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A preliminary study of corals recruitment using coral rubbles substrate in Seribu Island waters, Indonesia

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Abstract. Coral recruitment is important in natural recovery and coral rehabilitation program. Here, we tested the coral rubbles as substrate for coral recruitment. The study was conducted on the first week of September 2007 until the second week of January 2008 in Panggang Island, Seribu Islands, Indonesia. The results showed that the recruited coral were settled on the substrate in both depths (6 and 10 m). A total of 5 families of recruited coral were recorded during the study, namely Acroporidae, Pocilloporidae, Oculinidae, Fungiidae and Poritidae. There were no differences in term of the number of recruits that were found in 6 and 10 m depth.
Key Words: corals, destructive fishing, rubble, artificial reef.

Introduction. Destructive fishing practices are one of the critical threats on the coral reef ecosystem in Indonesia. According to Nontji (2004) in 2003, approximately 61% of Indonesian coral reef were in terrible condition, of these about 36% were in poor condition. One of the common threats is blast fishing practices. In remote areas, the blast fishing is more commonly practiced due no supervision by related agencies (Erdmann 1998; Kunzmann 2002).

Fox et al (2003) reported that rubbles can drift several centimeters (with some pieces of rubble drifting 10-15, or even 50 cm/day), which effectively forms ‘‘killing fields’’ for coral juveniles, hindering coral recovery. In the Philippines for example, many rubble fields virtually show no hard coral cover upon 20–30 years post-blasting (Raymundo et al 2007).

Several techniques have been utilized to restore coral reefs damaged includes the transplantation of living coral colonies (Clark & Edwards 1995; Harriot & Fisk 1995; Rinkevich 2000; Cabaitan et al 2008), eco-reefs modules (Moore & Erdmann 2002), electrolysis to accelerate the deposition of calcium carbonate and enhance the growth of the transplanted coral (Hilbertz 1992; van Treeck & Schuhmacher 1997), substrate stabilization (Rinkevich 2005), ship grounding, topography rebuilding with specialized cements, and transplantation (Hudson & Diaz 1988). In addition, rehabilitation of reef community has also been attempted through removal of macro algae (McClanahan et al 2001), bio-eroding sea urchins (McClanahan et al 1996) and clearing soft coral of the rubble (Fox et al 2003). However, these methods were costly, time consumed and skills. Therefore, various low-cost artificial substrates and methods have been tested in coral transplantation, for example, bamboos frame (Freytag 2001), string-grid method (Lindahl 2003), metal grid (Yap 2004), and cements (Dizon & Yap 2006). According to Lindahl (2003) the artificial substrates should possess the ability to avoid the abrasion,

dislodgement and transport due to water movement, and it should be placed high enough above the bottom substrate to minimize burial and abrasion (Fox et al 2005). However, transplantation methods using coral rubble as direct transplantation substrate has not been examined.
Hence, the objective of present study was to evaluate the corals recruitment on the rubble as an artificial substrate in Seribu Island.

Material and Method. The Seribu Island is situated in Jakarta City the capital of Indonesia. The study was carried out on September 2007 until January 2008. The study location was on the western reef-flat of the Panggang Island (Figure 1). Our preliminary observation showed that the corals condition in this location are considered in poor condition with the coral cover less than 25% and dead coral cover almost 50% in 6 to 10 meters depth, and the rubble covers reached 25%.

Figure 1. Location of the study site (pink circle = experimental site) within Seribu Islands (Fadli 2008).

The rubbles were collected from the vicinity of study sites. Approximately 7 kg of rubbles were collected and strapped with the nets (nylon and polyethylene nets) formed as basket nets substrate (20 cm x 30 cm x 40 cm in sized). A total of 56 baskets nets substrates were placed into two different depths (28 baskets at 6 m and 28 baskets at 10 m). The substrates unit were settled in the location using SCUBA equipment and a fisherman boat, and left for 135 days in the waters.

The new recruitments were monitored three times i.e. 85, 109 and 135 days after deployment in the waters. One basket of substrate was randomly taken at every monitoring time for further microscope analysis to observe the new recruitments. The basket sample was unscrambled then the rubbles were sorted out and the rubbles with new coral recruits were collected and bleached in 2% chlorine solution, and the samples were sun dried for 3 hours. Then after, every rubble sample was examined with a stereo microscope (10-63x magnifications).

The size and the families of the recruited corals were recorded and identified following Baird & Babcock (2000). Wilcoxon Rank Sum tests were utilized to test the differences of the recruit number according to the depths. All data were subjected to statistical analysis using JMP 7.0.1 software (trial version).

Results and Discussion. A total of 5 families of coral were recruited on the artificial reef substrates namely Acroporidae, Pocilloporidae, Oculinidae, Fungiidae and Poritidae. The Acroporidae was a predominant family in both depths (Figures 2 and 3, Tables 1 and 2). There were no differences on the number of recruit corals between 6 and 10 m depths. In addition, the average size of Acroporidae at 6 m and 10 m were 2.14 mm and 2.08 mm, respectively.

Table 1

Comparison of number of recruit corals according to depths (*significant difference (p<0.05))

	Non-parametric comparisons - Wilcoxon/Kruskal-Wallis test	
	Statistic	*P*
6 m vs. 10 m	1136	0.0756

Table 2

Comparison of number of recruits among family per depth (*significant difference (p<0.05))

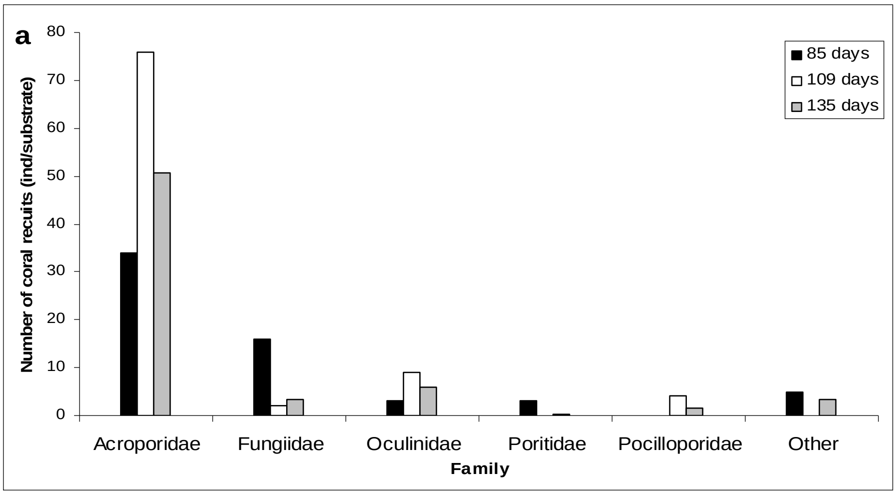
	Non-parametric comparisons Wilcoxon/Kruskal-Wallis test	
	Statistic	*P*
Acroporidae vs. Pocilloporidae vs. Oculinidae vs. Fungiidae vs. Poritidae (6 m)	25.27	0.0001*
Acroporidae vs. Pocilloporidae vs. Oculinidae vs. Fungiidae vs. Poritidae (10 m)	17.21	0.0041*

We presumed that the crevices among rubbles have been providing favorable spaces for growing of new coral due to this space has protecting from coral predator and extreme environment condition. Furthermore, the rubble provides an appropriate biofilm for coral larvae to settle (Harriott & Fisk 1988; Pawlik 1992; Mundy 2000; Harrington et al 2004). In this study, the new recruited coral are growing at the edge of rubble in the first layer of the substrate (approximately 5 cm from the surface). The corals prefer the edges of rubble probably due to this side providing higher sun light intensity. This result is in agreement with Mundy & Babcock (1998) who reported the Acroporids prefers high light intensity during settlement.

In the term of recruited corals family, our finding is in agreement with Saputra (2004) who conducted coral settlement study in other parts of the Seribu Island (at Payung Island). He found that Acroporidae, Pocilloporidae, Poritidae and Occolunidae were predominant in this location. These families are the common corals in Seribu Island waters (Estradivari et al 2007). In addition, the higher numbers of Acroporidae settled on the tested substrates indicate that probably their spawning season has occurred during this period (September–January). This finding is corresponding with Fox (2004) who reported that Acroporids in Komodo National Park in Eastern Indonesia were settled primarily during October-April, while Pocilloporids and Poritids settled over the years. Moreover, Tomascik et al (1997) also reported that the mass spawning season of the coral in the central Java Sea is occurred during October and November.

However, the higher numbers of recruits on the substrates do not necessarily correspond to the number of recruits that will survive until they become adult corals, it means that not all of recruited corals will be survived. The survival and growth of corals are strongly depending on the environmental conditions for example temperature, turbidity and salinity, predatory and nutrients. Fox (2004) stated that even they found a very high number of recruits (potential recruitment) in their tiles in Komodo National Park, but in the real substrate (actual recruitment) the recruits were very low, suggesting varying survival of recruits after settlement.

Figure 2. Acroporidae, the predominant recruited coral family at Seribu Island.



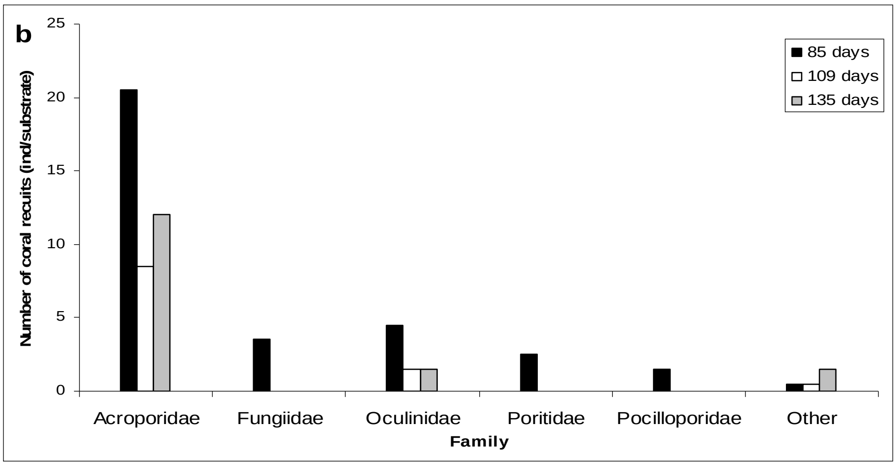


Figure 3. Number and family of the recruits pooled per each depth (a) 6 m and (b) 10 m. 85 (n=4), 109 (n=4) and 135 (n=12) days after deployment.

Conclusions. The corals were recruited and settled on the rubble substrates in both depths (6 and 10 m). A total of five families of coral recruits found on the substrates i.e. Acroporidae, Pocilloporidae, Oculinidae, Fungiidae and Poritidae. The Acroporidae was a predominant family in both depths. There were no differences on the total number of recruit corals between 6 and 10 m depth. The number of recruits that could be found in this study indicates that this corals rubble substrate can be used as an alternative media for coral recruitment. However, this media requires testing at additional sites, to determine the replicability of the results.

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