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The growth of *Eucheuma spinosum* in different depth of Batubao marine waters West Kupang

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ABSTRACT

This research was aims to know the growth of red algae *Eucheuma spinosum* cultured with different depth, and several environmental factors which affect algal growth. An experimental method was used in the research. Long line cultivation method was obtained for binding 60 seeds at various depths of 10 cm, 1 m, and 2 m. The measurements were carried out every week for two months. Several environmental parameters measured were temperature, salinity, current velocity, pH, Nitrate and Phosphate. The result indicated that the average growth at the end of cultivation showed that the growth at 10 cm depth weighed 671 g heavier than 1 m and 2 m depths, (423 g and 248.5 g). While the average of daily growth were 13.028 g at the depth of 10 cm, 7.612 g in depth 1 m and 4.428 g in depth 2 m. The comparison of algae growth from all three different depths showed that at 2 m depth was the lowest; this was thought to be caused by predator attacks Baronang fish (*Siganus* sp) and also due to lack of light penetration, whereas the measured environmental parameters are still within the normal range for algal growth.

Key words : *Eucheuma spinosum, Growth, Depth.*

Introduction

Indonesian waters are believed to have very high seaweed cultivation potential. *Eucheuma spinosum* is seaweed that has been cultivated in Indonesia. Seaweed is a potential biological resource. Seaweed is also one of the coastal resources that has a high economic value and is one of the mainstay export commodities that are in high demand in the world market. Indonesian people use seaweed as traditional food and medicine. The results of seaweed processed in Indonesia in the form of agar, carrageenan, and alginate. These processed products can be used in the food industry, non-food industry, pharmaceutical industry and biotechnology (Anggadiredja *et al*., 2006). The availability of seaweed in nature is limited, and need to be cultivated and modifying cultivation techniques to increase the amount of seaweed production.

The potential of seaweed cultivation in East Nusa Tenggara is almost in all coastal areas of this province, including Kupang Regency which has an area of 4,063 km^2 with coastline length of 485 km. According to BPS data (2016), West Kupang District has approximately 1,650 farmers with dried seaweed production reaching 1,200 tons. Kamlasi

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(2008) West Kupang contributed 939.77 tons with an area of 91.69 ha. Some of the seaweed development areas are located in Bolok, Tablolong, Nitnoe and Tesabela Village.

West Kupang Sub district has generally flat beaches with type of substrates of white sand, sand-muddy, coral and sandy sand. Ocean waves around the waters of West Kupang District are strongly influenced by the west and east seasons. In the west season the wind blows very hard from the west and raises wave height in the western and southern parts of West Kupang District waters ranging from 0.5 to 3.0 meters. In general, water surface salinity in Indonesia ranges from 32-34 ppt while salinity in the waters of Kupang Barat District ranges between 27-35 ppt. These salinity conditions are included in the medium category and are very suitable for cultivation activities such as seaweed. While the sea surface temperature around the waters of West Kupang District ranges from 26-32 ºC. Tides and waves are the main factors of current generation on the coast. Current caused by waves is very influential on the process of sedimentation and / or coastal abrasion. The average flow velocity encountered in the Kupang Barat District waters is 16-36 cm / second (Kamlasi, 2008).

The village of Tesabela is located in West Kupang District, Kupang Regency, with the majority of the people's livelihood being fishermen. Most of the residents of Tesabela Village cultivate seaweed as their main income. Seaweed which is widely cultivated by the local community is the type of *Kappaphycus alvarezii* and *Eucheuma spinosum*, the *long line* method is a method used in the Tesabela Village, West Kupang District. The Tesabela villagers used the long line method only by using riis ropes that were stretched horizontally and never used rhythm rope that spanned vertically or cultivated at different depths.

Based on the description in the background, the authors are interested in conducting research with the title Growth of Red Algae *Eucheuma spinosum* with a Long Line Method in Different Depths in the Waters of Batubao Beach, Tesabela Village, West Kupang District, Kupang Regency.

The purpose of this study was to determine and identify the growth of *Eucheuma spinosum* in different depth.

Methods

This research was carried out in Batubao coastal waters of Tesabela Village, West Kupang Sub district, Kupang Regency on July - August 2017.

Seaweed Growth Analysis of

a. Daily Growth

Measurement of growth is calculated using the formula proposed by Aslan (2011) *in* Kase (2017):

$$pH = \frac{Wt - W0}{t}$$

b. Percentage of Daily Growth

Measurement of daily growth percentage using the formula proposed by Aslan (1998) *in* Kalla (2015), namely:

$$P\ pH = \frac{pH}{W_t - W_0} \times 100\%$$

Where:
PH : daily growth of algae (g)
PPH : percentage of growth in daily weight
Wt : weight of algae at the end of observation (g)
Wo : initial weight of algae (g)
T : length of study (days)

c. Absolute Growth Analysis

Measurement of absolute growth on marine algae using the formula used by Efendie (2003) *in* Abdan, *et al* (2013) namely:

$$GW = W_t - W_0$$

Where,
G = Absolute Average Growth (%);
Wt = Seed Weight at the Beginning of Research (g);
W0 = Seed Weight at End of Research (g).

d. Environmental Analysis

Environmental Parameters were analyzed qualitatively and qualitative.

Results and Discussion

The Growth *of Eucheuma spinosum at* Different Depths

The growth of *Eucheuma spinosum* during the cultured in different depths shows differences in value (Figure 1).

Weight of *Eucheuma spinosum* in Figure 1 at a depth of 10 cm, 1 m and 2 m showed a significant

increase, where the average weight gain of alga from the first week to the seventh week ranged from 50g - 671g. The cultivation with different depths resulting that at the depth of 10 cm at the seventh week shows the highest weight of *Eucheuma spinosum* with value of 671 g (± 53.4498), the average weight gain at a depth of 10 cm was higher than at a depth of 1 m which was 423 g (± 53.616) and at a depth of 2 m which was 248.5 g (± 61.838).

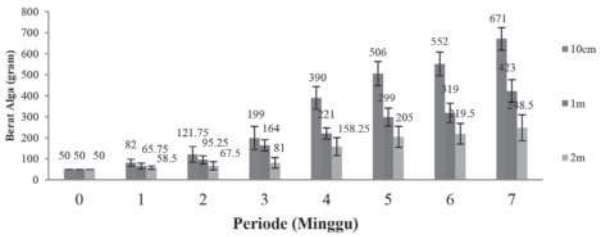

Fig. 1. Average Weight of Red Algae *Eucheuma spinosum*

Highest growth at a depth of 10 cm is suspected because of more nutrients available and was absorbed by the seaweed compared than 1 m and 2 m depths.

At this depth, it was thought that the rate of nutrients absorption takes place faster because the distance between the surface of the water and seaweed was not too far, making it easier for seaweed to absorb the nutrients. The amount of light is affected by the brightness of sea water. The low growth of seaweed with the increasing depth is due to the low circulation of oxygen. Photosynthesis will increase as the intensity of light increases at a certain optimum value. The intensity of light was also directly related to the primary productivity of waters, the higher the intensity of a light, the higher the primary proclivity at a certain limit (Sunarto, 2008; Susilowati *et al.*, 2012).

Weight gain at a depth of 1 m and 2 m is lower than at a depth of 10 cm allegedly due to food availability and less light was absorbed optimally which reduced primary productivity at a certain depth. Less light will reduces organic materials. Very high light intensity actually makes the photosynthesis process hampered while too low becomes a limiting factor for photosynthesis that occurs in seaweed (Sunarto, 2008; Susilowati *et al.*, 2012; (Soenardjo, 2011).

Another factor that reduced weight of seaweed at the depth of 2 m were pests and diseases that attack seaweed. During the research activities baronang fish (*Siganus* sp) were observed attaching the thallus. Ice-ice disease were also observed during the research, which causes thallus turn white and eventually broken.

Daily Growth of *Eucheuma spinosum*

Daily growth of red algae *Eucheuma spinosum* shown in Figure 2.

Figure 2 shows growth rates of Red Algae *E. spinosum* at depths of 10 cm, 1 m, and 2 m, where the average daily growth ranged from 4.571 g – 13.028 g at depth 10 cm, 2.250 g, 7.612 g at a depth of 1 m and 1.214g - 4,428 g at a depth of 2 m.

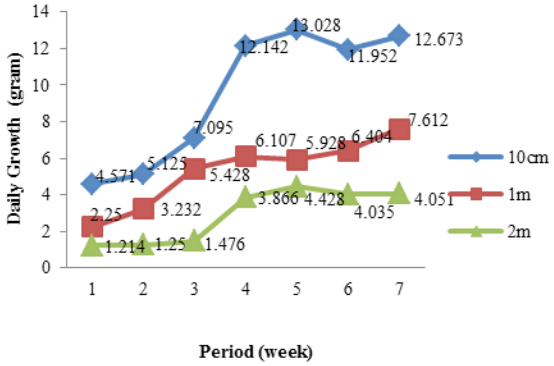

Fig. 2. Daily Growth of *E. spinosum*

Based on the weekly measurements, there were weight differences from those three depths. The weight of *E. spinosum* at the first week of cultivation at the depth of 10 cm, 1 m and 2 m was almost the same, whereas at a the depth of 10 cm which was slightly higher than the depths of 1 m and 2 m. This shows that the seedlings of *E. spinosum* in the early weeks were still in the process of being adapted to the new environment, however, from the second weeks to fourth weeks at a depth of 10 cm, 1 m and 2 m shows an increase in weight.

In the fifth week there was a decrease in weight in 1m this was caused by rapid thallus growth so that the thallus became heavy and unable to withstand the current, as a result there were parts that were broken and washed away by the current. Thallus *Eucheuma spinosum* has a soft and watery (succulent) texture that breaks easily. At the sixth week at a depth of 10 cm and 2 m, there was a severe decline caused by pests and diseases.

Poncomulyo *et al.*, (2006); Kalla (2015) explained that marine algae cultivated are often attacked by herbivorous fish. The dominant disease was ice-ice. Ice -ice disease attack seaweed on the thallus, which

causes thallus turn white and eventually broken.

Daily Growth Percentage of *E. spinosum*

Daily growth percentage of Red Algae *Eucheuma spinosum* during the study obtained the following results.

The results of percentage daily growth in Figure 3 shows that *E. spinosum* at the three depths had the same trend. The research conducted by Kalla (2015) who obtained the highest percentage of daily growth on the first week observations and experienced a decrease percentage of growth in the following week.

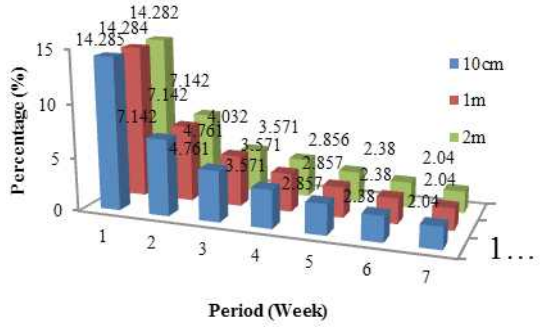

Fig. 3. Percentage Daily Growth of *Eucheuma spinosum*

Absolute Growth of *E. spinosum*

The absolute growth of *E. spinosum* shows in Figure 4.

The absolute weight of Red Algae *E. spinosum* in this study shows the value of 621 g at a depth of 10 cm, 373 g at a depth of 1 m and 198.5 g at a depth of 2 m. Absolute growth at a depth of 10 cm is higher than the depth of 1 m and 2 m. The difference in the absolute growth (weight) in the three depths was thought due to the differences of light intensity and attack of baronang fish (*Siganus* sp).

Environmental Parameters

Environmental parameters measured were, Temperature, Current, pH, Salinity, Nitrate and Phosphate.

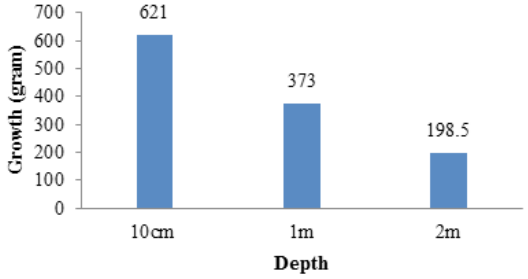

Fig. 4. Absolute Growth of *E.spinosum*

Temperature

Temperature is one of the factors to determine the feasibility of seaweed cultivation. Temperature is very influential for the growth of seaweed in photosynthesis and indirectly affects the solubility of oxygen used for respiration of marine organisms even though the temperature is not deadly but can inhibit the growth of seaweed. An increase in temperature can cause the thallus of the seaweed to turn pale yellowish.

Temperature measurements during the study in Figure 5 ranged between 24-26 °C. The lowest temperature range is in the fourth week while the highest temperature is in the first week. The temperature difference is caused by light intensity in the first, second, third and fifth weeks while in the fourth week there is a decrease in temperature due to cloudy or cloudy conditions. However, the temperature range at the study site is still in normal conditions for the growth of Red Algae *E. spinosum*. This is supported by the opinion of Puslitbangkan (1991); Farnani *et al*., (2013) who said that the good water temperature for cultivation *Eucheuma spinosum* was 20-28 ºC.

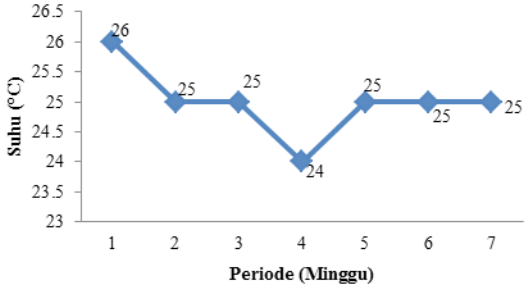

Fig. 5. Temperature Measurement in Batubao Waters Location

Current velocity

The results of current velocity during the study can be seen in Figure 6.

The results of current velocity range from 0.2 m / sec - 0.3 m / sec. The highest current velocity is found in the second, fifth and seventh weeks, while the lowest speed is in the third, fourth and sixth weeks. Ambas (2006); Farnani *et al.*, (2013) the ideal current velocity for the cultivation of *E. spinosum* ranged from 0.1-0.3 m / sec. Current velocity plays

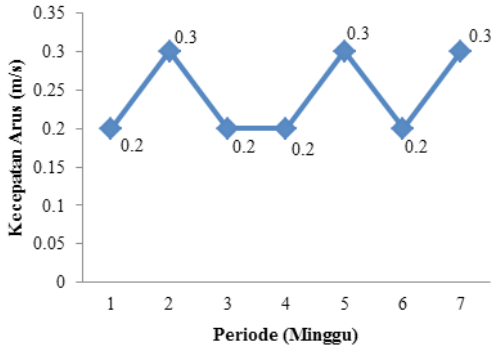

Fig. 6. Measurement of current velocity

an important role in the waters, of transporting nutrients, transporting oxygen. Current was an important factor that must be prioritized in selecting the location of seaweed cultivation because the current will be affecting the sedimentation in the waters, which is also affects penetration of light. Sudino (2004); Farnani *et al.*, (2013)

Salinity

The measurement of salinity at this study obtained the same results, with the value of 33 ‰. According to Prasetyarto and Suhendar (2010); Armita (2011), the high and low levels of salinity are dependent on the fresh water supply from the rivers that flow into the sea, the more rivers flows into the sea, the sea salinity will be low. Salinity values influenced by several factors including fresh water supply to sea water, rainfall, season, topography, tides and evaporation (Nybakken, 2000; Alifatri, 2012). In addition Nontji (1993); Alifatri (2012) also states that the distribution of salinity is influenced by various factors such as patterns of water circulation, evaporation, rainfall and river flow.

pH

The pH measurements during the study in Batubao coastal waters.

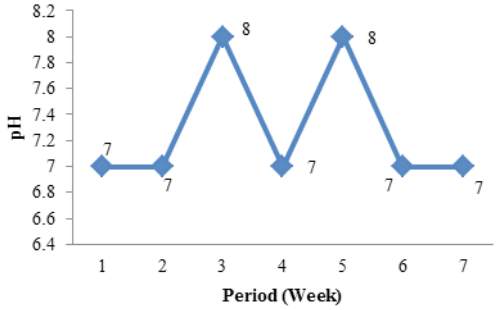

Fig. 7. pH Measurement

The pH measurement explained that the pH value ranged from 7 to 8 during the study and it was in the normal range of the growth of *E. spinosum*. Partosuwiryo and Hermawan (2008); Kalla (2015) says that the pH value that is still feasible for seaweed cultivation was in between 6-9 and the optimal value of pH is expected to be around 7.5-8.0. Whereas according to Aslan (1998); Kalla (2015) stated that the optimum pH for marine algae cultivation ranged from 6.8 to 8.2.

Nitrate

The results of nitrate measurements in Batubao coastal waters at different depths shows in Table 1.

Table 1. Nitrate Measurement Results

Kepmen. Lh No. 51 Tahun 2004 Tentang Baku Mutu Air Laut Untuk Biota Laut Nitrat=0.008 mg/L		
Depth 10 cm	Depth 1 m	Depth 2 m
<0.01 mg/L	<0.01 mg/L	<0.01 mg/L

Weight of seaweed *E. spinosum* cultivated in the sea was influenced by the availability of nutrients around the planting location. Nutrients needed are Nitrates and phosphates. Nitrates in marine waters were described as macronutrients and as primary productivity control. The nitrate measurement results in the study at three depths were <0.01 mg/L. This was in accordance with Effendi (2003) statement in Susilowati *et al.*, (2012) that nitrate-nitrogen levels in natural waters are almost never more than 0.1 mg/L, but if the nitrate content is greater 0.2 mg/L will result eutrophication which then stimulates the growth of algae and aquatic plants rapidly.

Phosphate

The phosphate measurements in Batubao coastal waters at different depths shown in Table 2.

Phosphate is one of the nutrients were important for plant cell metabolism. Phosphate content affects

Table 2. Results of Phosphate Measurement

Kepmen. Lh No. 51 Tahun 2004 Tentang Baku Mutu Air Laut Untuk Biota Laut		
phosphate=0.015 mg/L		
Depth 10 cm	Depth 1 m	Depth 2 m
1.5 mg/L	0.1 mg/L	0.7 mg/L

the level of aquatic fertility. The results shows that value of phosphate content in Batubao waters at all three depths were 1.5 mg/L at a depth of 10 cm, 0.1 mg/L at a depth of 1 m and 0.7 mg/L at a depth of 2 m. This is in accordance with the opinion of Andarias (1992) in Alifatri (2012) stating that the good phosphate range for seaweed growth is 0.09-1.80 mg/L. The height of the phosphate content in the waters is caused by the mixing of water masses which carry the phosphate content from the bottom of the water to the surface. This is in line with Simanjuntak's opinion (2006); Alifatri (2012) which states that high phosphate levels are caused by currents and stirring of water masses which results in elevated phosphate content from the base to the surface layer.

The results of this study were different from the results obtained by Kase (2017) obtaining a value of 0.046 mg/L in the first week, 0.042 mg/L in the fourth week, 0.055 mg/L in the fifth week and 0.05 mg/L in the eighth week. Phosphate levels in the research location can be said to be relatively normal as a support for the growth of seaweed cultivation.

Conclusion

The cultivation of red algae *Eucheuma spinosum* had different weight, which the growth of *Eucheuma spinosum* at 10 cm depth was better than the depths of 1 m and 2 m. The differences were due to the influenced of light intensity and predators.

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