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Growth Rate of *Acropora formosa* and *Montipora digitata* Transplanted on Biorock in Gili Trawangan

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Abstrak

Gili Trawangan memiliki keanekaragaman karang yang tinggi dan merupakan salah satu Taman Wisata Perairan di Indonesia Timur. Keanekaragaman ini mulai terancam oleh aktivitas manusia dan bencana alam termasuk perubahan iklim. Hal ini menyebabkan perlu dilakukan usaha rehabilitasi. Biorock adalah salah satu metode rehabilitasi karang yang dapat meningkatkan laju pertumbuhan karang. Penelitian ini bertujuan untuk menentukan tingkat pertumbuhan koloni Acropora formosa dan Montipora digitata tumbuh di substrat Biorock dan diluar substrat (sampai 10 meter). Penelitian ini dilakukan di Gili Trawangan dari bulan April sampai Agustus 2011, dan mengunakan metode pengukuran langsung pada tinggi koloni. Hasil analisis t-test menunjukkan perbedaan yang signifikan antara pertumbuhan karang pada struktur Biorock dan luar struktur Biorock. Ketinggian koloni A. formosa ditransplantasikan pada struktur Biorock (0,43 cm / minggu) pertumbuhannya mencapai empat kali lebih cepat dari A. formosa di luar struktur Biorock (0,09 cm / minggu). Pertumbuhan koloni pada Biorock adalah 0,3009 cm / minggu sementara M. digitata di luar Biorock adalah 0,009 cm / minggu.

Kata Kunci **:** *Tingkat Pertumbuhan, Acropora formosa, Montipora digitata, Biorock*

Abstract

Gili Trawangan has a high diversity of coral reefs and is one of the Aquatic Parks in Eastern Indonesia. This diversity has begun to be threatened by the human activities and natural disaster due to climate change. So we needed to start doing some rehabilitation projects. The creation of Biorock is one of coral rehabilitation method which can increase growth rate of coral. This study was to determine the growth rate of colonies of *Acropora formosa* and *Montipora digitata* growing on Biorock substrate and away (up to 10 meters) from Biorock substrate.This study was conducted in Gili Trawangan from April to August 2011, and used a method of direct measurement on colony height. The result of t-test analysis showed a significant difference between the coral growth on the Biorock substrate and outside Biorock substrate. The height of *A. formosa* colonies transplanted on Biorock substrate (0.43 cm/week) is around four times faster than that outside of Biorock substrate (0.09 cm/week). The growth of a *M.digitata* colonies on Biorock was 0.3009 cm/week while outside Biorock at was 0.009 cm/week.

Key Words : Growth Rate, *Acropora formosa, Montipora digitata*, Biorock

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INTRODUCTION

Coral reefs are part of marine ecosystem that important for marine life. Coral reefs ecosystem provide shelter, spawning, nurturing, and feeding a variety of marine life, so that the ecosystem is very complex and have high productivity (Nybakken, 1992).

Gili Trawangan has a high diversity of coral reefs and is one of the MPA: Marine Protected Area, in Eastern Indonesia. This diversity has begun to be threatened by the human activities and natural disaster due to climate change. So we needed to start doing some rehabilitation projects. Gili Trawangan is the only one that has been applying the Biorock® method as coral reef rehabilitation efforts in the province of West Nusa Tenggara.

The Biorock method is one of coral rehabilitation was invented, developed, and patented by the late Prof. Wolf Hilbertz and Dr. Thomas J. Goreau. The Biorock® technology uses low voltage direct currents (above 1.2 Volts) passing through a steel structure (Robbe, 2010). The Biorock® process, also called electrolysis, occurs when two metals - the anode and the cathode - conduct electricity in sea water. Te result is the accreation of solid limestone onto a steel structure while the other metal to slowly disintegrate. The limestone is the best substrate for hard coral. The Biorock® process is used to regenerate coral reefs, re-populate damaged reefs with coral and fish, break the wave action, grow beaches, etc (Goreau, 2009). The Gili islands have nowadays more than 60 Biorock reefs around and the projects have been very successful.

Coral reefs ecosystem in Gili Trawangan is very diverse. Two types are commonly found such as *Acropora formosa* and *Montipora digitata*. Both of them are from same family that is *Acroporidae*, life form colonies is branching and relatively fast-growing coral species, but highly susceptible to environmental influences (Suharsono, 1996). This study is to determine the growth rate of colonies of *Acropora formosa* and *Montipora digitata* growing on Biorock substrate and away (up to 10 meters) from a larger Biorock structure. Another purpose of this study is to determine growth rate between *Acropora formosa* and *Montipora digitata* on Biorock substrate.

METHODS

Location

This study was conducted from April until Augustus 2011 in Gili Trawangan, Lombok, Indonesia. The location at 080 21' 28.2" LS and 1160 02' 33.3" BT. The Biorock structure that choice as Biorock substrate is "Dolphin Structure" (Fig. 1). This structure at depth 8 meters and the electric supply is always flowing to this structure.

Fig. 1. Biorock Structure

Fig. 2. Block Substrate Away from Biorock

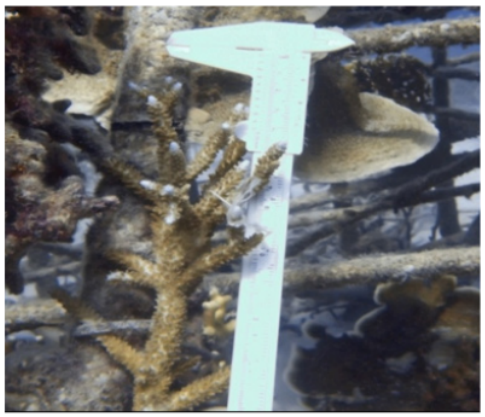

Fig. 3. *Acropora formosa*

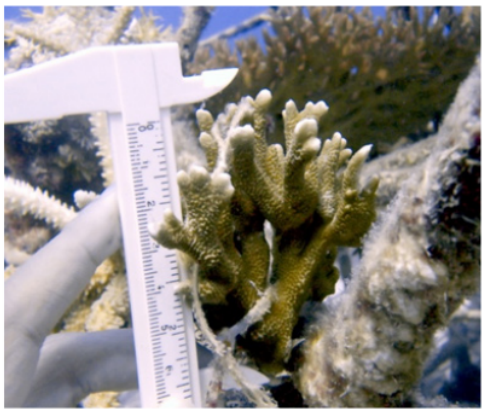

Fig. 4. *Montipora digitata*

Transplantation Process

Fragment of *A. formosa* and *M. digitata* transplanted on Biorock substrate and block substrate (Fig. 2). that away from Biorock structure.

Biorock already exists at location of this study. The Biorock structure was built since 2004. To make a Biorock we prepared iron that has been cut to size needed to make the shape cathode structure and titanium that becomes anode. Anode and cathode structures placed under the sea and distance of between anode and cathode is 1 meter. Cables on the structure of the anode and cathode connected to power sources located on land.

Block away from Biorock was made by mixed cement, sand and water. Put 9 pieces pipe into block. Taken colonies of coral *M. digitata* and *A. formosa* from the same parent colony. Colonies were cut into 20 fragments for each species. The fragment was tied to the Biorock substrate by using cable ties each of 15 fragments for each species of coral. A total of five fragments of coral for each species were tied to concrete blocks which is placed away from the Biorock.

Data Collection and Data Analysis

All the data retrieval process has been done while SCUBA diving. We have dived every 2 weeks to control height of coral colonies of *A. formosa* (Fig. 3). and *M. digitata* (Fig. 4). attached on Biorock structure and placed on concrete blocks away from the same Biorock substrate (up to 10 meters) by direct measurements on coralum methods (Supriharyono, 2000).

A. formosa growth parameter measured is the height of the colony to determine the growth and growth rate. Growth obtained by the equation:

$$\alpha = Lt - Lo \quad ...(1)$$

Description:

a = Growth of the transplanted coral
Lt = height after 8 weeks
Lo = height at the first time transplanted.

While the coral growth rate measurements using the following formula:

$$\beta = \frac{L_{i+1} - L_i}{T_{i+1} - L_i} \quad ...(2)$$

Description:

B = Growth rate of coral fragments
Li +1 = Average height of the colony on the measurement i+1
Ti +1 = Time of measurement Ti +1

Sources: Affandi and Tang (2001) in Fauziyah and Herdiansyah (2006).

T-test in this study to determine any difference or not between the growth of *A.formosa* and *M.digitata* on the Biorock substrate and away from Biorock with a value of α is 5%.

RESULTS

High colony is one of the corallum dimensions are measured to show the vertical growth of corals. From average growth *A. formosa* at Biorock substrate showed the greatest changes in growth. Based on the t-test, there are significant differences between the growth rate of *A. formosa* on Biorock and on the blocks away from Biorock. Similar results were found on *M. digitata*, between *A. formosa* and *M. digitata* on the Biorock substrate also showed significantly different growth. *A.formosa* has a better growth rate than *M.digitata*.

Using the equation we have value growth each species of coral colony. The highest coral colony growth is for *A. formosa* on Biorock substrate. For *A. formosa* colonies growth also reached up to 3.42 cm within 8 weeks. For *M. digitata* on Biorock substrate has reached up to 2.40 cm. For the growth of coral colony on the blockes away from Biorock, we have found that *A.formosa* is 0.78 cm and for *M. digitata* is 0.72 cm within 8 weeks

Growth rate of coral colony is show the growth of each species every 2 weeks. Growth rate of each species is different depend on species and placed there was transplanted. Comparison between *A. formosa* on Biorock and *A. formosa* away from Biorock showed that growth rate of *A. formosa* on Biorock substrate is

Table 1. Growth of Coral Colonies

Coral Species	On *Biorock* Substrate (cm)	Outside *Biorock* Substrate (cm)
A. formosa	3.426	0.78
M. digitata	2.407	0.72

Table 2. Growth rate of Height Colonies

Time of measurement	*A. formosa* Biorock (cm/2 weeks)	*M. digitata* Biorock (cm/2 weeks)	*A. formosa* outside (cm/2 weeks)	*M. digitata* outside Biorock (cm/2 weeks)
T0-T1	0.68	0.44	0.12	0.13
T1-T2	0.766	0.62	0.2	0.21
T2-T3	0.98	0.68	0.18	0.18
T3-T4	1	0.65	0.28	0.2

4.39 times faster than away from Biorock. The growth rate of *M. digitata* is 3.34 times faster on Biorock than away from Biorock. The growth rate of *A. formosa* at Biorock substrate is 1.4 times faster than *M. digitata*.

Based on this concept Biorock, $CaCO_3$ precipitate formed by reaction of electricity from the anode and cathode. In the context of electro chemistry (electrochemistry), the cathode is a connection that supplies electrons to the ions in solution to promote a chemical reaction occurs. Cathode can be made of various minerals which delivers electricity, after several trials, it is advisable to use non-galvanized iron ram.

While the anode is a connection that takes electrons from the ions ions in the solution in order to facilitate chemical reactions occur. Anodes can be made of carbon, tin or titanium (Furqan, 2009).

Judging from the formation of mineral deposits, mineral accretion is not a direct oxidation reactions such as elektroplatting, but is an indirect process, in which mineral deposition occurs as a byproduct of changes in pH around the cathode when the process of electrolysis on sea water (Furqan, 2009).

When chlorine and oxygen accumulated around the anode, then the minerals magnesium and calcium are abundant in sea water will settle to the cathode. Deposited material is composed largely of calcium carbonate which is a chemical structure similar to coral reefs (Goreau, 2009). Hard coral/ rock in Biorock structure can grow 2-6 times faster than the coral that grows in nature. Biorock will grow coral in branched and has a beautiful color and can recover from physical damage up to 20 times faster than natural reefs, also has a survival rate 50 times higher against the high temperatures can cause bleaching events (Goreau, 2009).

The differences of growth rate of both coral species can maybe explain by the fact that these 2 species have different coralite structure. *A. formosa* have axial and radial coralite but *M. digitata* only have radial coralite. Biorock reef restoration method greatly and positively affects the growth of coral colonies. Mineral accretion on Biorock trigger calcification process of coral that transplanted on Biorock.

CONCLUSION

Growth rate of *Acropora formosa* and *Montipora digitata* on Biorock substrate is 3-7 times faster than those on the blocks outside Biorock structure.

The magnitude of the Biorock effect is various depending on coral species, where positive effect of the Biorock on *A. Formosa* were more than those on *M. digitata*.

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