# Composition of Juvenile Corals in Different Morphotypes of Substrate at Karimunjawa Archipelago, Indonesia

*by* Munasik Munasik

# Composition of Juvenile Corals in Different Morphotypes of Substrate at Karimunjawa Archipelago, Indonesia

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## *Abstract*

*Patterns of coral recruitment are partially explained by fitness consequences of substrate selection, and may be affected by substrate morphology. This study examined juvenile coral assemblages on morphologically different dead coral substrate in shallow water reefs (4-5 m) at Karimunjawa Island, Java Sea (Indonesia). Surveys on juvenile corals were performed using 0.5×0.5 m transects on two different morphotypes of natural substrate; tabular dead corals (stable) and branching dead corals (unstable). Results showed that the morphological characteristics of dead coral substrate had a significant influence on the generic composition of juvenile corals. Coral recruits on tabular dead coral substrate (stable) which composed micro-cervices was more diverse than on branching dead coral substrate (unstable). Juvenile corals of the genus Acropora were dominant on (exposed microhabitats of) tabular dead coral substrate, while those of the genus Fungia and Montipora were dominant on (cryptic microhabitats of) branching dead coral substrate. These results suggest that Acroporid juveniles can be settled to the various morphotype of the substrate, thus the distribution pattern of juvenile corals in shallow reef Karimunjawa maybe correlated with the distribution pattern of natural substrates.*

***Keywords**: juvenile, microhabitat, dead coral, substrate Karimunjawa Archipelago*

## Introduction

Coral Recruitment is the basic information to determine the pattern of distribution of hard coral in coral reef area. Recruitment of coral can be interpreted as a hard coral larval settlement success to happen deposition process to form the skeleton on the substrate surface and last up to a certain period (Wallace, 1985; Harrison and Wallace, 1990). Recruitment of hard corals (Scleractinia) varies between locations (spatial), the type of substrate and occurs seasonally or temporally (Dunstan and Johnson, 1998). Larval recruitment is essential processes for coral population maintenance and reef recovery. Coral larval settlement which succeeds is determined by its behavior in the planktonic stage and surface structure of the substrate (Babcock and Mundy, 1996; Nozawa, 2010). Coral larvae are generally settled to the bottom of the substrate (Harriott and Fisk, 1987), and settled on micro-crevices (Nozawa, 2008, 2012) and also on the sub-cryptic settlement microhabitat (Arnold *et al*., 2010). A microhabitat considerably as protective refuges for coral recruits by fish and invertebrate predation (Harriott, 1983; Babcock and Mundy, 1996; Edmunds *et al*., 2014; Doropoulos *et al*., 2016). Micro-crevices considerably influence coral settlement and early post settlement survival (Nozawa, 2008, 2010; Nozawa *et al*., 2010; Edmunds *et al*., 2014) and the ability of microhabitat selection by coral larvae is also influenced by the species and life form of corals (Babcock and Mundy, 1996).

The present study examines composition of coral recruits on different morphotypes of substrate at the reefs of Karimunjawa Archipelago, Java Sea. Natural substrates of Karimunjawa reef flat are mostly composed by two different dead coral structures due to physical disturbance during west monsoonal storm (Tomascik *et al*., 1997; Nababan *et al*., 2010) i.e. branching dead corals and tabular dead corals. Branching dead corals as unstable substrates which are found in west Sambangan Island reef while tabular dead corals are stable substrates and available in east Genting Island reef. Branching dead corals are generally assorted form made of broken dead coral, rubble and cemented together by CCA (Crustose Coralline Algae) and their surface structure is characterized as plain surfaces (cryptic microhabitats) while their surface of tabular dead corals generally composed by micro-crevices

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(exposed microhabitats). Previous study indicated that varied in mechanical stability (stable vs. unstable) substrates influence settlement structure (Yadav *et al*., 2016). The results are needed to the underlying knowledge of the vulnerability to physical disturbance in structuring coral communities of Karimunjawa (Java Sea).

## Materials and Methods

The survey of coral recruitment on different morphotypes of substrate were performed in 3 (three) station which is 2 (two) stations in natural branching dead corals substrates (unstable substrate) of west Sambangan Island, and one station as natural tabular dead corals (stable substrate) in the east side of Genting Island, Karimunjawa Archipelago (Figure 1.). In order to determine these natural substrates, has been examined in the reef flat by Swim Time method. Subsequently, square transect of 0.5 X 0.5 m were applied at a depth of 4-5 m to observed juvenile corals. A total of 49 square transects have been observed in stable substrate of Genting Island (ST-1; 5° 50' S, 110° 37' E), while for observations on unstable substrates of Sambangan Island in Station 2 (ST-2; 5°50' S, 110°34' E) totally 6 square transects and totally 8 square transects in station 3 (ST-3; 5°50'S, 110° 35' E). Juveniles of hard coral measuring ≤ 5 cm (using a scale/ruler) contained in the squared transects photographed using Underwater Digital Camera Canon G-10. Identification of juvenile of hard coral genus (Scleractinia) made from digital images taken at the time scale survey with the help of computer software. Determination types of juvenile hard coral genus undertaken to follow Veron (2000). Coral juvenile density data that found in the transects are then calculated by using the formula of Odum (1971) that the number of juvenile corals per unit area.

## Result and Discussion

### *Composition of juvenile corals on tabular dead coral substrate*

A total 233 juvenile corals (Scleractinia) were observed on natural tabular dead corals (stable substrate) in the east Genting Island. The highest density of coral recruits was 24 colonies/transect (0.5 X 0.5 m) with an average density of 4.76 juvenile/transect. Seven family and twelve genera were found in the stable substrates, including Acroporidae, Pocilloporidae, Poritiidae, Faviidae, Oculinidae, Agariciidae, and Mussidae (Table 1.). While genera of juvenile corals were found in stable substrate as follows Acropora, Montipora, Astreopora, Pocillopora, Porites, Favia, Favites, Goniastrea, Cyphastrea, Galaxea, Pavona, Lobophyllia. Most of juvenile corals were found on the stable substrate Family Acroporidae especially genus Acropora is about 47.6% (Figure 2). Subsequently, Porites (20.2 %), Favites (10.2%), Pocillopora (7.2%), Montipora (6.9%) and Galaxea (3.4%) are found in the stable substrates.

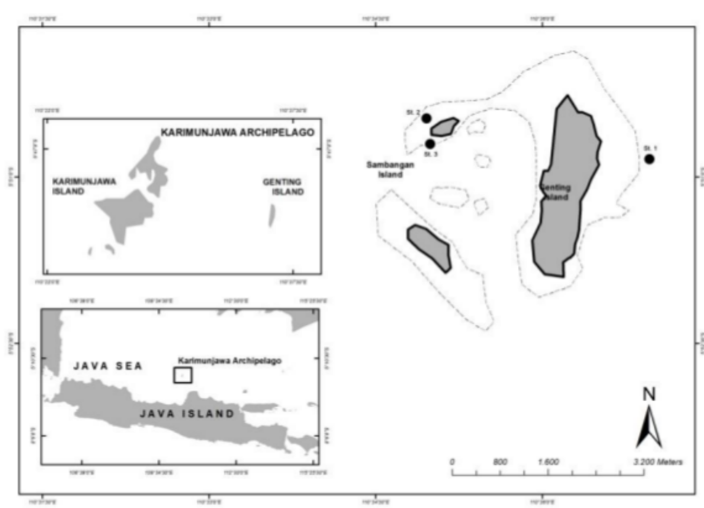


**Figure 1.** Study site at Genting Island and Sambangan Island, Karimunjawa Archipelago, Indonesia

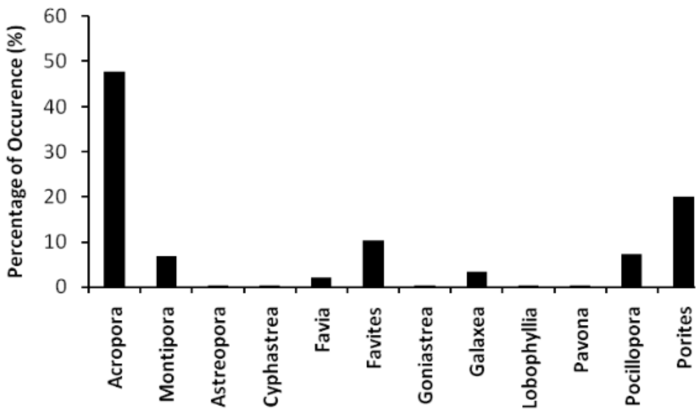


**Figure 2**. Percentage occurrence of coral juvenile on the surface of stable substrate at Genting Island, Karimunjawa.

Corals recruits were settled on the surface of natural tabular dead corals which composed more micro-cervices. Acropora juveniles generally showed planar growth and grew initially by budding daughter polyps in a small hole (cryptic) and microhabitat, and then the encrusting Acropora grew to branching form in open surfaces of substrate. The results indicated that dead table corals substrate is highly preferred by coral recruits because their composition of more micro-crevices (Nozawa *et al*., 2010). This study also showed that the natural tabular dead corals substrate is composed many genera of coral recruits (Figure 3).

***Composition of juvenile corals on branching dead coral substrate***

A total of 59 colonies and 28 colonies of juvenile hard corals (Scleractinia) respectively observed on natural branching dead corals substrates (unstable substrate) of west Sambangan Island in Station 2 and Station 3 Sambangan Island. The highest density of corals recruit was 17 colonies/transect (0.5 X 0.5 m), while the average density of corals recruit in Station 2 (9.8 colonies/transect) was higher than in Station 3 (3.5 colonies/transect). Six family were found in Station 2, while four family were recorded in Station 3. Family of juvenile corals which found in Station 2 is Acroporidae, Faviidae, Fungiidae, and Oculinidae, while in Station 3 is Acroporidae, Fungiidae, and Oculinidae (Table 2.). Generic composition of coral juvenile in both station of Sambangan Island showed a similar which is Acropora, Montipora, Fungia and Galaxea (Figure 4.).

**Table 1**. Generic composition of coral juvenile (Scleractinia) on the dead massive coral substrate in the reef flat of Genting Island, Karimunjawa. The number of juvenile corals and its proportion (%) in each genus are shown.

| No | Family | Genera | Number (% Occurrences) |
|---|---|---|---|
| 1 | Acroporidae | Acropora | 111 (47.6) |
| 2 | Acroporidae | Montipora | 16 (6.86) |
| 3 | Acroporidae | Astreopora | 1 (0.43) |
| 4 | Pocilloporidae | Pocillopora | 17 (7.3) |
| 5 | Poritiidae | Porites | 47 (20.2) |
| 6 | Faviidae | Favites | 24 (10.3) |
| 7 | Faviidae | Favia | 5 (2.14) |
| 8 | Faviidae | Goniastrea | 1 (0.43) |
| 9 | Faviidae | Cyphastrea | 1 (0.43) |
| 10 | Oculinidae | Galaxea | 8 (3.4) |
| 11 | Agariciidae | Pavona | 1 (0.43) |
| 12 | Mussidae | Labophyllia | 1 (0.43) |
| | | | 233 |

Branching dead corals substrates in west Sambangan Island are generally assorted form made of broken dead coral, rubble and cemented together by CCA and their surface structure is characterized as plain surfaces and frequently covered by turf algae and dominated by specific generic. Consequently, density of juvenile corals which settled on branching dead coral substrate (unstable) is lower than density of coral recruits on stable substrate and the coral recruits were dominated by coral mushroom Fungia and coral foliose Montipora (Figure 5.). The results confirmed

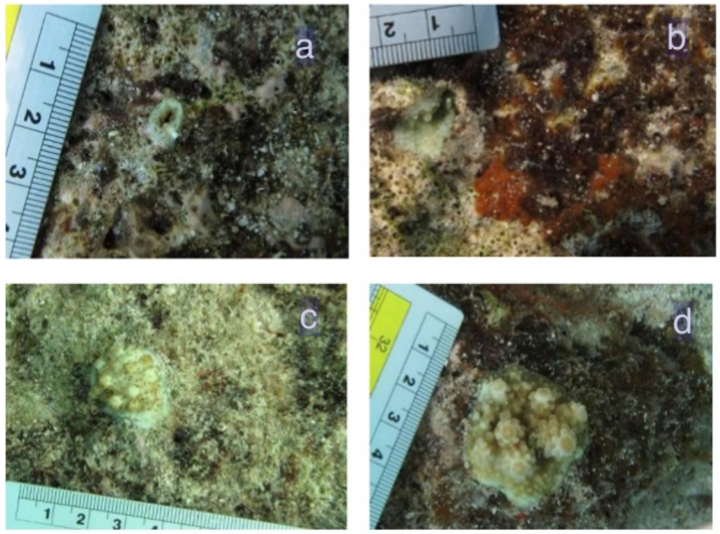


**Figure 3.** Juvenile Acropora settled on the dead massive corals substrate on the small hole (a) and small refuge (b), after survived and then growing to make some small branchs (c, d).

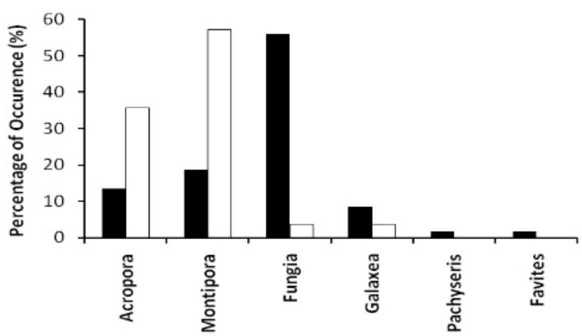


**Figure 4**. Percentage occurrence of coral juvenile on the surface of dead branching corals substrate at Sambangan Island, Karimunjawa. **Note.** □ : Station 3, ■ : Station 2

**Table 2.** Generic composition of coral juvenile (Scleractinia) on dead branching coral substrate in the reef flat of Sambangan Island, Karimunjawa. The number of juvenile corals and its proportion (%) in each genus are shown.

| No | Family | Genera | Number (% Occurrences) | |
|---|---|---|---|---|
| | | | ST-2 | ST-3 |
| 1 | Acroporidae | Acropora | 8 (13.5) | 10 (35.7) |
| 2 | Acroporidae | Montipora | 11 (18.6) | 16 (57.1) |
| 3 | Faviidae | Favites | 1 (1.7) | - |
| 4 | Faviidae | Pachyseris | 1 (1.7) | - |
| 5 | Fungidae | Fungia | 33 (55.9) | 1 (3.6) |
| 6 | Oculinidae | Galaxea | 5 (8.5) | 1 (3.6) |
| | | | 59 | 28 |

to Yadav *et al.* (2016) that structure on reef varied in mechanical stability and substrat composition.

Coral larvae may select microhabitat based on the surface structure and substrate composition (Nozawa, 2008; Yadav *et al.*, 2016). Surface structure of branching dead corals substrates generally plain and covered by turf algae rather than tabular dead coral composed by micro-crevices. The surface structure of tabular dead coral enhanced both settlement rate and survival rate of juvenile coral (Nozawa, 2008). Coral larvae behavior were similar among species while larval size is varied among taxa (Whalan *et al.*, 2016), suggesting surface structure had influence taxa composition in

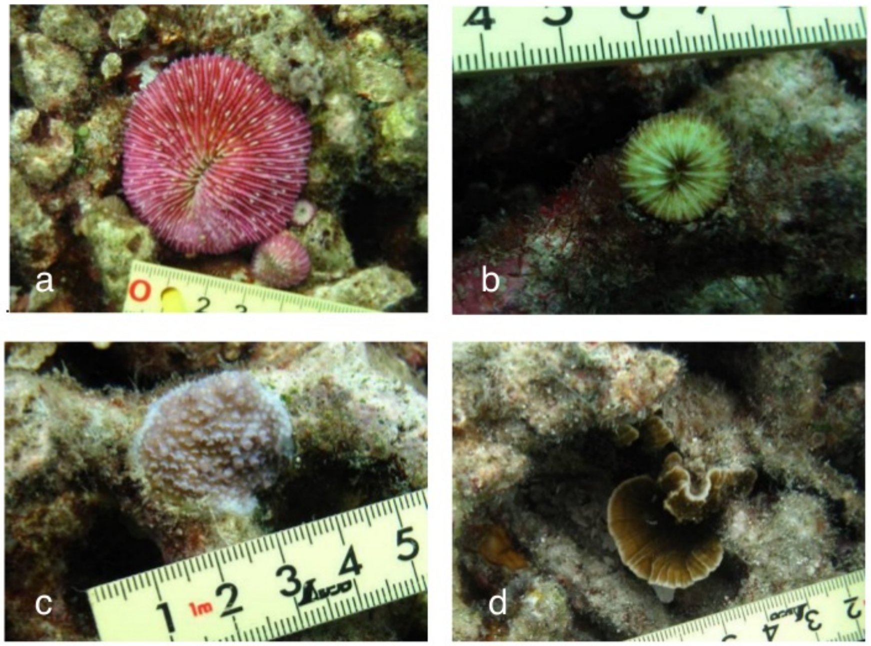


**Figure 5.** Coral juvenile settled on small refuge of the unstable substrate at Sambangan Island, Karimunjawa (a. Juvenile Fungia in various stages; b. Juvenile Fungia; c. Acropora; d. Montipora)

coral settlement. Solitary coral Fungia is generally gonochoric brooder (Loya *et al*., 2012), produce larvae had high tolerance to elevated temperature stress (Baria *et al*., 2015) and can recruit locally. The results of this study indicate that the solitary coral (free-living) Fungia has settlement preferences on to microhabitat under surface and cryptic of branching dead corals substrates while branching coral Acropora prefer microhabitat on the upper surface of the tabular dead coral substrates.

## Conclusion

Coral recruits on tabular dead coral substrate (stable) which composed micro-crevices was more diverse than on branching dead coral substrate (unstable). Juvenile corals of the genus *Acropora* were dominant on (exposed microhabitats of) tabular dead coral substrate, while those of the genus *Fungia* and *Montipora* were dominant on (cryptic microhabitats of) branching dead coral substrate. The results suggest that Acroporid juveniles can be settled to the various morphotype of the substrate, thus the distribution pattern of juvenile corals in shallow reef Karimunjawa may correlated with the distribution pattern of natural substrates.

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