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THE SUCCESSFUL TRANSPLANTATION OF *ACROPORA MICROPHTHALMA* AT BARRANG LOMPO REEF EDGE, SOUTH SULAWESI

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ABSTRACT

Research on transplantation of *Acropora microphthalma* was conducted at Barrang Lompo Island reef edge of South Sulawesi from September to December 2002. The aim of this research was to know the successful rate of several coral transplantation methods for rehabilitation of coral reefs, covering the survival and growth rates. The methods used were framework earthenware (FE), iron stake (IS), dead coral tying (DCT), where the mother colony (MC) was used as control. These transplantation techniques were applied at five meter depth in two stations, north and south sites of the island. The survival rate for each method FE, IS, DCT and MC at the northern station was 85.71; 42.86; 85.71; 57.14%, while for southern station was 85.71; 85.71; 71.43 and 85.71%, respectively. The growth rates observed for each method at the first station were 2.18; 2.02; 1.40; 1.05 cm, and for the second station were 2.56; 2.21; 1.61; 1.04 cm, respectively.

Keywords: coral reefs, growth rate, Spermonde, survival rate, transplantation techniques

INTRODUCTION

Indonesia possesses the wealthiest coral reef ecosystem in the world, harboring a high diversity of marine fauna and flora. Nowadays, more than 480 species of stony corals accounted for 60% of stony coral in the world, have been described from eastern Indonesian waters (Burke *et al.*, 2002). Coral reef conditions in Indonesia are classified into: 7% very good, 53% moderate, and 40% heavily damaged (Ikawati, 2001). Spermonde Archipelago is known as one of the areas having very diverse coral species. Coral reefs in Barrang Lompo Island as part of Spermonde Archipelago is categorized as moderate with coral cover of 41.86% (Raymakers, 2001; Yuliantri, 2002).

Human activities have been known as one of several factors that affect coral cover. Restoration of destructed ecosystem can be done using several methods such as coral transplantation and artificial reef. As coral needs longer time to recover in nature, transplantation is considered to help restoration. However, transplantation without artificial fragment is costly as a big colony is needed and in some extent it could hamper overall

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ecosystem. A transplantation using artificial fragment is preferable due to fact that it is cheap and rehabilitation time is quick. Therefore, this method can be used by ordinary people to develop, utilize and rehabilitate coral reefs (Sandy, 2000).

Branching coral *Acropora* is a genus that is suitable for transplantation. It has a high survival rate, beautiful, high growth rate and capability to cover on empty coral reef area. In addition, *Acropora* can grow up to 5-10 cm per year (Harriot and Fisk, 1988; Edwards and Clark, 1998). Several coral transplantation techniques using different substrates such as cement, plastic glue, stainless steel, plastic iron wire have been tried (Maragos, 1974; Birkeland *et al.*, 1979; Auberson, 1982; Harriot and Fisk, 1988). Transplantation of 11 species of coral using ceramic as artificial substrate has been attempted in Indonesia (Sadarun, 1999).

This paper describes the growth rate and survival rate of transplanted *Acropora microphthalma* using several methods of transplantation.

MATERIALS AND METHODS

This study was done at Barrang Lompo reef edge of South Sulawesi, from September to December 2002. Experiments were placed at two areas at five meters depth, i.e. north site (05°02'29.54" and 199°19'26.52") and south site (05°03'19.98" and 199°19'30.60"). Transplantation methods used were Framework Earthenware (FE), Iron Stake (IS), Dead Coral Tying (DCT), where Mother Colony (MC) was used as control. Each method consisted of seven replications. Schematic of transplantation methods was shown in Fig. 1. Initial length of *A. microphthalma* (± 10 cm) was noted before it was placed on substrates. First measurement was done two weeks after specimens being transplanted. *A. microphthalma* skeletal characteristics were: corallum arborescent, branching 45° to 90°; branches up to 14 mm in diameter.

Water quality variables such as, current, temperature, salinity, alkalinity and turbidity, were recorded using current meter, thermometer, salinometer, alkalinity paper and secchi disk, respectively.

In this study, two main variables, growth and survival rate were observed. Growth was measured every two weeks using calipers (0.05 mm scale) and it was expressed as $\beta = L_t - L_o$, where â = growth (mm/2 weeks) and L_o = initial average hight and L_t = average hight after t (time). Survival rate was calculated using the equation $S = \frac{N_t}{N_o} \times 100\%$ where N_o = initial number of individual / colony and N_t number of individual / colony at the end of study. Data was subjected to Univariate Varian Analysis and Tukey Test using SPSS version 10.

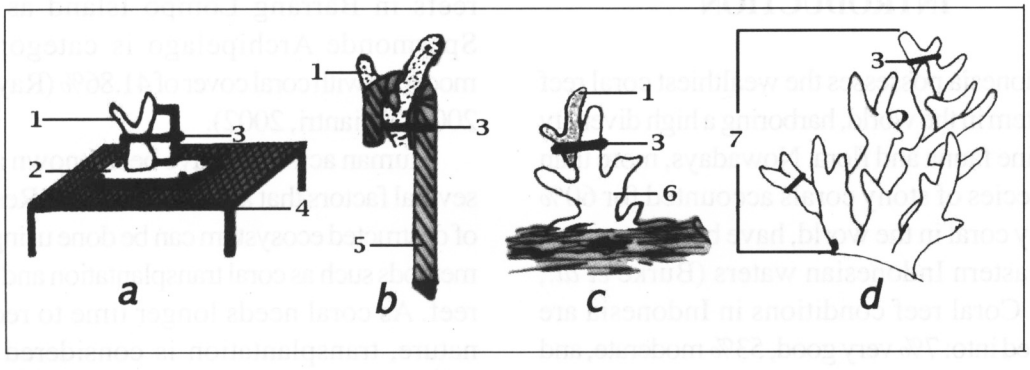

Figure 1. Transplantations techniques used in this study: a) FE (Framework Earthenware), b) IS (Iron Stake), c) DCT (Dead Coral Tying), d) MC (Mother Colony). Note: 1) coral fragment, 2) earthenware, 3) cable tie, 4) iron frame, 5) iron stake, 6) dead coral, 7) mother colony

RESULTS AND DISCUSSION

The survival rate (SR) of *A. microphthalma* on different substrate is shown in Fig. 2. It appears that SR range from 42.86 to 85.71% on north site, while at south site it was from 71.43 to 85.71%.

The growth of *A. microphthalma* at Barrang Lompo reef edge varied among methods used as presented in Fig 3. It ranged from 1.05 ± 0.02 to 2.18 ± 0.10 cm at north site and from 1.04 ± 0.02 to 2.56 ± 0.11 cm at the south. There were significant difference on growth between sites and among methods (Table 1 and 2), but no interaction between sites and methods. However, *A. microphthalma* on FE and IS has grown significantly higher compared to that on DCT and MC (Fig. 3).

Fortnightly measurements on growth rate of *A. microphthalma* were shown in Fig. 4 (north site) and 5 (south site).

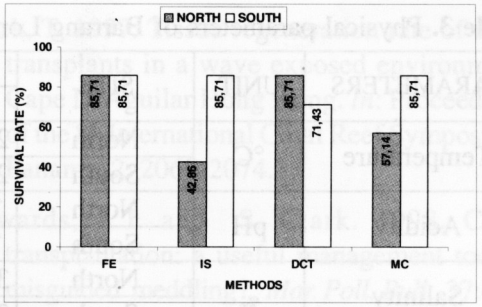

Figure 2. Survival rate of *A. microphthalma* using different substrate of transplantations at two study sites

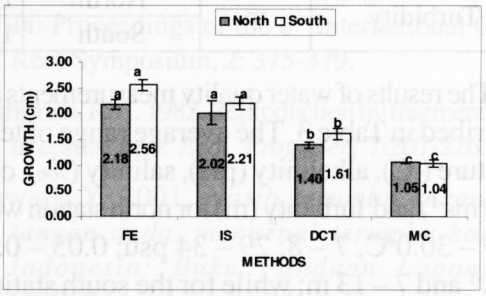

Figure 3. Growth rate of *A. microphthalma* using different methods of transplantation at two study sites

Table 1. The Result of univariate analysis

Source of variation	*SS*	*df*	*MS*	*Fs*	*Sig*
Site	0.420	1	0.420	7.183	0.011*
Method	11.628	3	3.876	66.362	0.000*
Site*Method	0.201	3	0.067	1.149	0.344
Error	1.986	34	0.058		
Total	146.676	42			

Table 2. Tukey analysis for different methods

METHODS	FE	IS	DCT	MC
FE	1.000			
IS	0.117	1.000		
DCT	0.000*	0.000*	1.000	
MC	0.000*	0.000*	0.001*	1.000

* Significance different at á = 0.05

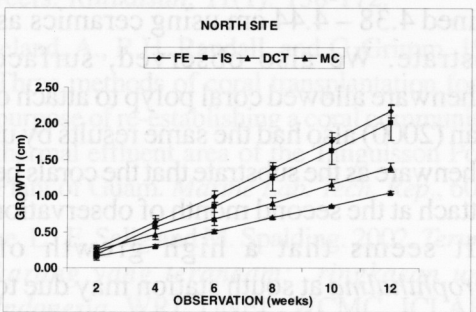

Figure 4. Growth of *A. microphttalma* at north site

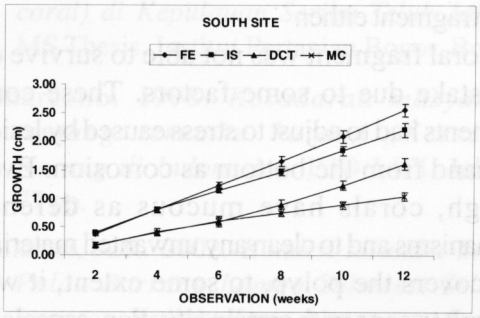

Figure 5. Growth of *A. microphthalma* at south site

Table 3. Physical parameters of Barrang Lompo waters from September to December 2002

PARAMETERS	UNIT	SITE	Fortnightly observation							AVERAGE ± SE
			I	II	III	IV	V	VI	VII	
Temperature	°C	North	27.9	28.7	29.8	30.2	30.9	31.0	30.5	29.9 ± 1.2
		South	27.6	28.7	30.0	30.2	30.6	30.9	30.5	29.8 ± 1.2
Acidity	pH	North	7.0	7.0	7.0	8.0	8.0	8.0	8.0	7.6 ± 0.5
		South	7.0	7.0	7.0	8.0	8.0	8.0	8.0	7.6 ± 0.5
Salinity	‰	North	34.0	33.0	31.0	30.0	30.0	29.0	29.0	30.9 ± 2.0
		South	34.0	33.0	32.0	31.0	30.0	29.0	29.0	31.1 ± 2.0
Current	m s^{-1}	North	0.06	0.08	0.08	0.08	0.05	0.06	0.07	0.07 ± 0.01
		South	0.06	0.05	0.05	0.02	0.03	0.04	0.06	0.04 ± 0.02
Turbidity	m	North	13.0	13.0	12.5	11.5	10.5	8.5	7.0	11.0 ± 2.34
		South	13.0	12.5	12.0	12.0	10.5	8.0	7.0	10.4 ± 2.34

The results of water quality measurements are described in Table 3. The average range of temperature (°C), alkalinity (pH), salinity (‰), current (ms^{-1}) and turbidity (m) for north station were 27.9 – 30.0°C, 7 – 8; 29 – 34 psu; 0.05 – 0.08 cm s^{-1} and 7 – 13 m; while for the south station, they were 27.6 – 31.0°C, 7 - 8, 29 – 34 psu, 0.02 -0.06 cm s^{-1} and 7 – 13 m, respectively.

Survival Rate

It takes about seven days for coral fragments to heal after having been cut. Using a different arborescent, Sadarun (1999) found that *A. formosa* needs seven to eight days to recover with 100% survival rate. Transplanted coral fragments have better adaptation level when their fragments were from a similar environment to habitat of mother colony (Suharsono, 1998)

In FE method, bio-erosion and algae caused the death of coral fragment of *A. microphthalma* at north site, while parrot fish was noted as a main cause for death at south station. Macroalgae of *Padina* sp and *Hypnea* sp that attached on earthenware did not affect coral growth. Similarly ascidians that lived on cable ties did not disturb coral fragment either.

Coral fragment was not able to survive on iron stake due to some factors. These coral fragments had to adjust to stress caused by lesion and sand from the bottom as corrosion. Even though, corals have mucous as defence mechanisms and to clean any unwanted materials that covers the polyp, to some extent, it was difficult to cope with certain situation, especially when coral fragment collapsed and covered by sand.

We observed death in DCT method was due to competition between *A. microphthalma* and turf algae. According to Nybakken (1992) turf algae could be the main competitor in coral reefs area where it can grow faster than corals themselves. This situation also occurred in using MC method where turf algae significantly increased after two weeks of transplantation. In addition, death of *A. microphthalma* was also caused by sea star *Acanthaster planci* as indicated in MC method. Obviously, *A. planci* killed basal part of mother colony, then this part was covered by turf algae where it finally destroyed.

Growth

We noticed that coral grew in axial direction two weeks after being transplanted. However, this growth only reached few millimeters. Corals that attached to FE attained the highest growth of 2.56 cm at south station and 2.18 at north station. This was in agreement with previous finding for different *Acropora* where after five months transplantation, (Sadarun, 1999). He found that *A. formosa* attained 4.38 – 4.44 cm using ceramics as the substrate. We also observed, surface of earthenware allowed coral polyp to attach on it. Johan (2000) also had the same results by using earthenware as the substrate that the corals began to attach at the second month of observation.

It seems that a high growth of *A. microphthalma* at south station may due to the fact that fewer predators occurred in this area.

Coral predators such as parrot fish and sea star *A. planci* were more abundant at north site than that at south site. Differences in percentage of coral cover between the two study sites contributed to predation level. A high percentage of coral cover at north area provided a good feeding ground for parrot fish.

Differences in growth rate of *A. microphthalma* may be due to season. This study was conducted during west season where north site of the island was exposed to big waves. This was in agreement with study conducted by Clark (1997) in which wave affected newly transplanted coral. Clark also stated that current could affect growth and mortality of coral.

Slow growth rate in IS method may be due to the corrosion of the iron in which corals have to use certain amount of energy to adapt with such condition. Highsmith (1982) argued that fragmented corals need to allocate a lot of energy to survive.

In DCT method, coral growth was observed not only toward the apical of the fragment, but also to its basal. By using this method, we also noticed that turf algae which grew on the dead coral also affected coral growth.

Finally, we conclude that *A. microphthalma* grew and survived better when using earthenware as transplantation substrate. Therefore, we recommend Framework Earthenware method for transplantation of branching coral. However, application of this method for others coral species needs further investigation.

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