

# Recent coral reef conditions in Weh Island, Aceh Province, Indonesia

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Manuscript received: 26 September 2018. Revision accepted: 19 November 2018.

**Abstract.** *Utama RS, Hadi TA. 2018. Recent coral reef conditions in Weh Island, Aceh Province, Indonesia. Ocean Life 2: 47-53.* Over the past several decades the coral reef conditions have been declining globally due to human activities and natural disturbances. In the last decade, several natural phenomena such as a 2010 tsunami and 2016 coral bleaching event have been recorded in Weh Island and resulted in coral cover decline. The aims of this study are to observe current status of coral diversity and reef conditions at Weh Island. The study was carried out during February 2017 at ten study sites. The methods used were Underwater Photo Transect (UPT) analyzed with CPCe 4.1. software. Live coral coverage ranging from 10% to 57,33% with average live coral cover at Weh island at  $28.48\% \pm 5.334$  (moderate condition). 82 species, 31 genera, 13 families of coral were recorded in this study with four species found at all sites. No take and no anchor zones from Panglima Laot regulation at the Iboih areas provide a positive impact for maintaining coral health.

**Keywords:** coral cover, coral reef conditions, Weh Island

## INTRODUCTION

Coral reefs are important ecosystems that provide many benefits (food and services) to plenty of coastal societies (Moberg and Folke 1999). Weh Island water is influenced by three different ecoregions (Andaman Sea, Indian Ocean, and Malacca Strait), these thus effect the marine biodiversity of the area, especially on the reef. Weh Island is far from the coral triangle area and the national capital, making it difficult to obtain coral reef data from this area (Gibson et al. 2007). Based on records from the nearest locations of Thailand and West Sumatra, there are 339 species of corals from the Andaman Sea to West Sumatra, and around 59 species of which are *Acropora* (Veron et al. 2009; Wallace et al. 2012).

Over the past several decades the coral reef conditions have been declining globally due to human activities and natural disturbances. Human impacts contribute to a huge portion of the decline in developing worlds, through factors such as sedimentation, nutrient enrichment and habitat loss by destructive fishing, (Bruno et al. 2003; Erftemeijer et al. 2012; Nyström et al. 2000) and are the main cause of the decline of coral communities in these areas. Climate change accelerates natural influences such as coral disease prevalence, coral bleaching events and cyclone hurricanes that occur frequently (Hoegh-Guldberg 2011). Prolonged habitat degradation could affect coral community structure and coral diversity. In the last couple decades, several natural phenomena such as tsunami (2004) and coral bleaching in 2010 and 2016 have been recorded in Weh Island and resulted in coral cover decline (Ampou et al. 2017; Rudi et al. 2012). Therefore, it is important to obtain information related to the current status of coral diversity and reef conditions at Weh Island.

## MATERIALS AND METHODS

### Study site

This research was conducted at 10 sites spanning from west to east coast of Weh island (

Figure 1). In the west part of Weh Island, Aceh Province, Indonesia the reefs are short with strong current and wave action, and the slope is steep which creates a wall-like structure and high water visibility. In the eastern part, the reefs consist of a long flat area with moderate current and wave action, and the slope inclines less than 30°. In the bay areas, the reefs are short with low current and wave action, and the slope inclines between 30-45°. Of these three areas, only the west portion was less populated. The eastern and southern areas were moderately populated with many tourism activities.

### Coral survey method

In this study, we used a modified Underwater photo transect (UPT) method (Giyanto et al. 2010). Three replicates of 10 meter-long transects were laid parallel to the coastline on the reef slope at approximately 5-7 meter depth. Each replicate transect was separated by a 20-meter distance. A total of 30-meter transect lines were used in this study with a photo of quadrat frame (44 x 58 cm<sup>2</sup>) for each meter. An underwater camera (Canon Power Shoot G1X, 14 Megapixel image resolution) protected with a waterproof casing (Ikelite 6146.01) was used to take images of the benthic substrate communities along the transect lines. Additional close-up images of corallites were taken to help with the coral identifications.

### Image processing and data analysis

For assessment of benthic community compositions and substrate compositions, photos were analyzed using CPCe

4.1 software (Kohler and Gill 2006). A total of 50 random points were placed on each photo, and each point was assigned to one of the categories (in Giyanto et al. 2010) and the species of live coral was identified. In order to avoid clumped points, we used stratified random as the spreading method with 5 columns and 5 rows with 2 points on each box. Corals were identified following the Indo Pacific Coral Corals of the World (Veron and Smith 2000) and Revision and Catalogue of Worldwide Staghorn Corals

Acropora and Isopora (Scleractina: Acroporidae) in the Museum of Tropical Queensland for determined *Acropora* (Wallace et al. 2012). Each Overall total live coral cover was calculated. In addition, corals were further separated into morphological categories to assess coral morphology composition. The percent cover of living corals was categorized into 4 ranks, i.e., poor (0-24,9% live cover), moderate (25-49,9% live cover), good (50-74,9% live cover) and excellent (75--100% live cover).

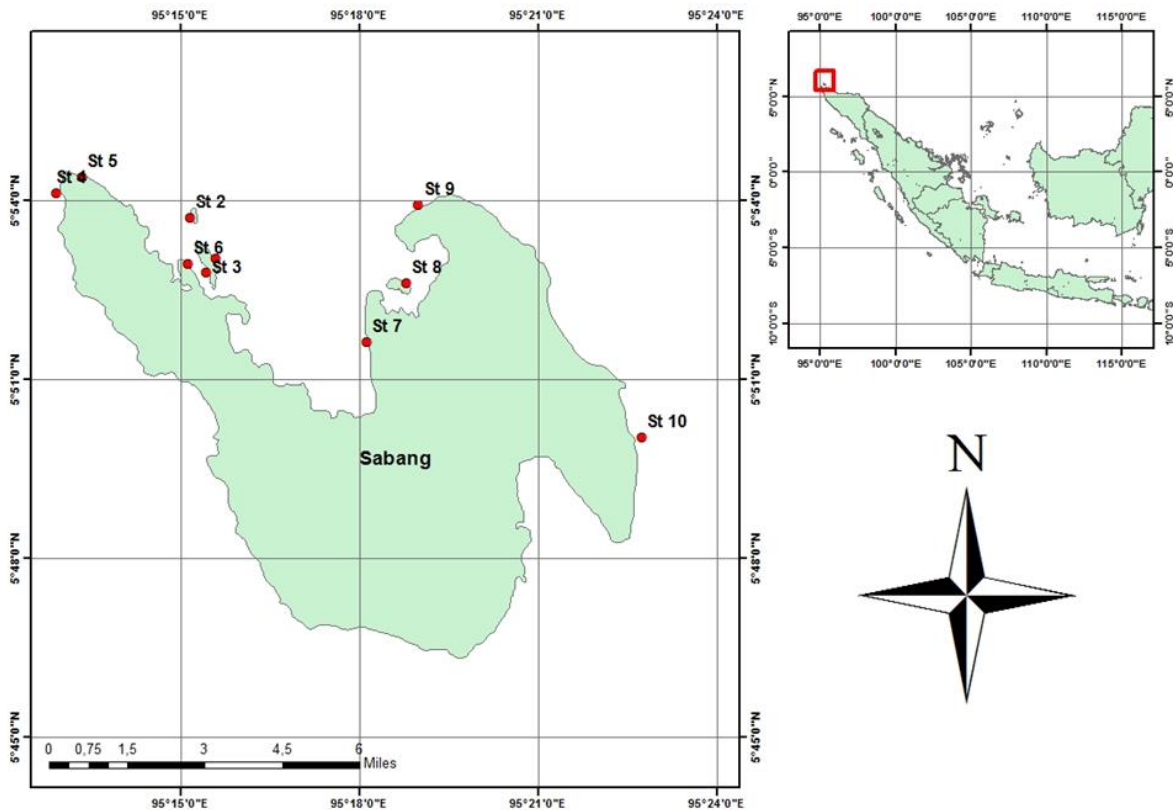


Figure 1. Location of study sites in Sabang waters

Table 1. Code for each benthic category (biota and substrate)

Morphology/Categories	Code	Description
Acropora	AC	Acropora branching, tabulate, digitate and submassive
Branching Coral	CB	Branching non-Acropora corals; especially <i>Porites cylindrica</i> , some other spp.
Encrusting Coral	CE	Low relief, often small colonies, Tabular non-Acropora
Massive Coral	CM	Massive or dome-like corals of all sizes.
Foliose Coral	CF	Foliose, either horizontal or vertical, non-Acropora, especially <i>Montipora</i> , <i>Echinopora</i>
Submassive Coral	CS	Multilobate or “lumpy” corals, sometimes columnar or mixed massive- columnar, especially <i>Goniopora</i> , <i>Galaxea</i>
Mushroom Coral	CMR	Free-living fungiid corals
Millepora	CME	Various species of <i>Millepora</i> . (hydrocoral) Blue coral (hydrocoral)
Heliopora	CHL	Free-living fungiid corals
Dead coral with algae	DCA	Recent death coral and dead coral covered by algae
Soft coral	SC	Alcyoniidae and gorgonians
Sponge	SP	All sponge
Fleshy seaweed	FS	Macroalgae and turf algae
Other fauna	OT	Other benthic fauna
Rubble	R	Broken dead coral (substrate)
Sand	S	Sand and silt (substrate)
Rock	RCK	Natural rock (substrate)

**Data analyses**

A multivariate analysis of benthic categories and substrate types were evaluated using multidimensional scale (MDS) ordination. The data were transformed by using log (x+1) to improve the spread of the data. The statistic test was performed using Primer software.

**RESULTS AND DISCUSSION**

**Coral condition and reef classification**

Based on UPT data, the live coral coverage ranged from 10% to 57,33% (Figure 2). The average live coral cover at Weh island was 28.48% ± 5.334 (SE). The highest live coral cover was found at site 02 and the lowest coral cover was at site 01. These two sites had different substrate, site 02 is mostly DCA substrate meanwhile site 01 is mostly sand substrate. Coral larva that attaches at stable substrates like DCA or rock had a more significant chance to grow compared to unstable substrates like sand and rubble. At site 01 coral stations grew in clusters with rock substrate or DCA. Dead coral dominated abiotic categories with algae (DCA) with average coverage of 35,92% followed by sand 18,78%. The highest DCA coverage was recorded at station site 06 with coverage of 61,44%. At station site 04, other biota was recorded at high coverage of 10.51%. This site was dominated by encrusting sponges and zoanthid. At this station, current and waves can be too strong for juvenile coral to attach to the substrate.

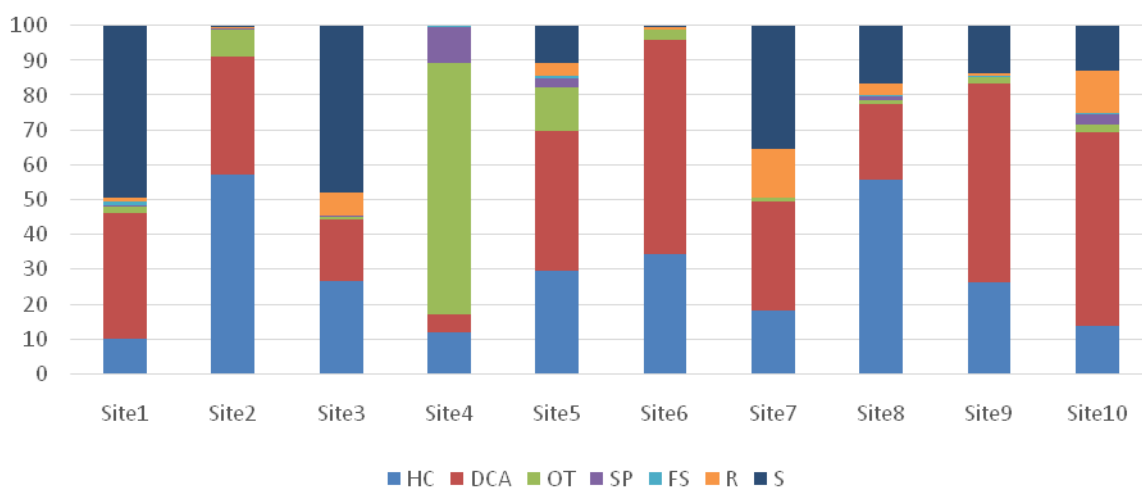
**Coral diversity and distribution**

Based on image processing data analysis, 82 species, 31 genera, 13 families of coral were recorded in this study,

with four species found at all sites (Table S1). Site 5 had the largest number of species (37 species) followed by site 2 (31 species). On the other hand, the smallest number of species were observed at site 10 (7 species). Acroporidae and Faviidae were the most diverse families at Weh Island. There were 21 species of Acroporidae and 31 species of Faviidae. Though less diverse in species, corals can still be found at 25 meters in depth.

Poritidae was dominant with a cover of 17,05% on average followed by Acroporidae, Helioporidae, and Faviidae with coverages of 3.61%, 3.50% and 1.99% respectively (Table 2). *Porites* was the most widely spread coral and was dominant among other genera with an average coverage of 17,05%. Other genera had an average coverage of < 5%. *Porites* was found well distributed and abundant at bay areas and along the east coast of Weh Island. On the west part of Weh Island (site 4 and site 5) *Porites* coverage was low and was dominated by *Pocillopora* and *Montipora*.

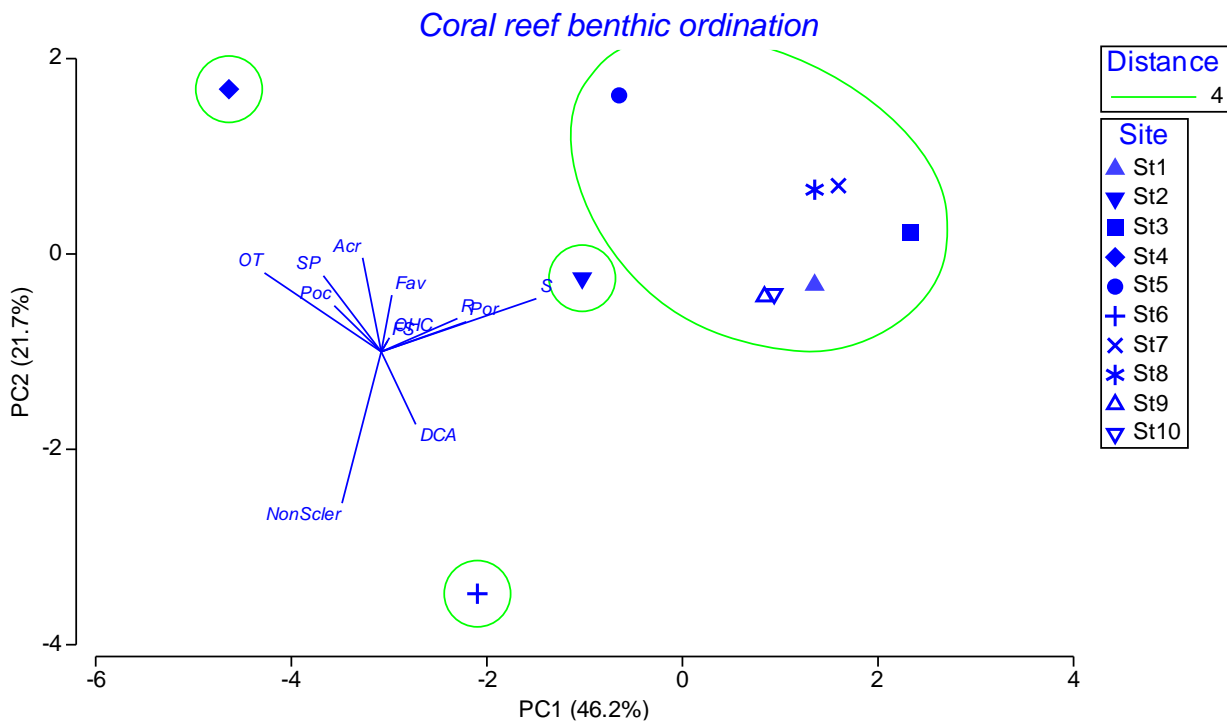
The multivariate analysis shows characteristics of the study sites with respect to the benthic category and substrate type (Figure 3). The results shows that there are 4 clusters of study sites. The first cluster was comprised of site 1, site 3, site 5, site 7, site 8, site 9, and site 10. All sites in this cluster were dominated with *Porites* but had a great diversity of corals. However, another cluster consisted of one site (site 2, site 4, and site 6) for each cluster which means each site has unique characteristics. Site 2 was placed near the center of the vector and was the most diverse among all sites. Site 4 was dominated by *Pocillopora* and the substrate was dominated by DCA. Site 6 was dominated by *Heliopora*.



**Figure 2.** Percentage coverage of benthic categories and substrate. HC: Hard coral cover; DCA: dead coral with algae; OT: other biotas; SP: sponge; R: rubble; S: sand

**Table 2.** Percentage coverage of coral families

Categories	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Acroporidae	1.22	1.56	0.44	4.11	17.67	0.44	3.78	4.33	1.78	0.78
Faviidae	1.44	5.78	1.00	0.67	5.00	0.00	2.67	2.11	0.78	0.44
Poritidae	6.00	46.78	24.67	0.89	4.78	0.89	5.89	46.78	22.89	11.22
Helioporidae	0.44	0.56	0.00	0.00	0.00	32.00	0.00	0.33	0.44	1.22
Pocilloporidae	0.00	0.11	0.00	5.78	1.11	0.78	4.22	0.11	0.11	0.00
Milleporidae	0.33	0.56	0.00	0.22	0.33	0.00	0.22	0.11	0.00	0.11
OHC	0.56	2.00	0.55	0.33	0.89	0.44	1.44	2.11	0.44	0.11



**Figure 3.** Multivariate analysis of benthic and substrate categories. Benthic and Substrate categories: Acr (Acroporidae), Fav (Faviidae), Por (Poritidae), Poc (Pocilloporidae), OHC (Other Hard Coral), Non Scler (Milleporidar and Helioporidae), SP: Sponge; FS: Fleshy Seaweed; OT: Others; R: Rubble; S: Sand; DCA: Dead Coral with Algae (DC and RCK category merged with DCA; Si merged with S

**Discussion**

Coral conditions at Weh island were generally at a moderate condition. There is no difference in terms of coral condition with previous studies conducted by Rudi (2010) (LIT method) and Hastuty and Adrianto (2014) (PIT Method). Most reef sites at developed areas, with many resorts and residential sites, have been a focal point for tourists to venture into water sports activities such as snorkeling, diving, and boating, and these activities may be harmful to coral reef health (Erftemeijer et al. 2012; Roche et al. 2016). However, a proper management system can reduce the risk of damage due to human impacts. Weh Island has two MPAs: Weh Island Marine Recreational Park (WMRP) and Weh Island Marine Protected Area (WMPA) which are managed by government enforcement (Natural Resources Conservation Agency and Marine Affairs and Fisheries Agency), NGO's and the local

community (Panglima Laot). In this area, they have a no take zone policy and restricted activities (only recreational, research, restoration, and fishing with limited gears). According to (Hughes et al. 2007) the existence of managed areas and the prohibition of fishing is an important way to ensure the occurrence of the food chain, the existence of a good ecosystem function, and the resilience of a coral reef. Good cooperation between government and the local community in the development of rules and regulations, enforcement, and monitoring is a major factor for successful management of marine protected areas in Sabang (Kusumawati and Huang 2015)

Based on multivariate analysis, there were 4 cluster groups by living coral and substrate (

Figure 3). Site 4 was different from other sites with corals from Acroporidae and Pocilloporidae families, growing fast and dominant among other stony coral. This

site was located northwest of Weh island, with good water visibility and good water circulation with low sedimentation, conditions which are good for *Acropora* and *Pocilloporato* to grow quickly (Wallace 2011). Site 5 was dominated with Poritidae, but this site was clustered different to the other sites. At this site, we can find all corals families that were observed in this research. Another site (site 6), was dominated by stress tolerant corals like massive coral and non-scleractinian.

Based on data, we found 82 hard coral species from 31 genera and 13 families. This number was high for an area that is far from the heart of the Coral Triangle. *Porites*, *Heliopora*, and *Montipora* were the highest coral genera recorded at this study. Previous studies reported that Weh Island was dominated by *Porites* and *Heliopora* (west) and *Acropora* (north and east) (Baird et al. 2012; Rudi 2010). *Porites* and *Heliopora* are known as stress tolerant corals (Edinger and Risk 2000; Loya et al. 2001). *Porites* tissue is seated deeper in the skeleton, thus it is better shaded from high irradiance. This makes *Porites* less prone to bleaching than *Acropora* (Hoegh-Guldberg and Salvat 1995). At high suspended sediment *Porites* colonies can survive by removing sediment with their own cleaning mechanism (Pichon 2011). Therefore, it can be assumed that dominance and abundance of *Porites* in Weh island is caused by the changing of the environment due to global warming and the increase of human activities in that area

## ACKNOWLEDGMENTS

We acknowledge Research Center for Oceanography for the financial support so that the research could be eventually conducted successfully and LIPI for providing the opportunity to present this study.

## REFERENCES

- Baird AH, Campbell SJ, Fadli N, Hoey AS, Rudi E. 2012. The shallow water hard corals of Pulau Weh, Aceh Province, Indonesia. *AACL Bioflux* 5: 23-28.
- Bruno JF, Petes LE, Harvell CD, Hettinger A. 2003. Nutrient enrichment can increase the severity of coral diseases. *Ecol Lett* 6: 1056-1061.
- Edinger EN, Risk MJ. 2000. Reef classification by coral morphology predicts coral reef conservation value. *Biol Conserv* 92: 1-13.
- Ampou EE, Johan O, Menkes CE, Niño F, Birol F, Ouillon S, Andrefouet S. 2017. Coral mortality induced by the 2015-2016 El-Niño in Indonesia: The effect of rapid sea level fall. *Biogeosci* 14: 817-826.
- Erftemeijer PLA, Riegl B, Hoeksema BW, Todd PA. 2012. Environmental impacts of dredging and other sediment disturbances on corals: A review. *Mar Pollut Bull* 64: 1737-1765.
- Gibson RN, Atkinson RJA, Gordon JDM. 2007. Coral reefs of the Andaman Sea—an integrated perspective. *Oceanogr Mar Biol Annu Rev* 45: 173-194.
- Giyanto, Iskandar BH, Soedharma D, Suharsono. 2010. Efisiensi dan akurasi pada proses analisis foto bawah air untuk menilai kondisi terumbu karang. *Oceanologi dan Limnologi di Indonesia* 36: 111-130.
- Hastuty R, Adrianto L. 2014. Tutupan karang dan komposisi ikan karang didalam dan luar kawasan konservasi pesisir timur Pulau Weh, Sabang Coral cover and composition of reef fishesinside and outsideofmarine protectedareas, eastern coast of Weh Island , Sabang. *DEPIK* 3: 99-107.
- Hoegh-Guldberg O. 2011. The Impact of Climate Change on Coral Reef Ecosystems. In: Dubinsky, Z., Stambler, N. (eds) *Coral Reefs: An Ecosystem in Transition*. Springer Netherlands, Dordrecht.
- Hoegh-Guldberg O, Salvat B. 1995. Periodic mass-bleaching and elevated sea temperatures: bleaching of outer reef slope communities in Moorea, French Polynesia. *Mar Ecol. Progress Series* 121: 181-190.
- Hughes TP, Bellwood DR, Folke CS, Mccook LJ, Pandolfi JM. 2007. No-take areas, herbivory and coral reef resilience. *Trends Ecol Evol* 22: 1-3.
- Kohler KE, Gill SM. 2006. Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. *Comput Geosci* 32: 1259-1269.
- Kusumawati I, Huang H. 2015. Key factors for successful management of marine protected areas: A comparison of stakeholders' perception of two MPAs in Weh Island, Sabang, Aceh, Indonesia. *Mar Policy* 51: 465-475.
- Loya Y, Sakai K, Yamazato K, Nakano Y, Sambali H, Van Woesik R. 2001. Coral bleaching: The winners and the losers. *Ecol Lett* 4: 122-131.
- Moberg FF, Folke C. 1999. Ecological goods and services of coral reef ecosystems. *Ecol Econ* 29: 215-233.
- Nyström M, Folke C, Moberg F. 2000. Coral reef disturbance and resilience in a human-dominated environment 15: 413-417.
- Pichon M. 2011. *Porites*. In: Hopley, D. (Ed.), *Encyclopedia of Modern Coral Reefs: Structure, Form, and Process*. Springer Netherlands, Dordrecht.
- Roche RC, Harvey CV, Harvey JJ, Kavanagh AP, McDonald M, Stein-Rostaing VR, Turner JR. 2016. Recreational Diving Impacts on Coral Reefs and the Adoption of Environmentally Responsible Practices within the SCUBA Diving Industry. *Environ Manag*: 58.
- Rudi E. 2010. Tutupan Karang Keras dan Distribusi Karang Indikator di Perairan Aceh bagian Utara. *Biospecies* 2: 1-7.
- Rudi E, Iskandar T, Fadli N. 2012. Effects of Coral Bleaching on Reef Fish Fisheries at Sabang. In: *Proceedings of 12th International Coral Reef Symposium*, Cairns, Australia, 9-13 July 2012.
- Veron JEN, Devantier LM, Turak E, Green AL, Kininmonth S, Stafford-Smith M, Peterson N. 2009. Delineating the Coral Triangle. *Galaxea, J Coral Reef Stud* 11: 91-100.
- Veron JEN, Smith M. 2000. *Corals of the world*. Australian Institute of Marine Science, Townsville.
- Wallace C, Done B, Muir P. 2012. *Revision and Catalogue of Worldwide Staghorn Corals Acropora and Isopora (Scleractina: Acroporidae)* in the Museum of Tropical Queensland. Museum of Tropical Queensland, Queensland.
- Wallace CC. 2011. *Acropora*. In: Hopley, D. (Ed.), *Encyclopedia of Modern Coral Reefs: Structure, Form, and Process*. Springer Netherlands, Dordrecht.

**Table S1.** List of coral species at Weh Island, Aceh Province, Indonesia

Species	Site									
	1	2	3	4	5	6	7	8	9	10
<i>Acroporaclathrata</i>	-	-	-	+	-	-	-	-	-	-
<i>Acroporacytherea</i>	-	-	-	-	+	-	-	-	-	-
<i>Acroporaflorida</i>	-	-	-	-	+	-	-	-	-	-
<i>Acroporagemmifera</i>	-	-	+	-	+	-	-	-	-	-
<i>Acroporamonticulosa</i>	-	-	-	-	+	-	-	-	-	-
<i>Acroporasolitaryensis</i>	-	-	-	+	-	-	-	-	-	-
<i>Acropora</i> sp.	-	+	-	+	+	+	-	-	-	-
<i>Astreoporamyriophthalma</i>	+	-	-	-	+	-	+	-	-	-
<i>Astreoporaocellata</i>	-	-	-	-	-	-	+	-	-	-
<i>Astreopora</i> sp.	-	+	-	-	-	-	-	-	-	-
<i>Barabattoiaamicorum</i>	-	-	-	-	-	-	-	+	-	-
<i>Coeloserismayeri</i>	-	+	-	-	-	-	-	+	-	-
<i>Cyphastrea japonica</i>	+	+	-	-	+	-	-	+	+	-
<i>Cyphastreaocellina</i>	-	-	+	-	-	-	-	-	-	-
<i>Cyphastreaserailia</i>	-	-	-	-	-	-	-	+	-	-
<i>Cyphastrea</i> sp.	-	-	+	-	-	-	-	-	-	-
<i>Diploastreaheliopora</i>	-	+	-	-	-	-	+	-	-	-
<i>Echinophylliaaspera</i>	-	+	-	-	-	-	-	-	-	-
<i>Echinoporagemmacea</i>	-	-	-	-	-	-	+	+	-	-
<i>Faviamatthaii</i>	-	+	-	-	+	-	+	-	-	-
<i>Favia pallida</i>	+	-	-	-	-	-	+	-	-	-
<i>Faviatruncatus</i>	-	-	-	-	-	-	+	+	+	+
<i>Favia</i> sp.	+	-	-	-	-	-	-	-	+	-
<i>Favitesabditia</i>	-	-	-	-	+	-	-	-	-	-
<i>Favitescomplanata</i>	+	+	-	-	+	-	+	-	-	-
<i>Faviteshalicora</i>	-	-	-	-	+	-	-	-	-	-
<i>Favitesmicropentagona</i>	-	+	-	-	+	-	-	-	-	-
<i>Favitespentagona</i>	-	+	-	-	+	-	+	+	-	-
<i>Favites</i> sp.	+	-	-	-	+	-	-	-	-	-
<i>Fungiadanaei</i>	-	+	-	-	-	-	-	-	-	-
<i>Fungiafungites</i>	+	-	+	-	-	-	-	-	-	-
<i>Fungiarepanda</i>	-	-	-	-	-	+	-	-	-	-
<i>Galaxeafascicularis</i>	+	-	-	-	-	-	+	+	+	-
<i>Galaxea</i> sp.	+	-	-	-	-	-	-	-	-	-
<i>Gardineroserisplanulata</i>	-	+	-	-	-	-	-	-	-	-
<i>Goniastreaminuta</i>	-	+	-	-	-	-	+	-	-	-
<i>Goniastreapectinata</i>	-	-	-	-	-	-	+	-	-	-
<i>Goniastreaoretiformis</i>	+	+	-	-	+	-	-	+	-	-
<i>Helioporacoerulea</i>	+	+	-	-	-	+	-	+	+	+
<i>Hydnophoramicroconos</i>	+	-	-	-	-	-	-	-	-	-
<i>Leptastreabeckensis</i>	-	+	-	-	-	-	-	-	-	-
<i>Leptastreaabottae</i>	-	-	-	-	-	-	-	+	-	-
<i>Leptastreaapruinosa</i>	-	+	-	-	-	-	-	-	-	-
<i>Leptastreaapurpurea</i>	+	+	+	-	+	-	+	+	+	-
<i>Leptastrea</i> sp.	-	+	-	-	-	-	-	-	-	-
<i>Leptastreatransversa</i>	-	-	-	+	-	-	-	-	-	-
<i>Leptoriaphrygia</i>	-	-	-	-	-	-	-	-	-	-
<i>Leptoserisyabei</i>	-	-	-	+	-	-	-	+	-	-
<i>Millepora</i> sp.	+	+	-	+	+	-	+	+	-	+
<i>Montastreaannuligera</i>	-	-	-	-	+	-	-	-	-	-
<i>Montastreaalenciennesi</i>	-	+	-	-	+	-	+	-	-	-
<i>Montiporacaliculata</i>	-	-	-	-	+	+	+	+	+	+
<i>Montiporagrisea</i>	+	+	-	+	+	-	+	+	-	-
<i>Montiporainformis</i>	+	-	-	-	+	-	-	-	-	-
<i>Montiporaorientalis</i>	-	-	-	-	+	-	-	-	-	-
<i>Montiporapeltiformis</i>	-	-	-	-	+	-	-	-	-	-
<i>Montipora</i> sp.	-	+	+	+	+	-	+	+	+	-
<i>Montiporastellata</i>	-	-	-	-	+	-	-	-	+	-
<i>Montiporatuberculosa</i>	-	-	-	-	+	-	+	+	-	-
<i>Montiporaturgescens</i>	-	-	-	-	-	-	+	-	-	-
<i>Montiporaundata</i>	+	-	-	-	+	-	-	+	-	-
<i>Montiporavenosa</i>	+	+	-	-	+	-	-	+	-	-

<i>Oulophylliabennettiae</i>	-	+	-	-	-	-	-	-	-	-
<i>Pachyserisgemmae</i>	-	-	-	-	-	-	+	+	-	-
<i>Pavonaminuta</i>	-	+	-	-	-	-	-	-	-	-
<i>Pavonavarians</i>	-	+	-	-	+	-	-	+	-	-
<i>Pavonavenosa</i>	-	-	-	-	-	-	-	+	+	-
<i>Platygyradaedalea</i>	-	+	-	-	-	-	-	-	-	-
<i>Platygyraryukyensis</i>	-	-	-	-	+	-	-	-	-	-
<i>Physogyralichtensteini</i>	-	-	-	-	-	-	-	+	-	-
<i>Pocilloporadamicornis</i>	-	+	-	-	-	+	+	-	-	-
<i>Pocilloporameandrina</i>	-	-	-	+	-	-	-	-	-	-
<i>Pocillopora</i> sp.	-	-	-	+	-	-	-	-	-	-
<i>Pocilloporaverrucosa</i>	-	-	-	+	+	+	+	+	+	-
<i>Porites lobata</i>	+	+	+	+	+	-	+	+	+	+
<i>Porites lutea</i>	+	+	+	+	+	+	+	+	+	+
<i>Porites rus</i>	-	-	-	-	-	+	-	+	-	-
<i>Porites solida</i>	-	-	-	-	+	-	-	+	+	+
<i>Porites</i> sp.	+	-	+	-	-	-	-	-	-	-
<i>Porites stephensoni</i>	-	-	-	-	+	-	+	-	-	-
<i>Psammocora</i> sp.	-	-	-	-	+	-	-	-	-	-
<i>Pseudosidera streatayami</i>	-	-	-	-	-	-	-	+	-	-
Number of species	21	31	9	13	37	7	26	30	14	7
Number of colony	31	94	28	34	108	36	65	88	51	25