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Fragmentation method of coral (*Caulastrea furcata*) for growth measured at controlling condition

Metode frakmentasi karang (*Caulastrea furcata*) untuk pengukuran pertumbuhan pada kondisi terkontrol

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Abstract

The objective of the research are: (1) to analyze the water quality condition of water circulation system at laboratory and (2) to measure the growth (length and height) and survival rate of *Caulastrea furcata* which was fragmented at the laboratory. The water quality condition at the laboratory showed that every parameter has normal value in which organism can live and grow. Natural feed such as Copepoda and Nannoclhoropsis were also cultured at the laboratory as food for the coral. Transplantation was done by cutting the colony of coral or by breaking the branch of coral into pieces from every kind of coral spesies and placed those on artificial substrate made from ceramic bricks. Cutting process was done after the acclimatization process. Fragmentation treatment of *C. furcata* become 1 polyp, 2 polyp, 3 polyp and 4 polyp that was reared on circulation system did not give significant impact on height and length growth after 160 days. Mean of growth length of *C. furcata* on treatment 1, 2, 3 and 4 polyps in every month after 160 days was 1.64 mm, 1.55 mm, 1.42 mm and 1.08 mm, respectively, whereas mean of growth broad was 0.71 mm, 0.82 mm, 0.51 mm and 0.62 mm, respectively. Fragmentation treatment of *C. furcata* become 1 polyp was best length if compare other treatment.

Keywords: Circulation, Fragmentation, *Caulastrea furcata,* Water quality

Abstrak

Tujuan penelitian ini adalah: (1) menganalisis kondisi kualitas air pada system sirkulasi air di laboratorium dan (2) mengukur pertumbuhan (panjang dan tinggi) dan tingkat kelulushidupan *Caulastrea furcate* yang telah difrakmentasi di laboratorium. Nilai kualitas air menunjukkan bahwa setiap parameter adalah normal dan dapat mendukung kehidupan dan pertumbuhan organisme. Pakan alami seperti Copepoda dan Nannoclhoropsis yang juga dikultur di laboratorium sebagai pakan karang. Tansplantasi dilakukan melalui pemotongan koloni karang pada bagian cabang karang kedalam bagian kecil dari setiap spesies karang dan ditempatkan pada subtrak buatan yang dibuat dari keramik. Proses pemotongan dilakukan setelah proses aklimatisasi dilakukan. Perlakuan frakmentasi *C. furcate* menjadi 1 polip, 2 polip, 3 polip dan 4 polip kemudian dididahkan dalam air berskirkulasi tidak memberikan efek yang signifikan terhadap pertumbuhan tinggi dan panjang setelah 160 hari. Rata-rata pertambahan lebar pada perlakuan 1, 2, 3 dan 4 polip pada setiap bulan setelah 160 hari adalah 1.64 mm, 1.55 mm, 1.42 mm dan 1.08 mm. dimana rata-rata pertumbuhan tinggi secara berurutan adalah 0.71 mm, 0.82 mm, 0.51 mm dan 0.62 mm. Perlakuan frakmentasi 1 polip pada *C. furcate* menghasilkan panjang terbaik dibandingkan perlakuan lainnya.

Kata kunci: Sirkulasi; Frakmentasi; *Caulastrea furcate*; Kualitas air

1. Introduction

Coral reefs are unique ecosystems in that they are defined by both biological (“coral” community) and geological (“reef” structure) components. The reef is constructed of limestone (calcium carbonate) secreted as skeletal material by corals and calcareous algae. Coral reefs are striking, complex, and important features of the marine environment. Coral reefs have the highest biodiversity of any marine ecosystem, and they provide important ecosystem services and direct economic

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benefits to the large and growing human populations in low-latitude coastal zones (Veron, 1993).

The coral reef crisis is almost certainly the result of complex and synergistic interactions among local-scale human-imposed stresses and global-scale climatic stresses. Both can produce direct and indirect chronic and acute stresses, leaving few, if any parts of the ocean truly hospitable for healthy coral reef communities. Documented human stresses include increased nutrient and sediment loading, direct destruction, coastal habitat modification, contamination, and the very important chronic indirect effects of overfishing. The major climate change factor that is becoming increasingly important for coral reefs is rising ocean temperatures, which have been implicated in chronic stress and disease epidemics, as well as in the occurrence of mass coral bleaching episodes.

The research is focused on fragmentation of coral, which has grown in natural habitat, by moving specific coral to other places so it can grow better and further develop a new community. Fragmentation method involves the success of coral exploitation in concordance to support the business of decoration corals that is now very popular in world trade. Hence, the objective of fragmentation is to add to the number of individual where they can grow normally at natural or new habitat.

2. Materials and methods

2.1. Preparation for acclimatization and coral pond

The size of pond that was used for coral acclimatization was 1.5 x 8 x 1m and it was equipped with bio-filtration pond (1 x 3 x 1m). The basement of pond was layered with big gravel (2cm), wave plastic (2cm), charcoal, pebble, sand and small gravel (0.5-1cm). Filtration process was done by pumping in the seawater into bio-filtration pond that flowed to both acclimatization and coral pond.

2.2. Fragmentation method

Coral sample for this research was *Caulastrea furcata* obtained, from natural habitat at Pulau Pari in Seribu Archipelago, by SCUBA diving at 3m depths. The coral was acclimatized for two weeks before the fragmentation process, whereby only healthy coral will be used in the next stage.

Fragmentation process was done in the water column (field and laboratory) to prevent the coral from stress. The tools used for the fragmentation or cutting process were knife or axe because of the hard body structure of the coral. However, when the cutting process took a longer time, electric grindstone was used to quicken the process and also to avoid the coral from becoming stress. Figure 1 shows *C. furcata* that has been cut to 1 polyp, 2 polyps, 3 polyps and 4 polyps. Growth and survival of *C. furcata* was measured every 20 days with consideration that the coral has changed by this time in terms of growth (length and height) and survival. Water quality was measured every 2 weeks to control the condition continuously.

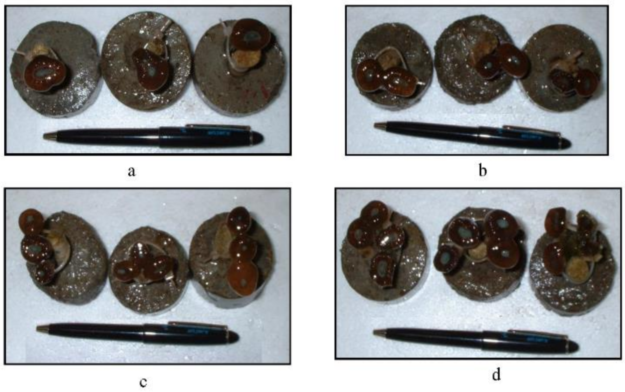

Figure 1. *Caulastrea furcata* after fragmentation into (a) 1 polyp, (b) 2 polyps, (c) 3 polyps and (d) 4 polyps.

3. Result and discussion

3.1. Water quality

Water quality measurement data has been observed in the pond (artificial habitat) and in the sea (natural habitat). Table 1 showed the comparison of water quality measurement between these two different habitats. The results showed that each parameter recorded in the pond were in normal range as the one in the sea, which also means that the pond is suitable for the growth of the coral. Thus, it was presumed that the condition of the pond was favorable for coral transplantation to the laboratory for fragmentation process.

3.2. Caulastrea furcata

Caulastrea furcata lives colonially and usually exist in the depth of 2-5 m. On normal condition at the sea, the color of this coral is light brown with green lines and the color of the center part (columella) is green too. Changes occurred when the coral was moved into the acclimatization pond. After 1.5 months in the pond, the color of the polyp changed into old brown with the center part still green, but the lines around the polyp started to vanish. When the coral reached two months old, it started to grow and the shape of the polyp become wider, these conditions happened to the coral that was fragmented into 1 polyp. This may be due to a mechanism developed to gain maximum light so that the newly formed polyp above it can grow wider. The amount of light that was recorded in the laboratory was 430-450fc. Other than that, availability of space to grow may also contribute to the growth of new polyp, whereby the growth may be slightly hindered if they live in colonies. *C. furcata* was also reared in a pond with the temperature 26°C. After 3 months, the corals were still alive but the polyp could not develop and only the corallites became more pointed. This may be due to the lack of light in the laboratory which was recorded at about 24°C during the research was conducted. The corallites grew longer to protect the polyp from severe condition. Later on, the corals were moved into the circulation pond so that the healing process could take place.

Table 1
Comparison of water quality measurement of the coral pond and the natural habitat of the coral.

Sample	Parameter							
	pH	Salinity(°/₀₀)	Temp. (°C)	O_2 (ml/l)	Phosphate (µg A/l)	Nitrate (µg A/l)	Nitrite (µg A/l)	Ammonia (µg A/l)
Pond	8.08	32-33	26-27	5.74	0.169	0.3448	0.35	0.218
Sea	7.5	33	29-30	5.91	0.015-0.018	0.003	0.048	0.005

The highest value of survival rate of *C. furcata* was 100 % and this was recorded in the treatment of one polyp T1 and followed by 3 polyp/T3 (88.9 %), T2 (66.7 %) and the lowest was on the treatment T4 (58.34 %) (Table 2). One-polyp coral could obtain optimal food production by zooxanthellae without any competition from other polyps unlike the treatment of 2, 3 and 4 polyps. In comparison, each of the polyps in treatment T4 needs to compete with the other three competitor polyps that need food and light.

Table 2
Survival Rate of *Caulastrea furcata* in different treatments.

Treatment	Survival rate (100 %)								
	1 day	20 days	40 days	60 days	80 days	100 days	120 days	140 days	160 days
T1 (1 polyp)	100	100	100	100	100	100	100	100	100
T2 (2 polyp)	100	100	100	83.4	66.7	66.7	66.7	66.7	66.7
T3 (3 polyp)	100	100	100	100	88.9	88.9	88.9	88.9	88.9
T4 (4 polyp)	100	100	100	100	66.7	66.7	58.34	58.34	58.34

3.3. *The growth of Caulastrea furcata (absolute length)*

The growth length of *Caulastrea furcata* after 160 days observation showed that the treatment of T1 had the longest polyp (8.77 mm), followed by T2 (8.10 mm), T3 (7.58 mm), and the lowest was at the treatment T4 (5.77 mm) which is showed in Figure 2. T1 produced the longest polyp because maybe there was no competition to get the food unlike the other treatments and its have many space to length gowth. Based on the statistical analysis, the difference of fragmentation become 1, 2, 3 and 4 polyp after 160 days observation did not give a real impact (P>0.05). Duncan's multiple area test showed that there was no significant difference between conduction of treatment (P>0.05).

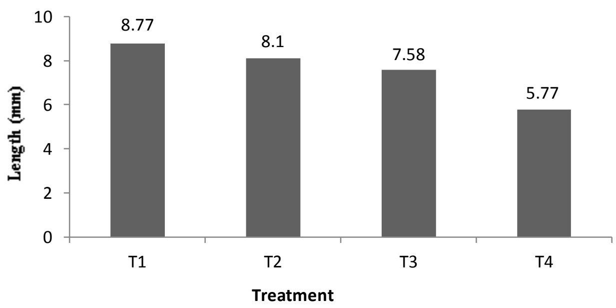

Figure 2. The growth of absolute length (mm) of *Caulastrea furcata*.

Although T1 yielded the best result compared to the other treatment, the growth of *C. furcata* is slow compared to other kinds of branching corals such as *Acropora* and *Pocillopora* which has the rate of colony diameter length growth 18-20 cm each year (1.5-1.67 cm/month).

According to Harriot and Fisk (1988), transplantation showed an effort to catalyze regeneration of coral reef ecosystem that was damaged or created new habitat of coral reef community. Fragmentation on the transplanted coral has an important role in accelerating the asexual reproduction, beside the coral can move to other place as new habitat. These activities will increase the biodiversity species along with accelerating rehabilitation of dead coral because of pollution and damage caused by human activities (Edward & Clark, 1998).

3.4. *The Growth of Caulastrea furcata (absolute height)*

The highest growth of absolute height of *Caulastrea furcata* for 160 days observation has been obtained at the conduction of T2 and T3 that is about 6.64 mm, followed by the conduction of T1 (6.43 mm) and the lowest was T4 (6.4 mm) (Figure 3). It is because *Caulastrea furcata* with 2 and 3 polyp can use zooplankton and phytoplanktons as food more efficient than the conduction of T1 that only reach the height of 6.43 mm.

It is adjustable with opinion which mention that the growth of coral is influenced by the existing zooplankton as its food in a large number Duncan's multiple area test result that is not significantly different between T4-T3, T4-T2 and T4-T1 (P>0.05). There is no different between conduction and the growth that is slow on growth of absolute height of *C. furcata* coral relatively same.

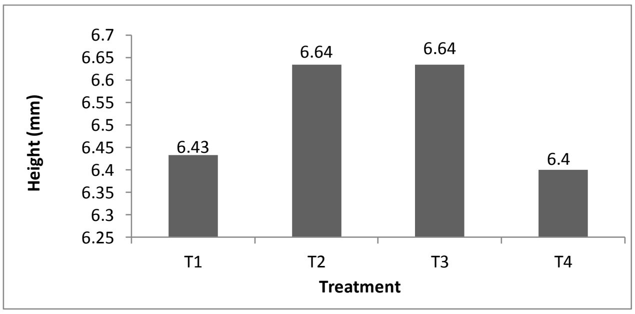

Figure 3. The growth of absolute height (mm) of *Caulastrea furcata*.

4. Conclution

- The majority factors involved growth and survival rate of *Caulastrea furcata* coral were water quality condition and natural feed.
- There were no significant impact on fragmentation treatment polyp 1, 2, 3 and 4 (height and length) of *Caulastrea furcata* coral.

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Bibliography

Bak, R.P.M., S.R. Criens, 1981. Survival After Fragmentation of Colonies of *Madracis mirabilis, Acropora palmata* and *A. Cervicornis (Scleractinia)* and The Subsequent Impact of

Coral Desease. Proc. Of 4th Int. Coral Reef Sym., Manila. 2: .221-227.

Brown, B.E., L.S. Howard, 1985. Assessing The Effects of Stress on Reef Corals. Pp: 1-63. In: Blaxter. J.H.S., *The late* Sir Frederick S. Russel and Sir Maurice Yonge (Editors). Advances in Marine Biology. Volume 22. Academic Press.

Harriot V.J., D.A. Fisk, 1988. Coral Transplantation as Reef Management Option. Proc. 6th. Int. Coral Reef Symp. Australia. 2: 375–378

Hubbard, D.K., 1997. Reefs as Dynamic Systems. Pp: 43-67. In: Birkeland, C. (Editor). Life and Death of Coral Reefs. University of Guam. International Thomson Publising.

Nybakken, J. W., 1992. Bologi Laut. Suatu Pendekatan ekologis. Terjemahan oleh Eidman, M., D.G. Bengen, Koesoebiono, M. Hutomo dan Sukristijono.

Suharsono, 1984. Pertumbuhan Karang. Oseana IX. Pusat Penelitian Biologi Laut. LON-LIPI, Jakarta. (2) : 41-48

Veron, J.E.N., 1986. Coral of Australia and The Indo-Pasific. August. Roberson. Publish. 644p.