

## Short Communication: Coral reefs condition in Aceh Barat, Indonesia

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**Abstract.** Annas RA, Muchlisin ZA, Sarong MA. 2017. Short Communication: Coral reefs condition in Aceh Barat, Indonesia. *Biodiversitas* 18: 514-519. The objective of the present study was to assess the condition of the coral reef ecosystems in the western region of Aceh Province. The study was conducted from September to November 2015 in two locations: Johan Pahlawan and Samatiga Subdistricts, and every location has two sampling sites. The Point Intercept Transect (PIT) method was used in this study. A total of two transects were used at 4-meter and 8-meter depth, respectively. The measured parameters were the percentage of live and dead coral covers, the number of genera, growth forms, species diversity, and dominance indices. Live corals were only found in Lhok Bubon, Samatiga Subdistrict, at 4-meter depth with a coral cover of 17.61%, and no corals were found at 8 meters. In addition, no live corals were also detected in Suak Indrapuri, Johan Pahlawan Subdistrict, at both 4- and 8-meter depth. There were five genera recorded in Lhok Bubon: *Favites* at 3.77% cover, *Montastraea* at 1.89% cover, and *Montipora* and *Porites* with coral covers of 8.18 and 3.14%, respectively. The diversity and dominance indices of live corals in Lhok Bubon were 1.94 and 0.45, respectively, indicating a low degree of diversity and predominant of *Montipora*. It is concluded that coral reefs condition in Aceh Barat was categorized as a severely damaged condition.

**Keywords:** Coral cover, *Favites*, *Montastraea*, *Montipora*, *Porites*

### INTRODUCTION

Indonesia has the highest ecological biodiversity in the world after Brazil (Muchlisin and Siti-Azizah 2009) including coral reefs. The area of coral reefs in Indonesia is estimated to be 87,500 square kilometers or 14% of the overall coral covers worldwide (Aldyza et al. 2015). This ecosystem can be found throughout Indonesia; this is because Indonesia has the tropical climate, so it is very suitable for the life and growth of coral reefs (Supriharyono 2000a; Fadli et al. 2013; Saptarini et al. 2017). A total of approximately 590 species of coral have been reported in the waters of Indonesia (Suharsono 2004; Veron 1995; Veron 2000) and several species are endemic to Indonesian waters (Rudi et al. 2009).

Aceh Province is one of the areas that have coral reefs. Rudi et al. (2012a) reported that the coral reefs in the waters of Aceh are a mix of species from the Indo-Pacific, the Indian Ocean, and the Andaman Sea. Furthermore, Rudi et al. (2012a) recorded 133 coral species on Pulau Weh, three of these were new records for the region, and five were presumed to be new species. Unfortunately, the condition of coral reefs in Aceh is threatened by human perturbations (Baird et al. 2005; Campbell et al. 2007) and climate change (Guest et al. 2012; Bridge et al. 2014). For example, coral bleaching during 2010 caused the death of almost 80% of the corals in the shallow waters of Pulau Weh (Ulfah 2011; Rudi et al. 2012b; Ilhamsyah et al. 2014), while damaging fishing practices (Campbell et al.

2012) and sedimentation are other threats to coral reefs in Aceh and Indonesia in general. Fortunately, the latest assessment on coral covers in the northern region of Aceh (Weh Island) has been recovered significantly from 24.33% to 49.38% during 2009 and 2011, respectively (Muliari 2011). This natural process of recovery is potentially assisted by the development of new marine protected areas (MPA) on Pulau Weh (Aldyza et al. 2015).

Study on the coral reefs in Aceh waters is still in its infancy and the previous reports were mostly focused on the northern region of Aceh especially in Pulau Weh (Sabang) and Pulau Aceh (Rudi et al. 2009; Rudi et al. 2012a; Rudi et al. 2012b; Ulfah 2011; Muliari 2011; Baird et al. 2012; Fadli et al. 2014; Aldyza et al. 2015). Meanwhile, there were very limited reports from other regions of Aceh. The field observation showed that the coral reefs ecosystem also occurred in the western region of Aceh, for example, Banyak Islands, Simeulue Island, and Aceh Barat waters. However, few scientific reports on coral reef condition from this region are available (Herdiana et al. 2008).

According to local fishermen of Aceh Barat coral reefs occur in several parts of Aceh Barat, in particular, Johan Pahlawan and Samatiga Subdistricts. The most serious threats to coral reefs in this region are poisoning, cruise lines of the fishing vessel and ecotourism activities which are rapidly growing and also sedimentation due to erosion from the inland. However, to date, the species composition and condition of coral reefs in Aceh Barat waters are poorly documented. The information of species

composition and coral covers are crucial in relation to planning a better conservation strategy in the future. Hence, the objective of the present study was to analyze the condition of coral reefs in Johan Pahlawan and Samatiga Subdistricts, Aceh Barat District, Aceh Province, Indonesia.

## MATERIALS AND METHODS

### Time and site

The study was conducted in September 2015 at the coastal areas of Aceh Barat District, Aceh Province, Indonesia at two locations: Johan Pahlawan and Samatiga Subdistricts (Figure 1). An initial survey was conducted using snorkeling to determine the sampling spots that best represent the condition of the sampling areas. Based on this initial survey, the first location was Suak Indrapuri (Johan Pahlawan Subdistrict) (4°7'38.0634"N, 96°7'20.028"E) and the second location was in Lhok Bubon Village (Samatiga Subdistrict) (4°11'17.1996"N, 96°2'0.4992"E). Two depths were surveyed at 4-meter and 8-meter at each site.

### Data collection

The data were collected using a SCUBA. The Point Intercept Transect (PIT) was used to examine the coral reefs condition following on English et al. (1997). The roll meter was stretched parallelly to the coastline along 50 meters with two replications at every sampling depth (4

meters and 8 meters). Every coral species found along the roll meter was recorded and calculated for number and coverage area. The coral species were identified based on Veron (2002).

### Life forms of coral covers

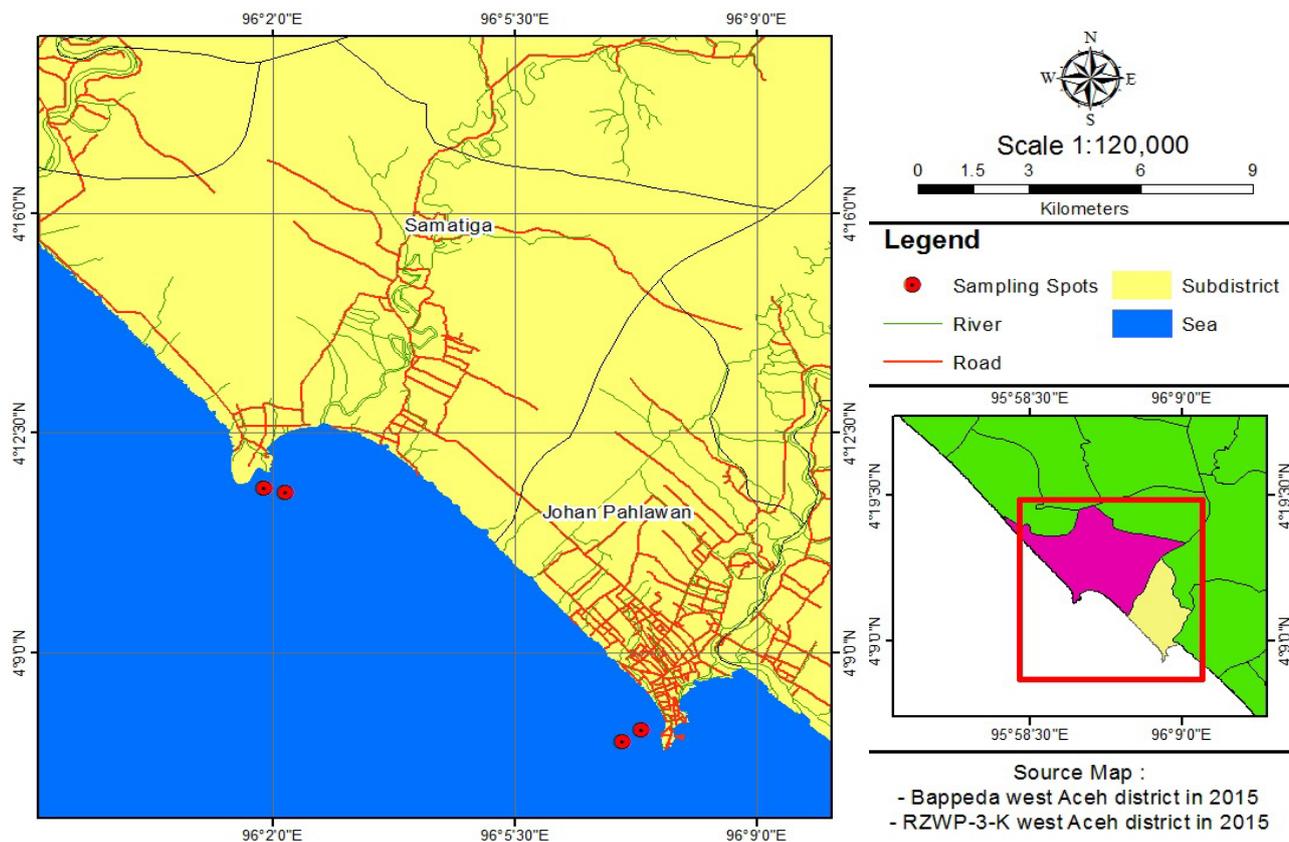
The main water quality parameters, that is, temperature, salinity, visibility, and pH, were measured in situ. Meanwhile, the life forms of coral and dead coral were calculated based on English et al. (1997) as follows:

$$C_i = \frac{ni}{L} \times 100$$

Where  $C_i$  (%) is life forms of coral covers,  $ni$  is the total length of bottom subtracting (cm), and  $L$  is the length of the transect (cm). Meanwhile, the category of coral reefs condition was based on Kepmen LH Republic of Indonesia No. 4, Year 2001 (Table 1).

**Table 1.** The category of life forms of coral covers (Kepmen LH Republic of Indonesia, No. 4, Year 2001)

Category	Life forms of coral covers (%)
Severely damage	0-24.9
Moderately damage	25.0-49.9
Good	50.0-74.9
Very good	75.0-100



**Figure 1.** The map of coastal areas of Aceh Barat District, Aceh Province, Indonesia showed the sampling locations and sampling spots (red circle)

### Shannon-Wiener diversity index ( $H'$ )

The diversity index expresses the species richness in a community and shows the balance in individual proportion of every species (Muchlisin and Siti-Azizah 2009). This value will increase as total species increased and total individuals of every species were proportional or even (Kreb 1989). According to Odum (1971) the diversity index is classified into three categories, that is, low ( $H < 2$ ), moderate ( $2 < H < 4$ ), and high ( $H > 4$ ). Shannon-Wiener diversity index was calculated using the formula:

$$H' = \sum (P_i \times \text{Log} (P_i))$$

Where  $P_i = N_i/N$  ( $N_i$  is a total number of individuals in a species  $i$  and  $N$  is a total number of individuals for all species).

### Simpson's dominance index

Simpson's diversity index is a measure of diversity which takes into account the number of species and the relative abundance of each species. Simpson's dominance index was calculated based on Krebs (1989) as follows:

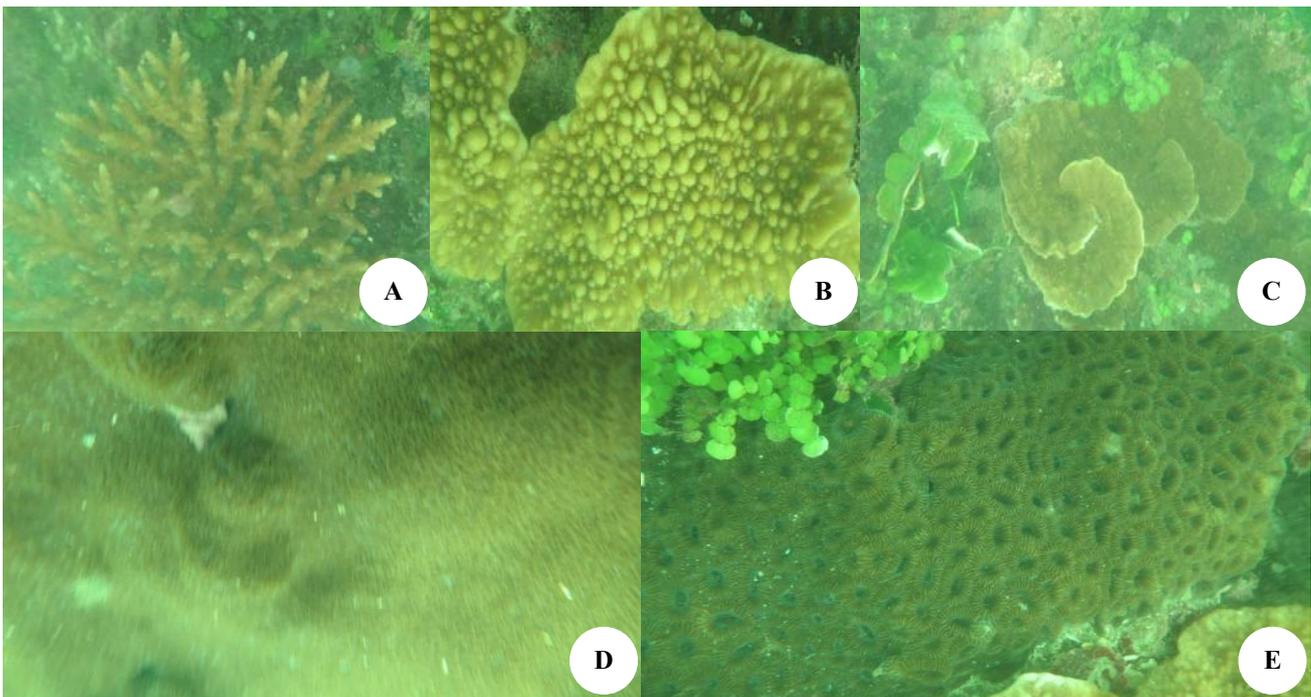
$$C = \sum_{i=1}^s (p_i)^2$$

Where  $C$  is an index of species dominance,  $P_i$  is the proportion of individuals found in species,  $i=1$  is species, and  $S$  is the number of total coral species.

The dominance index ranges between 0 and 1. If the values tend towards 0 (lower), it indicates that no dominant species occurred, whereas when the values tend towards 1, it indicates that a predominant species is present (Muchlisin et al. 2015).

## RESULTS AND DISCUSSION

Live coral was only found in Lhok Bubon site at 4-meter depth with a mean cover of  $17.61 \pm 2.86\%$ , and no live coral was recorded in 8-meter depth. In addition, there were no live corals detected in Suak Indrapuri (Johan Pahlawan Subdistrict) at either 4-meter or 8-meter depth (Table 2). The direct observation in Suak Indrapuri showed that many types of rubble were observed at 4-and 8-meter depth and no live corals were observed (100% dead corals). The coral identification from Lhok Bubon site showed five genera of corals were recorded at 4-meter depth, namely, *Montipora* ( $8.18 \pm 7.50\%$ ), *Favites* ( $3.77 \pm 3.46\%$ ), *Porites* ( $3.14 \pm 2.88\%$ ), *Montastraea* ( $1.89 \pm 1.73\%$ ), and *Acropora* ( $0.63 \pm 0.57\%$ ) (Table 3). Based on the life forms, *Montipora* had a foliose coral form; *Acropora* is the branching corals, while *Favites*, *Porites*, and *Montastraea* are the massive corals (Figure 2).



**Figure 2.** Coral reef species found in the location of study. A. *Acropora* , B. *Montipora*, C. *Montastraea*, D. *Porites*, E. *Favites*

**Table 2.** Percentage of live coral covers and death coral based on sampling sites in Aceh Barat District, Aceh Province, Indonesia

Sampling site	Depth (m)	Coverage (%)		Category
		Life corals	Death coral	
Lhok Bubon, Samatiga	4	17.61±2.86	82.38±28.74	Severely damage
	8	0	100	Severely damage
Suak Indrapuri, Johan Pahlawan	4	0	100	Severely damage
	8	0	100	Severely damage

**Table 3.** The life and death forms corals and its coverage at 4 meters depth in Lhok Bubon Village, Samatiga subdistrict, Aceh Barat District, Aceh Province, Indonesia

Life corals	Growth forms	Coverage		Death corals	Coverage	
		Meter	%		Meter	%
<i>Acropora</i>	BC	1	0.63±0.57	DCA	101	63.52±38.3
<i>Favites</i>	MC	6	3.77±3.46	DC	16	10.06±9.23
<i>Montastraea</i>	MC	3	1.89±1.73	RK	8	5.03±4.61
<i>Montipora</i>	FC	13	8.18±7.50	SD	6	3.77±3.46
<i>Porites</i>	MC	5	3.14±2.88	-	-	-
Jumlah		28	17.61		131	82.38

Note: BC = Branching, MC = Coral massive, FC = Foliose, DCA = Dead coral algae, DC = Dead coral, RK= Rock, SD= Sand

**Table 4.** The Shannon-Wiener diversity index and Simpsons dominance index of corals in Lhok Bubon Village, Samatiga Sub-district, Aceh Barat District, Aceh Province, Indonesia

Location	Shannon-Wiener diversity index (H')	Simpson dominance index (D)
Lhok Bubon, Samatiga	1.94	0.43
Suak Indrapuri, Johan Pahlawan	-	-

**Table 5.** The average values of physical and chemical of water parameters in the study sites in Aceh Barat District, Aceh Province, Indonesia

Location	Depth (m)	Parameter			
		Temp. (°C)	Salinity (‰)	Turbidity (m)	pH
Lhok Bubon,	4	31	32	1.3	7.5
Samatiga	8	30	36	1.0	7.8
Suak Indrapuri,	4	31	35	1.0	6.5
Johan Pahlawan	8	32	34	1.0	6.5

We found that many dead corals have been covered with algae or commonly known as death coral algae (DCA) in the Suak Indrapuri (DCA, 63.52±38.31%). The diversity and dominance indices of coral in Lhok Bubon were 1.94 and 0.43, respectively (Table 4). These values indicate low diversity and the presence of one predominant species of *Montipora* sp. In addition, based on *in situ* measurement the water temperature ranged from 30°C to 32°C, salinity ranged from 32‰ to 35‰, visibility ranged from 1.0 m to 1.3 m, and pH ranged from 6.5 to 7.8 (Table 5). The study revealed that the live corals were only in Lhok Bubon at 4-

meter depth, while no live corals were found at 8-meter depth. However, the condition of the coral in Lhok Bubon was bad (severe damage). Indeed, no live corals were recorded in Suak Indrapuri at both 4-and 8-meter depth. The absence of live corals in Suak Indrapuri was probably associated with unsuitable environmental conditions for coral growing, for example, high sedimentation caused by the activity of the mainland and poisoning practices.

Aceh Barat District had two main rivers one of which is the Meureubo River which empties into the sea in Suak Indrapuri Village, Johan Pahlawan. The watershed of this river has been intensively eroded and characterized by higher turbidity and frequently flooding during rainy season causes salinity drop at the rainy season and increases sedimentation in the coastal areas, and this might explain why no live corals were found at this area nowadays. However, the dead coral fragments are found in this area probably of live coral before 2014; therefore, it was presumed that the live corals found in this area were from previous decade before the tsunami in December 2004; it is in accordance with the information from the local fishermen that there were the coral reefs that occurred before tsunami, but after the tsunami the coral reefs have been destroyed.

The coral reefs of Lhok Bubon are of a fringing reefs type, but they lived far away from coastline reaching 300 m from the inland; it may be that the area closer to the inland is unsuitable for their growing; for example, the presence of residential areas and the fishing boat moorings resulted in water pollution. According to White (1987), fringing reefs are the most common corals found in Indonesia. These corals grow well along the shoreline with moderate waves, so the reef serves as a breakwater (Ikawati 2001).

As mention above that, the live corals were not found at 8-meter depth in both Lhok Bubon and Suak Indrapuri sites, this is because the water visibility is low. This

condition is blocking sunlight entering into the waters and it only reached 1.0-1.2-meter depth, but the live corals are still found at 4 meters; this is because probably little sunlight is still available at this depth. According to Supriharyono (2000b) the corals will be buried and dead when the sedimentation was too higher. In addition, Stafford-Smith (1993) stated branched corals intolerant of sedimentation; they will die when the sedimentation rate is higher than  $25 \text{ mg/cm}^2 \text{ day}^{-1}$ .

The study shows the coral reefs in Lhok Bubon dominated by *Montipora*. The similar results have been reported from other parts of Indonesia, for example, in the Andaman Sea (Brown 2007), Pulau Weh (Baird et al. 2012), and the waters of northern part Aceh (Rudi et al. 2012a). *Montipora* had foliose growth form and they have the ability to grow in waters with high turbidity, sedimentation, and waves (Supriharyono 2000a), and therefore this genus dominated the coral community in Lhok Bubon, Aceh Barat District.

Almost dead corals were infected by dead coral algae in all sampling sites. The presence of these algae in higher density is an indication of eutrophication. This condition is caused by higher loading of organic materials from the inland, for example, from residential areas. Besides the absence or rarity of herbivorous fishes such as *Hipposcarus* spp. and *Scarus* spp. is another cause of overgrowth of dead coral algae (Ndruru 2009). The direct observation shows that very low abundance of herbivorous fishes was observed during the study.

The main water quality shows that the temperature and visibility passed the optimum limit for corals. According to Nybakken (1997), the corals are growing well in water temperature ranged from  $30 \text{ }^{\circ}\text{C}$  to  $32 \text{ }^{\circ}\text{C}$ . Furthermore, Dahuri (2003) cited in Ramadhani (2015) stated that the corals require the salinity ranged between 30 and 35‰. This case is almost similar to Supriharyono (2000b) who states that the salinity required ranged from 32‰ to 36‰. Therefore, the salinity in the study area is still in the optimum limit for corals growing.

Based on the study there are two main problems that caused the corals decreasing especially in Suak Indrapuri and Lhok Bubon and Aceh Barat District generally. The problems are high sedimentation and pollution. The sedimentation is caused by erosion of watershed or water catchment area due to deforestation (logging), while the pollution comes from domestic and tourism activities. Therefore, the management of coastal area should be done comprehensively between fisheries and forestry sectors and involves all stakeholders. To conclude, the live corals were found in Lhok Bubon with a coverage area of 17.61% indicating a bad condition or severe damage and no live corals were found in other sampling sites. These corals belong to five genera, that is, *Acropora*, *Favites*, *Montastraea*, *Montipora*, and *Porites* where *Montipora* is predominant.

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