algae. Red alga

(*Gracilaria* sp.) has high nitrogen content compared to sea grass and brown algae. It is one of the nutrient requirements for the better growth of sea hare. Herbivores species of marine fauna feed selectively on microphytes with enriched nitrogen (Tenore, 1977).

Herbivores are thought to attain sufficient nutrition by consuming numerous species of plants but they also select food diet (Cruz-Rivera, et al, 2000). According to Pennings (1993) *Dolabella auricularia* maintained a mixed diet than a single species diet. Animal that fed by mixed diet grow better than those fed by single species diet. Marine specialist herbivores are stimulated to fed by host natural products. Sea hare Stylocheilus longicauda species specializes on the benthic filamentous cyanobacterium (*Lyngbya majuscule Gomont*) Hay (1989 and 1990).

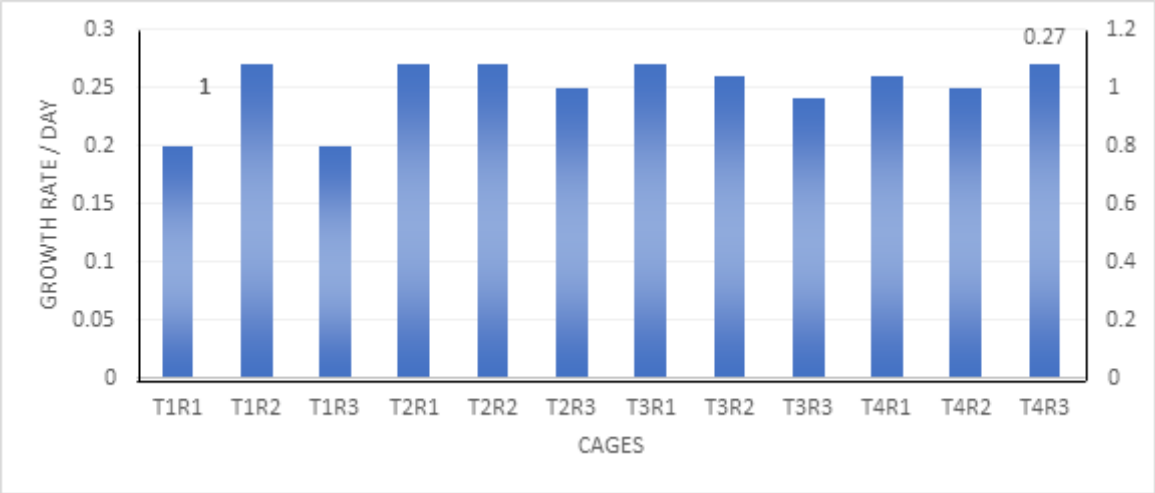

Figure 3. Growth rate of sea hare in gram per day.

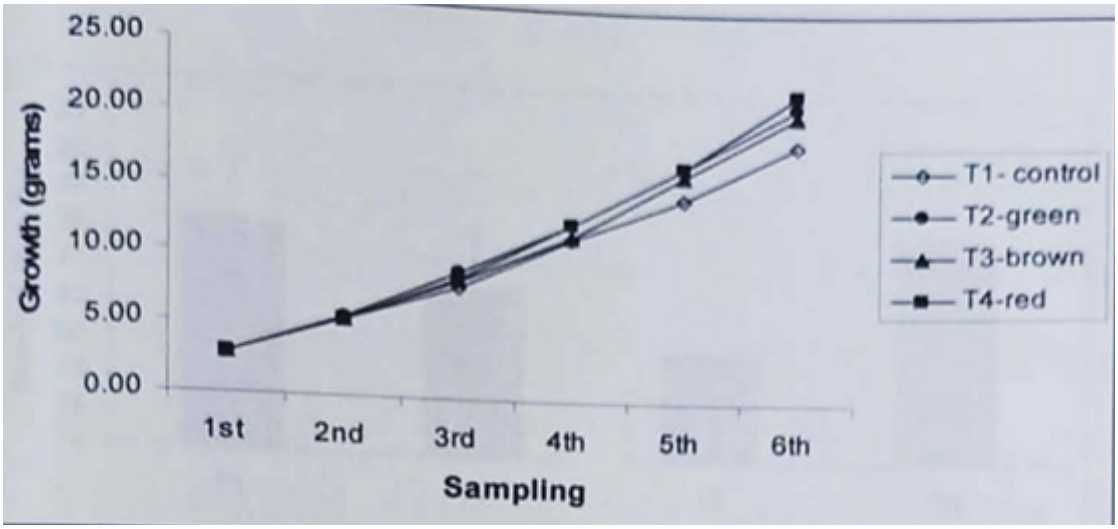

Figure 4. Growth of sea hare in gram per day in every treatment.

One way analysis of variance (ANOVA) analyzed the difference in growth rate; result showed no significant difference among treatments (Table 1). This indicates that the growth of sea hare fed with different algae were almost similar. However, feeding on algae by the sea hare has not influenced the growth of sea hare, no statistically significant differences. This result also coincides to the result of an experimental laboratory work of Capo (1998) he worked on feeding the laboratory model: dietary induced variability in Aplysia growth.

Table 1. Analysis of variance for growth of sea hares fed with seaweeds.

Source of variation	df	MS	F	*p*-value
Between Groups	2	0.001	0.28	0.75
Within Groups	9	0.004		
Total	**11**			

No significant difference.

Survival rate (%)

At the end of the sampling period, the percent of survival was determined. Figure 6 showed that the T4 had the highest percent of survival of 86%, while T3 had the lowest percent of survival of 80%.

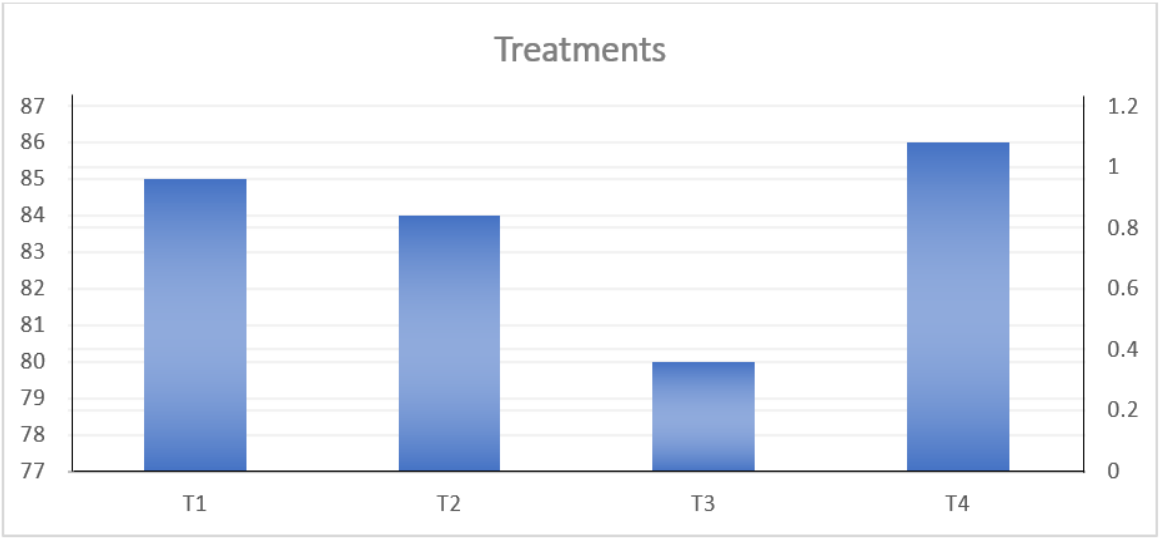

Figure 5. Mean survival rate (%) of sea hare in every treatment.

The death of some sea hares maybe due to some environmental factors. Some of the condition can affect the survival of sea hare such as new habitat with limited space and the presence of food (Capo, 1998). Table 2 showed the result of ANOVA for survival rate of sea hare. Result showed that no significant difference among treatments. This indicated that different environmental parameters as well as different feeding treatment have not affected much in the survival of sea hares. Moreover, even some other treatments has high survival rate, this has no effect with the growth of sea hare. This analysis of variance (ANOVA) results also coincides to the work of Capo (1998) no significant difference.

Table 2. Analysis of variance for survival rate of sea hare under cage condition.

Source of variation	df	MS	F	*p*-value
Between Groups	3.00	30.55	1.22	0.36
Within Groups	8.00	25.00		
Total	**11.00**			

No significant difference.

Environmental Parameters

Water temperature (°C)

The highest water temperature was 31.89°C in TI. While to the contrary, T2 cages showed the lowest water temperature with a value of 31.28 °C. Figure 7 represents that all cages have a minimal temperature change. Hence, seawater temperature may not have affected the growth and survival of sea hares. Aquatic organisms are cold blooded. Each aquatic organism has its own optimum water temperature. The favorable temperature of the sea hare is not higher than 30 °C. The organisms could suffer when water temperature shifts too far from the optimum range. Cold blooded animals cannot survive in temperatures below 0°C. Metabolism increases when water warms and decreases when it cools down.

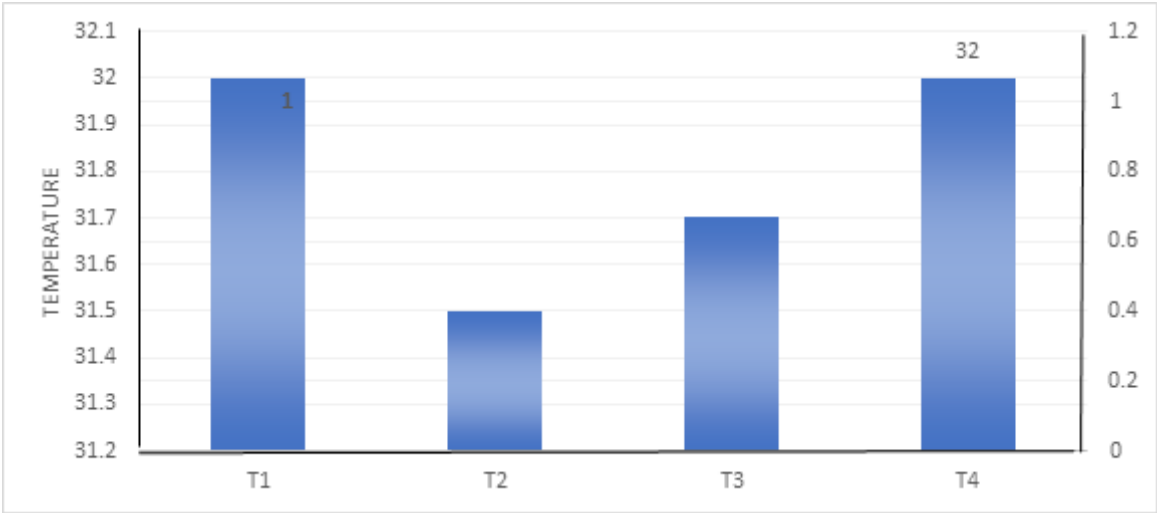

Figure 6. Mean temperature in every treatment.

Salinity (%)

The salinity measurements in every treatment were almost similar, with a measurement range from 33.42 to 33.83 ppt (Figure 7). The highest salinity value was 33.83 ppt exhibited in T'I and T4, while the lowest salinity value was 33.42 ppt in T2.

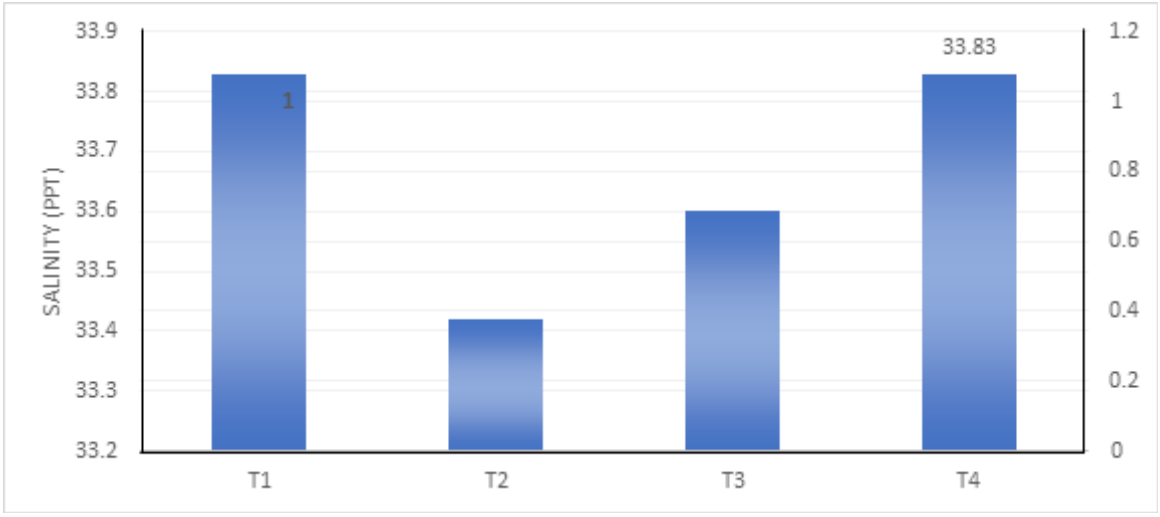

Figure 7. Mean salinity reading in every treatment.

Salinity is an ecological factor influencing the type of organisms that lives in a body of water Standard value of salt content in marine ecosystem is about 35 parts of salts per 1,000 parts of water. The normal salinity value of seawater is within 35%% where marine o rganisms including sea hares are able to survive.

pH

Figure 8 indicate that the pH in all treatment was almost the same with a reading range from 7.93 to 7.95. T1 and T3 had the lowest pH while T2 and T4 had the highest pH. Normal pH values in sea water run around 8.1 at the surface and decreases to about 77 in deep water. The generally accepted pH level in saltwater systems is between 7.6 and 8.4 (http://saltaquarium.about.com). The pH reading during the sampling was within normal pH of seawater Highly acidic or alkaline would kill marine life. However, oceans are very stable with regard to pH.

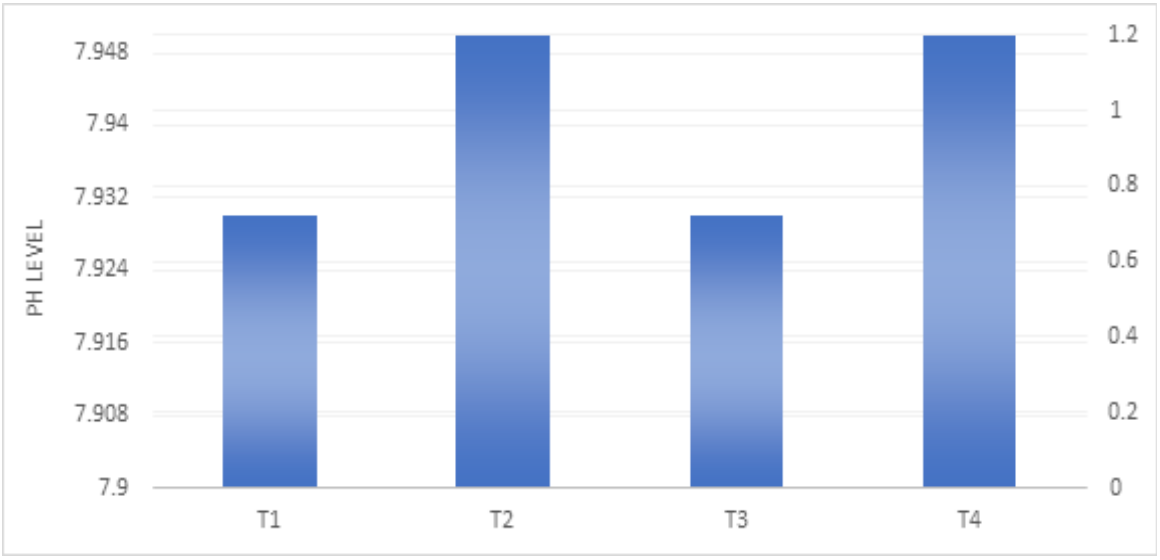

Figure 8. Mean pH reading in every treatment.

Turbidity (cm)

The depth of seawater in T4 had the highest reading of 109 cm. T2 had the lowest reading of 108.42 cm (Figure 9). The depth of the sea water varied but the clearness of the water in all cages was similar. The sea water becomes murky when the sandy substrate is disturbed by human. In the conducted area, the level of water did not affect the clearness of water. The water was very clear in every sampling but gets murky when the sandy substrate was disturbed. Cloudiness of water can cause damage to the sensitive gill structure of an organism. Organisms were prone to disease. It can prevent proper egg development, (http:// wateronthe web.org, 2006). Turbidity in a short period of time may cause less hazardous than that turbidity that stays longer.

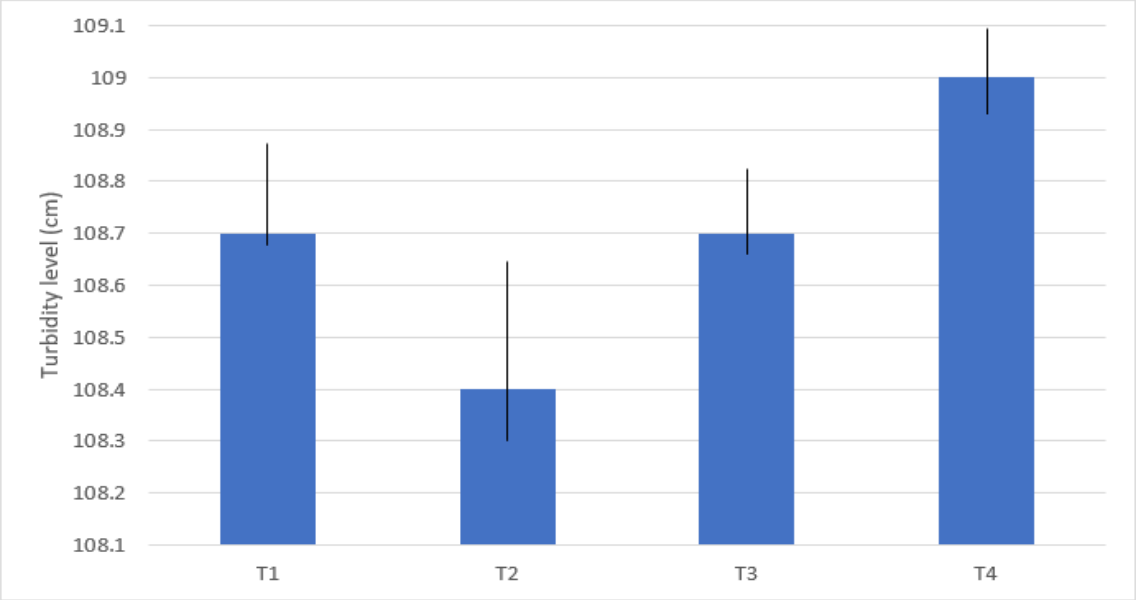

Figure 9. Mean turbidity level in every treatment.

Gut Analysis

Sea hares (*Dolabella auricularia*) were dissected and examined the internal part especially between the mouth through the intestinal part. We found out that their seaweeds remained undigested in mastax. In T4 species, some part of seaweeds was found undigested, the red algae (*Gracilaria* sp.). In 13 specimen sample, Brown alga (*Sargassum polycystum*) was also found in the mastax of the specimen. Otherwise, the green alga was not present in the T2 specimen sample. While in control treatment no algae remain in the digestive part of the specimen.

Conclusion

Based on the analyzed data, sea hares that fed on seaweeds had no significant difference in all treatment in terms of growth and survival. Also, environmental parameters do not affect the growth and survival of sea hares because they were in a normal marine environmental condition. As observed, T3R1 and T4R3 exhibited fast growth at 0.28 g/day compared to those in other cages, T3R1 treated with brown algae (*Sargassum polycystum*) while T4R3 treated with red algae (*Gracilaria* sp.), TIRI and TIR3 exhibited the lowest growth of 0.20 g/day. *Gracilaria* sp. was found in the internal part of the sample specimen in T4, as well as *Caulerpa racemosa* in T2. In TI and T3 no remains of algae was found inside their gut. However, environmental parameters such as pH, salinity, water temperature, and turbidity did not affect the growth and survival of sea hares because no fluctuations observed during the sampling period. Environmental factors such as limited space and controlled environment may have influenced the natural growth of sea hare. Biotic parameters such as food treatments partly affect the growth of sea hare but not in a wider range of difference.

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