Using non-invasive method to detect the actually growth rate of hard corals on electro-stimulated structure in Sabang-Aceh, Indonesia

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Introduction

Calcium carbonate ($CaCO_3$) is the main mineral produced by reef-building Scleractinian corals and calcareous algae. A biorock® method invented and developed by Prof. Wolf Hilbertz and Dr. Thomas J. Goreau has shown that it can generate calcium and magnesium minerals as a crystalline coating over artificial structures. Biorock® is capable producing minerals by applying a low voltage direct electrical current, which is commonly recognized as mineral accretion. The mineral, largely aragonite ($CaCO_3$) and brucite ($Mg(OH)_2$), is quite identical with reef limestones in term of chemical and physical properties. Some studies show this method has success to increase growth and survival rate on some coral species. However, there is still debate to what the exact growth rate is in situ since most of the literature used the increment of fragment to infer growth rate. In present study, we will apply Biorock approach with a 3 D measurement to reveal a precise growth rate based on its planar area and volume. We have conducted two photographing trials including in swimming pool and Kenting between November 2018 to March 2019 with either coral skeleton or live fragments. Through series of photographs covered a parametric view of fragments, we are able to develop an auto-detected software which can generate a 3D model of coral fragment. The software is expected to complete around May 2019. This software will be used to estimate surface area and volume of fragments in the field. Three electro-stimulated structures will be installed at 5-6m depth in Sabang-Aceh with an additional control (no-electricity).

Objective

In this study, we will observe and analyse the growth and survival rate of hard coral that stimulated by electrolysis

Materials and methods

The study will use following materials, i.e. iron (cathode), titanium mesh (anode), solar panel, power supply, controller, wire, cable ties, epoxy, multimeter, GoPro 3+ black with dual 3D hero system, a camera sitting frame (80x80cm), a distance metal for camera with calibration bar (20cm), underwater stationery, diving equipment, coral fragments and a software which can generate the 3D model base on underwater photos.

Fig 1. Specimens used on preliminary study (a) *Acropora* sp. (b) *Pocillopora* sp.

Fig 2. Two GoPro Hero 3+ embedded in a dual system dive housing (a) front view and (b) back view

This study will use 3 genera comprising of *Acropora*, *Pocillopora* and *Porites*. The number of *Acropora* and *Pocillopora* at a biorock structure are 16 fragments that will be obtained from 4 different colonies, respectively. While, samples of *Porites* are 32 fragments consisting of 8 different colonies. Therefore, samples will be distributed on a structure which has 64 live fragments. Then, the total coral fragments that will be used for 3 biorock structures and a control structure are 256 fragments.

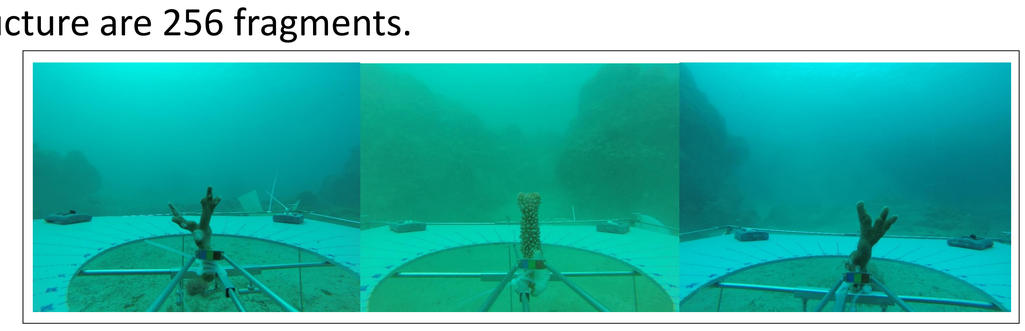

Fig 3. A number of fragment photographed 360^0 at Kenting MPA, Taiwan

All coral fragments will be photographed with a fix distance between lences and coral fragment. Through an advance of digital 3D GoPro camera, it will decrease time spent on the field and increase the precise of coral fragments growth. We will develop an auto-detect software to generated 360^0-photograph from a fragment to be a 3-dimensional view. We will collect photos every four months in a year. Several projects will be developed base on this experimental design including the biodiversity of benthos associated with this structure and mineral composition on cathode etc.

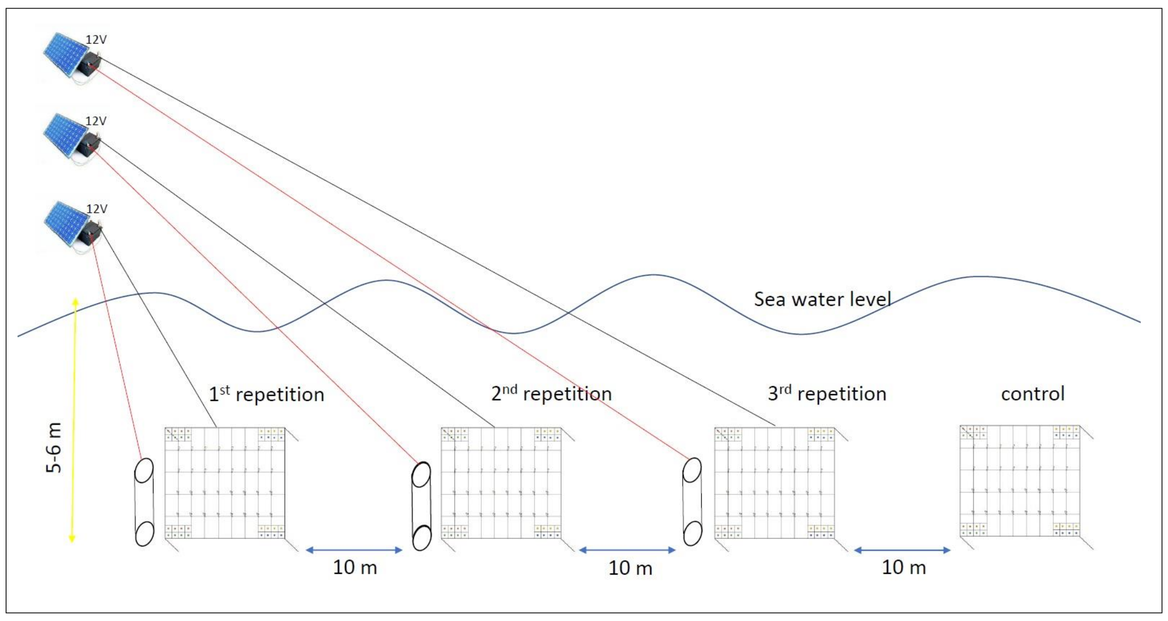

Fig 4. Design of electrolysis structure on coral transplantation

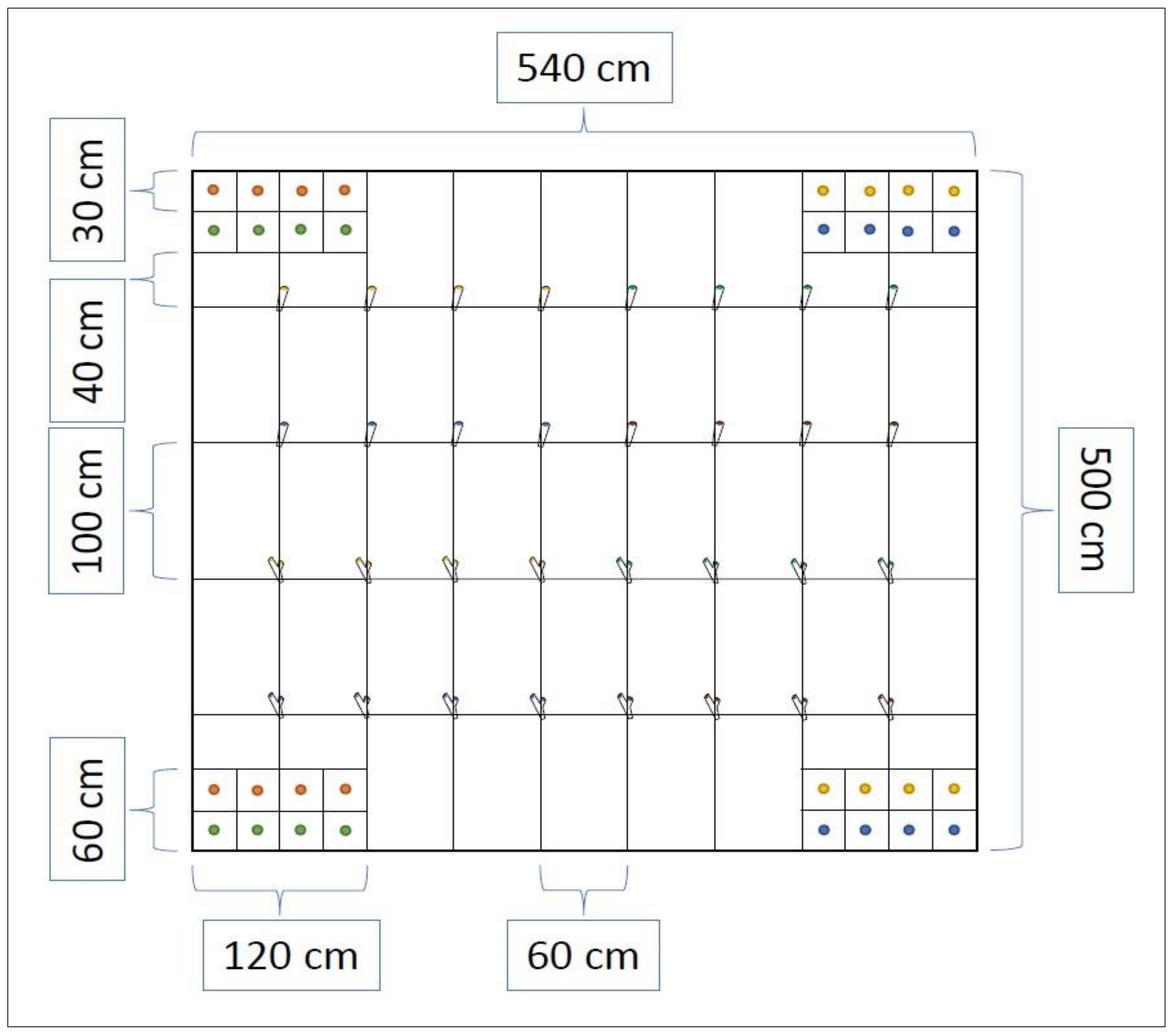

Fig 5. A Schematic of cathode structure with included several number of fragments

Expected Result

1. Growth and survival rates of different coral species which transplant to electro-simulated structure will be revealed.
2. The increment of total volume will be used for comparison between branching corals, the planary area will be used for the comparison between branching and massive corals.

Side projects

1. The biodiversity of benthos associated on structure
2. Mineral composition on cathode
3. Symbiodinium and bacterial community in coral before and after the treatment
4. Fish and other inhabitants around the treatment structure before and after submerging