

# 6\_Syafyudin\_Yusuf\_et.al\_CORAL\_DISEASE\_IN\_SAVU\_SEA\_IN\_DONESIA.pdf

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## **Ecological Status of Coral Disease Threatened by Reef Sessile Organisms Overgrowth in the Savu Sea National Park of Indonesia**

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### **ABSTRACT**

Anthropogenic impacts in combination with natural stressor may lead to coral disease. Coral disease is one of the most recent in a series of threats that is a challenging the resilience of coral community. Naturally, beside threatened by predation of benthic invertebrates and fishes, the scleractinian are also compete for spaces with various sessile organisms such as sponge, algae and soft corals. These interactions bring a negative impact to the corals. This study attempts to observe coral disease, and reef health condition in the Savu Sea National Park. In addition, it includes the overgrowth disturbances of sponge, algae and soft corals to the community of the scleractinian corals. Collection of coral health data was done during the Rapid Ecological Assessment survey as initiated by The Nature Conservancy Indonesia in Savu Sea Marine National Park (SSMNP) in November 2014. We were diving for 60 minutes at each dive sites. Of 54 surveyed reefs, we recorded 2,068 scleractinian coral colonies with health problems. The result shows 31% of corals were experiencing overgrowth. Those mostly overgrowth by algae, sponge and soft corals, whereas disturbance from cyanobacteria and flat worm is lower. The coral colonies that suffered by sponge and soft coral overgrowth have bigger colony size compared to those attack by Cyanobacteria and Coralline Algae. The ratio of coral mortality disturbance caused by these sessile animals is between 0.259 – 0.353. Intensity of coral colony disturbance due to overgrowth was categorized as high and may harm to the existence of coral community. This considered to be caused of the decrease of the immunity of the coral polyps at certain coral species, or by the high toxicity of these sessile animals. The future challenge is to understand the toxicity of these sessile organisms to the community of hard corals. Owing to the significance of corals as indicators for the status of the marine environment. This scientific information is crucial for management of coral reef conservation areas within the Marine Conservation Area especially in the Savu Sea Marine National Park.

**Keywords** : *Coral Disease, Reef Health, Savu Sea National Park, Coral Triangle*

## INTRODUCTION

Coral reefs are sentinel indicators of ocean health and the impacts of climate change. The link between recent dramatic declines in the health of coral reefs around the world and local and global anthropogenic stressors is well documented (Knowlton & Jackson, 2008; Bruno & Selig, 2007; Pandolfi, et.al., 2003). Coral disease is now recognized as a significant cause of coral mortality and the growing number of reports reflects real increases in the number of diseases, host species affected, and geographic range (Sokolow 2009).

The presence of coral diseases give the negative impacts to the coral reef's health and the corals community structure. This lead to corals death and sobrings to the coral resilience degradation (Willis *et al.*, 2004). However, coral disease occurs naturally in certain organisms population and play an important role in regulating the community as a dynamic spasiotemporal competition (Ostfeld *et al.*, 2008). Coral disease research in the Indo-Pacific since the 2000s suggests that coral disease coverage is still very small (less than 10 percent) and relatively secure to the coral reefs existence. However, when human and climate change pressure continues, it leadsto a serious problemto the coral reefs.As a result, coral disease can be usedto be a bio-indicator of climate change and marine life threat (Harvell *et al.* 1999; Ward & Lafferty, 2004).

Coral disease research in Indonesia recorded from Johan *et al* (2014& 2015). Savu Sea National Park of Indonesia is legally established in 2013 covers an area of 3.5 million hectares, within 10 administrative districts in the East Nusa Tenggara Regency. The Rapid Ecological Assessment (REA) in the Savu Sea National Park is a program of 'Coastal Resource Assessment' from The Nature Conservancy. The assessment includes coral reefs health, reef fish communities, mangrove condition, as well as observation of seaturtle, birds and marine mammals. In the assessment of these marine resources, coral disease is one indicator of the health of coral reefs in the Savu Sea.

There are only few of coral disease research in Indo-Pacific (Harvell, *et al.*, 2013; Wilson *et al* 2015 *inpress*). Whilst coral disease research is consider to an important knowledge as well as how to deal with in the future. In addition, the Indo-Pacific region is the epicenter of the world's coral reefs and the hotspot of marine biodiversity (Veron *et al.*, 2009). Therefore, the aim of the survey is to provide information of coral disease evidence and coral reef health condition in the Savu Sea as a part of the World's Coral Triangle.

## METHODS

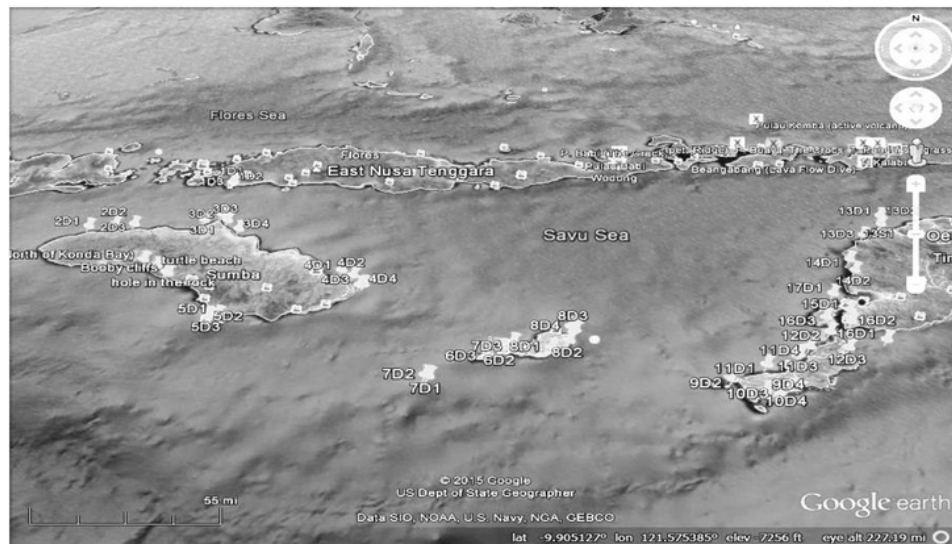
This Rapid Ecological Assessment (REA) in the Savu Sea National Park conducted from 28 October to 17 November 2016. The locations ranging from Manggarai District of west Flores Island, Sumba Island, Sabu

Island, Raijua Island, Ndana Island, Rote Island to Timor Island and Batek Island (in the border with Timor Leste). The REA covers 54 dive sites.

The REA used two methods of Belt Transect and Time Swim <sup>10</sup> (English, *et al.* 1997); Hill & Wilkinson, 2004). The belt transect sized 50 m x 4 m, while the observation method based on time swim used the time for approximately 50-60 minutes or equivalent to the belt transect coverage. During the dive, we recorded the type and number of hard corals (into genus level) experienced by disease. All of the coral colonies were measured maximum diameter and the colony diseased portion in centimeters.

The REA includes observation of coral reef substrate coverage <sup>6</sup> [Hard Coral (HC), Soft Coral (SC), Sponge (SP), Algae (AL), Dead Coral (DC), Dead Coral with Algae (DCA), and coral's Rubble (R)] and coral diseases.

Coral disease can be divided into four groups, namely (1) a group of coral infected with microbes (infectious disease), (2) groups of corals affected by bleaching, (3) groups of coral predation by other animals (predation), (4) a group of coral disrupted due excess growth (overgrowth). Especially for coral impaired due to overgrowth of other biota divided into five categories, namely CYA\_OG = Cyanobacteria overgrowth; CCA\_OG = Crustose Coraline Algae overgrowth; SC-OG = Soft Coral overgrowth; AL\_OG = Algae overgrowth; SP\_OG = Sponge overgrowth. Disease Index analysed by extensive damage to coral colonies compared to the overall area of each genera of coral colonies. All the data is analysed using an Excel program.



Gambar 1. Dive sites of REA 28 Oktober – 17 November 2014 .

## **RESULT AND DISCUSSION**

### **Coral Reef Habitat Condition**

Coral reef habitat in Laut Sawu are facing serious threats. Based on the analysis of the live coral cover of 54 diving spots, there were 52% and 40% coral in bad and moderate conditions, respectively. However, there was only 8% coral in good condition and none was in very good condition. Based on the hard coral cover (the Scleractinians) the condition of the coral reefs was low, due to natural (such as storms) and anthropogenic activities (destructive fishing, such as bomb-fishing). In parts of Kupang bay, good coral reef condition was mostly found in waters with low clarity, because high frequencies of bomb-fishing are conducted in clear waters, as to ease the fishers in sighting and collecting their catch. Other natural threats are storms (due to Sawu Sea that is directly facing the Indian Ocean) and dominant algae competition. The western monsoon in this area may give significant impact to the coral reef condition.

The coral reef of Savu Sea NP are affected by numerous factors including both anthropogenic and nature stressing. Based on the hard Scleractinians coral cover, the condition of the coral reefs was low. In parts of Kupang bay, good coral reef condition was mostly found in waters with low clarity, because high frequencies of bomb-fishing are conducted in clear waters, as to ease the fishers in sighting and collecting their catch. Other natural threats are storms (due to Sawu Sea that is directly facing the Indian Ocean) and dominant algae competition. High wave storm from open sea in this area may give significant impact to the coral reef condition.

### **Coral Disease Index**

Overgrowth can be defined as the over growing of coral associated organisms or shading by other organisms that can affect the growth of the reef. Moreover, only algal overgrowth is considered as a threat to hard coral (compromised health) (Raymundo et al. 2008). However, during REA Sawu National Marine Park survey, there were several types of overgrowth especially by sponges (SP-OG), soft coral (SC-OG), cyanobacteria (CYA\_ OG), crustose coralline algae (CCA\_ OG) and algae (AL\_ OG).

From 54 diving sites per 60 minutes, it was recorded that 2.068 coral colonies (Scleractinians) were unhealthy. Thirty one percent of those colonies were overgrowth by sessile reef organisms and 45% were under predation and lesions. Results showed that there were more coral colonies under sessile organisms overgrowth i.e., by algae (AL-OG) compared to sponges (SP-OG), soft coral (SC-OG), cyanobacteria (CYA-OG) and crustose coralline algae (CCA\_ OG). Coral disease prevalence index due to overgrowth did not

correlate with the number of coral colonies under algal and CCA overgrowth with 175 and 12 colonies, respectively, but correlated with both disease wide from the colony size of the scleractinian.

The highest coral disease index was due to crustose coralline algae overgrowth (0,470), then from cyanobacteria (0,424) and the lowest disease index was recorded from soft coral (0,259). Although algae overgrowth have a most coral colonies affected, but it's prevalence is lower than soft coral overgrowth. On the other hand, the Crustose Coralline Algae and Cyanobacteria overgrowth have less affected to the coral colony number, but they have higher disease index because of small colonies size with wider disease infected. Sponge overgrowth had been threatening more and the bigger size of coral colonies (98 cm<sup>2</sup>) and most wide of disease (Table 2 & Figure 2).

Table 1. Disease Index of coral were threatened by reef organisms overgrowth

Reef Organisms Overgrowth	Scleractinian corals				
	Code	Number . of Colony	Colony Size (cm <sup>2</sup> )	Disease wide (cm)	Disease Index
Algae	AL-OG	175	29,67	10	0,337
Sponge	SP-OG	149	98,00	34,6	0,353
Soft Coral	SC-OG	92	84,16	21,83	0,259
Cyanobactery	CYA-OG	27	66,55	28,19	0,424
Crustose Coralline Alage	CCA-OG	12	58,07	27,29	0,470

### Coral Genera Disease Index

In this research, there were 58 coral genera known to have been infected by various diseases and other health problems (compromised health). Coral genera dominantly infected by diseases are *Porites*, *Acropora*, *Montipora*, *Stylophora*, *Pocillopora*, *Seriatopora* (Table 3). These coral genera are mostly found in coral reef areas and characterised as fast grower, opportunistics and are prone to diseases.

Disease Index or health problems due to reef organisms overgrowth are varied according to coral genera. Results showed a weak correlations between values of overgrowth colony and disease index ((R<sup>2</sup> = 0.027), where *Porites*, *Acropora*, dan *Montipora* had the most overgrowth colony with low disease index compared to *Seriatopora*, *Goniopora*, *Platygyra* dan *Favia*.

Soft coral overgrowth affected 28 genera and mostly were *Seriatopora*, *Galaxea* and *Stylophora*. Sponge overgrowth attacked 29 genera, such as *Acanthastrea*, *Favia*, *Lithophilon* and *Labophyllia* (the lowest impacted). Algal overgrowth impacted 34 genera, such as *Alveopora*, *Lobophyllia* dan *Lithophilon*. Eventhough *Porites*, *Acropora*, and *Montipora* had the most colonies, yet did not received many algal threats.

The highest threats of crustose coralline algae (CCA\_ OG) was found in *Isopora*, *Millepora* dan *Platygyra* (Table 3). Each overgrowth threats had varied prevalences as according to coral species.

Table 3. Top ten Coral Genera threatened by reef organisms overgrowth.

Coral Genera	Colony Count	Overgrowth Colony Count	Disease Index	Correlation
<i>Porites</i>	577	185	0.32	R <sup>2</sup> = 0.027 y = -0.000x + 0.377
<i>Acropora</i>	258	85	0.33	
<i>Montipora</i>	127	47	0.37	
<i>Stylophora</i>	107	26	0.24	
<i>Pocillopora</i>	68	19	0.28	
<i>Seriatopora</i>	65	36	0.55	
<i>Turbinaria</i>	64	22	0.34	
<i>Goniopora</i>	63	26	0.41	
<i>Platygyra</i>	62	25	0.40	
<i>Favia</i>	52	21	0.40	

Coral reefs in Sawu Sea National Park are highly and moderately damaged. Apart from anthropogenic factors it can also be resulted from natural events such as storm, climate change and predation. Coral reefs in open waters are influenced by high energy hence with low diversity of coral, such as in Banda Sea (Suharsono, 2002). In addition, Ahmad et al (2013) manta towed in Rote Timur (Eastern Rote) District waters in Rote Ndao Regency, and found bad conditions of the reefs. The average coral live cover was 23,98%, in Selat Mulut Seribu Puau Timor, live coral cover was 15,8% and in the eastern side was 12,33%.

In general, coral genera with the highest disease index are those with low number of colonies in Scleratinians coral community, except *Porites* (by crustose coralline algae) and *Isopora* (by cyanobacteria). Whereas *Acropora* and *Seriatopora* were recorded as common corals that are mostly found in nature.

Sponge overgrowth affect coral tissues, as they contain microbes that contribute the most to microbe population in marine ecosystem (Thomas et al, 2016). Some of those microbes act as a substance or a tool against preys including hard coral tissues.

Fast growing Coral genera in a coral reef habitat that are dominantly attacked by disease are *Acropora*, *Montipora*, *Porites*, *Seriatopora*, *Pocillopora*, *Stylophora*. These coral genera are also affected by other diseases. On the other hand, they are not commonly found in nature such as *Barabattoia*, *Echynophyllia*, *Halomitra*, *Polyphyllia*, *Montastrea*, *Millepora* and *Acathastrea* were less infected.

In Sawu Sea, the proportion of corals infected by diseases are bigger than those recorded in Wakatobi, i.e. 0.57 % in 2005 (Hapkyla et al 2007) and 0.33% in 2007 (Hapkyla et al, 2009). The prevalence of coral disease infection in Indonesia is generally low (Muller et al, 2014), under 10%, (Yusuf et al. 2015).

Physical contact of coral with macroalgae *Halimeda opuntia* can trigger a virulent disease known as white plague that had caused widespread mortality in most Caribbean coral species. This condition also occurs mostly in Pacific coral reefs, but had not been well documented. In Indonesia, dominant coral genera, *Acropora*, *Montipora* dan *Porites*, had not been much exposed by macroalgae, except those located near the coastal area where eutrophication occur. Research from UNHAS and LIPI (Yusuf et al., 2015) recorded that due to eutrophication, most macroalgae altered the position of hard coral in coastal areas of the Spermode archipelago. Our result showed that the sessile marine organisms can serve as a bridge for any disease pathogens over past.

Finally, coral reef still have any threatening from nature are include from coral disease. Increases in marine disease are linked to deterioration in environmental conditions resulting increased abundance of competition with other marine sessile organisms. Savu Sea NP is in the regional scales of conservation area is located between Indian Ocean and Banda Sea, so threats include increasing input from two of them include storm and infected disease. Catastrophic storms affect reefs at regional scales and thermal anomalies at global scales which are predicted to increase in frequency and intensity due to climate change. This scientific information is crucial for management of coral reef conservation areas within the Marine Conservation Area especially in the Savu Sea Marine National Park.

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