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LEMBAR HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW* KARYA ILMIAH : JURNAL ILMIAH BEREPUTASI TERINDEK SCOPUS

Judul Jurnal Ilmiah (Artikel) : **Prevalence and incidence of white syndrome in echinopora lamellosa coral at nature reserve pulau sempu, malang, indonesia**

Penulis Jurnal Ilmiah : Rosdianto (**Penulis 1**)

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Prevalence and incidence of white syndrome in *Echinopora lamellosa* coral at nature reserve Pulau Sempu, Malang, Indonesia

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ABSTRACT

White syndrome disease (WS) has led to extensive damage to coral reef in Indo-Pacific area. The emerging of WS first reported from Philippine and Australia affected Acroporidae and Pocilloporidae coral. Subsequently, it was reported on other regions in Indo-Pacific. Underwater monitoring at Nature Reserve Pulau Sempu (NR Pulau Sempu) unveiled that WS affects foliouse coral, *Echinopora lamellosa*, rather other corals. The disease prevalence was 23.11% on average for 2 months period, whereas the incidence was 19.67%. *E. lamellosa* colonies in NR Pulau Sempu have been found in shallow in very dense population. The pathogens, which cause WS, easily transmits from diseased coral into health that caused width spread of WS in these corals. This study, overall, has confirmed that WS is now impacting reef in west part of the Indian Ocean. In addition, WS also affects on wide range of species not only on Acropora, Montipora and Pocillopora corals but also Echinopora and may be infected on the other coral in different wide regions.

Key words: *Coral disease, White syndrome, Echinopora, Sendang Biru, Nature reserve PulauSempu*

Introduction

Coral diseases are rising in many regions in the world and create a significant threat to the coral reef (Harvell *et al.,* 1999; Sutherland and Ritchie, 2004; Luthfi *et al.,* 2019a; 2019b). Coral role as main builder of coral reef has been ruined by disease and breaking-out is projected to increase in the coming times (Bruno *et al.,* 2003; Willis *et al.,* 2004). The increasing of number of coral disease is considered since early millennia has become one of the most important factors that caused coral declining in Indo-Pacific area (De'ath *et al.,* 2012; Pandolfi *et al.,* 2003). Coral disease outbreaks are usually linked to the environmental factors such as increasing sea surface temperature, rainfall, sedimentation or run-off, and nutrient enrichment (Bruno *et al.,* 2007; Patterson *et al.,* 2002; Sibero *et al.,* 2018; Borell *et al.,* 2008; Umar *et al.,* 2019).

White syndrome (WS) has been known as the most devastating and common type of coral disease in the scleractinian coral. It outbreaks caused of

mortality in coral at Palmyra Atoll (Northern Line Island), Northwestern Hawaiian Islands, Christmas Island, American Samoa, Philippines and Great Barrier Reef (Aeby, 2005; Aeby *et al.,* 2011; Hobbs *et al.,* 2015; Roff *et al.,* 2011; Williams *et al.*, 2011; Willis *et al.,* 2004). Coral disease prevalence has been defined as number diseased coral of coral in a population, usually calculated on percentage; likewise, coral incidence is the number emerging new diseases in population at specified time (Rogers, 2010). Both prevalence and incidence value provides a remark of anticipation which to estimate following changes. The value of prevalence WS can differ between areas or regions, with span from coast, different depth and between sides of an island (windward and leeward) (Willis *et al.,* 2004).

In Indo-Pacific white syndrome sometimes assigned as various names such as Acropora white syndrome AWS), Atramentous Necrosis, Australian subtropical white syndrome (ASWS), Montipora white syndrome (MWS), White plague disease, Porites white patch syndrome (PWPS), Porites tissue loss (PorTL), Porites ulcerative white spot disease (PUWS) and Ulcerative white spot disease (UWS) (Bourne *et al.,* 2013). All terms referred in coral's tissue loss resulted bare skeleton of coral where located on basal, peripheral and central of coral colony. Initially with small lesion (white color) spreading across colony surface (Beeden *et al.,* 2008b; Bourne *et al.,* 2013). The microorganisms that are caused by WS are various and compounded of fungi, algae, sponge, cyanobacteria, and vibrio (Work *et al.,* 2008; Work and Aeby, 2011).

Indonesia has many marine reserves (Arisandi *et al.,* 2018; Ruswahyuni and Purnomo, 2009; Sibero *et al.,* 2018; Wee *et al.,* 2017), and Pulau Sempu is one and only nature reserve left in East Java, Indonesia (Luthfi *et al.,* 2014). Coral reef distributed around periphery of island and concentrated in northern part of Pulau Sempu. *E. lamellosa* colonies lived in specific place in the west part of Pulau Sempu with local name is Kondang Butung (Depan) (8°26′23.65"S; 112°40′51.81"E). These colonies distributed from 1 to 7 m depth; thus, once the lowest tide occurred some of them exposed by air. Besides, it broke due to anchoring boats and any water sport activities. The laminar and thin formation of these colonies are easily broken. Hence, the aim of this study was to determine coral disease prevalence and incidence of WS in NR Pulau Sempu, which extending reported of spreading WS in Indo-Pacific area.

Materials and Methods

Study site

This study was carried out between July and August 2018 during the end of east monsoon at NR Pulau Sempu, Malang, East Java (Figure 1). The field survey was conducted in one site on Kondang Buntung (Depan) (KBD). The distance of NR Pulau Sempu with Java mainland around 500 m away which separated by a narrow strait. In the mainland, a big fisheries port has been constructed and almost every day hundreds of boats loaded fish on it. Moreover, docking and repairing fishermen boats were located in west part of port that likely contributes to chemical pollution in Pulau Sempu. During rainy season (September-November), the two rivers originated from mainland are likely to be contributor of terrigenous sediment on coral reef. Wind and current drive sediment plume southward affected on sediment accumulation in Pulau Sempu beach.

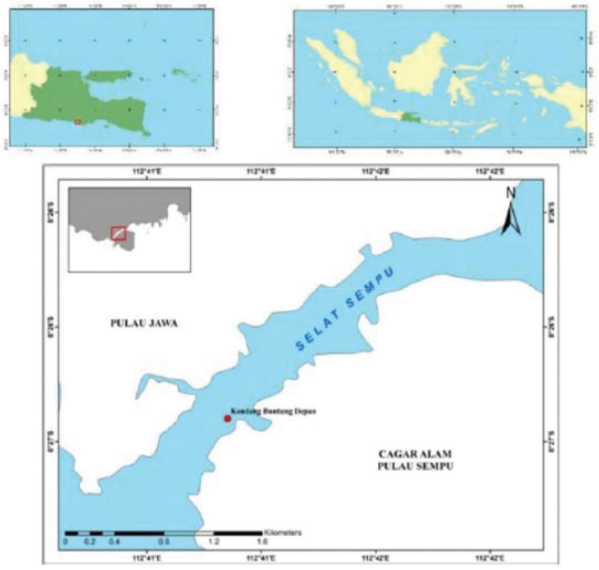

Fig. 1. The research location indicates of red round tips in NR Pulau Sempu, Malang. Pulau Jawa: Jawa Island; Cagar Alam Pulau Sempu: Nature Reserve Pulau Sempu; Selat Sempu: Sempu strait.

Coral Taxonomy

E. lamellosa has been photographed as a whole colony and macro in certain parts by using underwater camera to ensure their morphology character-

istics. In general, colony forms thin leaves (laminar) or arrange whorl and tiers which has common color amber to greenish. Calices have 3-6 mm in diameter that can be clearly seen from the colonies' surface. Each calice is spaced around 3-5 mm with another. The primary septa noticeably protrude and carry paliform lobes (Veron, 2000).

Fig. 2. Colony of *E. lamellosa* (A); corallites spread on colony surface (B).

Lesion Description

WS was first recognized during the survey conducted in March 2018. The gross lesion on observed coral was similar toWS's detailed by (Beeden *et al.*, 2008a). Briefly, WS has resulted irregular tissue loss in coral, the pattern is not concentrating on coral surface (focal) but diffuse marking of tissue loss that exposes bare white skeleton meeting live tissue. The color of syndrome is bare white skeleton to brown because development of algae. Often deriving from a small lesion front and escalating to a band front across the entire colony.

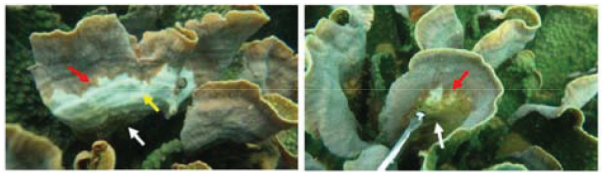

Fig. 3. White syndrome in *E. lamellose* showed by white arrows

Data collections: incidence, prevalence, and coral percentage

Data WS prevalence came by using belt transect 1 x 100 m through July and August 2018. A quadrat transect 1x1 m placed on line intercept transect rolled it which tape position in the middle quadrat transect from 0 to 100 m following tape length resulted in the total surveyed area was 100 m^2. Every 10 m two plastic number tags were tied each side of the belt transect area to obtain same area for the next month survey. An underwater camera recorded coral condition in each quadrat transect to meet affected coral by WS, detail of coral colony, WS lesions and marked as initial condition to calculate disease incidence following month. WS incidence was comparison of the number of coral colonies that showed white syndrome signs on a survey date that had not shown on any previous survey date. Furthermore, it calculated by dividing new emerging of WS by total health colonies in marked area, while WS prevalence calculated as affected colonies divided by total colonies (healthy and diseased) (Beeden *et al.*, 2008b).

Coral cover data were obtained by laying 100 m tape transect parallelly to depth and coral contour, a metal stick was nailed down in the beginning and end of the transect. All substrates (algae, soft coral, rock, dead coral, sponge, rubble, sand, and silt or clay) under the transect were recorded at underwater slates and photographed. Percentage of life coral was obtained by dividing total length of live coral compared to total length of transect (English *et al.*, 1997).

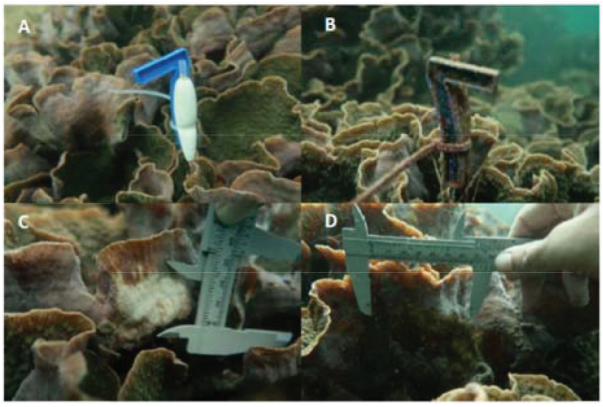

Fig. 4. White syndrome tagging in *E. lamellose* colonies tagged (A, B) and progress of WS spread during 1-month period (C, D).

Results and Discussion

White Syndrome

Field study revealed that *E. lamellosa*'s showing bare skeleton in basal area, single big lesion displaying clear, diffuse border, and apparent zone transition coral tissue and denuded skeleton(Fig. 3 red arrows) separating health and bleached tissue (Fig. 3 yellow arrow). The nude skeleton in basal colony recently covered by alga (Fig. 3 white arrow), and WS seems progress to apical area (Figure 3). Based on microbiological assay, high number of bacteria found in margin of diseased tissues such as

*Vibrio*spp and *Roseovarius*spp, and the present of those contribute to degrading of coral tissue (Dalton *et al.*, 2010). Another vibrio (*Vibrio coralliilyticus*) known caused tissue lysis at *Pocilloporadamicornis* in Red Sea, moreover these bacteria demonstrated positive results when *V. coralliilytycus* directly induced on coral tissue displayed WS signing (Bourne *et al.*, 2016). Other theories stated that enzyme zinc-metalloprotease, produced by vibrio, killed zooxanthellae in living coral and disrupted tissue of coral causing WS.

In a previous study, WS had various name which reported from several reefs in Indo-Pacific area, and the name was specific on affected genus of coral. For instance, Acropora white syndrome (AWS) was reported from Hawaiian Islands, Marshall Island, Wakatobi (Indonesia), American Samoa and Australia (Aeby, 2005; Carpenter *et al.*, 2008; Haapkylä *et al.*, 2007; Hobbs & Frisch, 2010; Jacobson, 2006; Weil *et al.*, 2012; Williams *et al.*, 2011). Montipora white syndrome in Hawaii *et al.*, 2010), Porites white patch syndrome (PWPS) in Western Indian Ocean (Séré *et al.*, 2012), and Porites ulcerative white spot disease (PUWS) in Philippines and Wakatobi (Indonesia) (Haapkylä *et al.*, 2007; Raymundo *et al.*, 2003). All nomenclatures are based on direct observation in the field using macroscopic lesion characteristics, some seem bias due to decision of disease classification dependent on skills of observer. And this is big challenge in the future to standardize disease classification using tools that accepted among scientists.

WS Incidence and Prevalence

This study monitored on 178 coral colonies in total. In the beginning of research (July 2018) 24 colonies of *E. lamellosa* were infected by WS and the end period of the survey, August 2018, the diseased coral sharply increases to 58 colonies. WS incidence in NR PulauSempu was 19.66% and became new information about new emerging diseases in this area. Monitoring coral disease to calculate the disease incidence is quite challenging due to must monitoring for new emerging of disease in individual colony within permanently belt transect. Environment stress, sea temperature, for example, alter interaction of host and bacteria inside coral body. In higher temperature pathogen growth rate are increase and more virulent, on the other hand coral, host, may more susceptible to infection due to in stress condition resulted on emerging of disease (Ward *et al.*, 2007). During the research (July-August 2018) the average sea temperature was 25.85 °C was the lowest sea temperature during these years which the highest sea temperature in surround PulauSempu has reached 30.6 °C on average at December-February that was influenced by Austral summer. Low sea temperature sometimes leads bleaching in high-latitude coral and it has identical conditions to hotter water. Mass bleaching had reported from coral of Heron Island in July 2003 that affected on Acroporids coral (Hoegh-Guldberg and Fine, 2004). During bleaching coral in a compromised health condition due to decreased immune system, lose their antimicrobial property in SML (surface mucus layer), starving due to lack of zooxanthellae and loss of energy for regenerative process (Brandt and McManus, 2009). Therefore, that developed a disease such as WS.

The average WS prevalence was 23.11%, which experienced an increase from 13.64% to 32.58% almost three-fold during 1-month period (Figure 5). Increasing of percentages of WS prevalence as a result of physical oceanography of seawater, temperature, which experienced on the lowest point and living of coral colonies in shallow area. The higher temperature of seawater from the normal condition made coral stress often promising more susceptible to disease infection. WS prevalence tends to increase during warmer period (summer) and decreases in winter. The previous study revealed that WS prevalence in Great Barrier Reef (GBR) may have a seasonal constituent, with higher prevalence during temperate month (Lozada-Misa *et al.*, 2015). In the same vein, WS prevalence in NR PulauSempu had similar pattern with on GBR.

Depth is suggested to influence the dynamic of coral disease which is related to number of irradi-

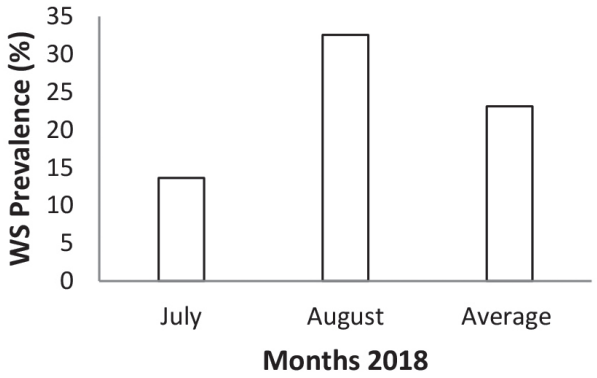

Fig. 5. White syndrome prevalence at NR Pulau Sempu in two months of 2018.

ances penetrate in seawater. A combination of light and temperature drove black band disease (BBD) in GBR (Sato *et al.,* 2011), however light alone did not have major impact on BBD progression. Almost all of *E. lamellosa* colonies in NR Pulau Sempucan be found in shallow water areas, they grow in slope substrate on 1-7 m depth, this condition might affect on high disease prevalence in this area. The percentage of disease prevalence in Christmas Island, Australia was higher in shallow water than deeper one (Hobbs and Frisch, 2010).

Percentage of coral cover

Nine substrates were recorded from NR Pulau Sempu, which consists of biotic and biotic complement. Percentage of live cover coral was total of percentage of coral in any lifeform (CB, CE, CF, CM, and CS) (Fig. 6), it was 32.17%. Coral foliose (CF) was dominance following by coral massive (CM) representative of *E. lamellosa* and Poritids coral. The highest percentage of rubble (36.15%) might from the accumulation of break parts of Acoporid and *E. lamellosa* colonies. Naturally, breaking coral has important contribution of sand formation and becomes nesting and foraging of reef fish in this area (Harahap *et al.,* 2019). Most of rubble invested by alga that important for scarids fish and sea urchin as well.

The outbreak of white syndrome in GBR suggested had strong correlation with high temperature and high coral percent cover (>50%) (Bruno *et al.,* 2007). The high percentage of coral lessen interspace between adjacent coral colonies and thus between health colonies and infected one, increasing the possibility for horizontal disease dispatch between colonies of coral. Moreover, coral can compete between them using their tentacle and digestive filament affected on damaging coral tissue of their opponents caused lesion and necrosis that easily pathogen transmit and infected the coral colonies (Lang, 1990).

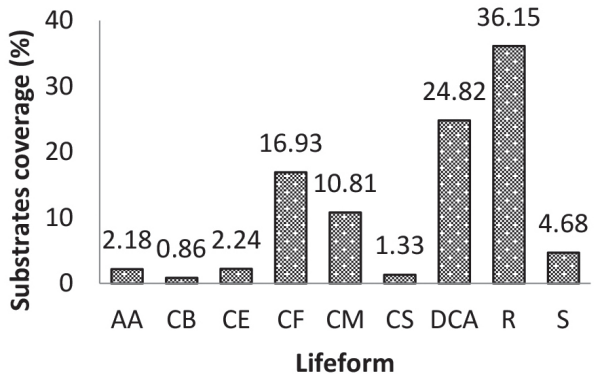

Fig. 6. Biotic and abiotic substrate in NR Pulau Sempu. AA: Alga Assemblage; CB: Coral Branching; CE: Coral Encrusting; CF: Coral Foliose; CM: Coral Massive; CS: Coral Submassive; DCA: Dead Coral Algae; R: Rubble; S: Sand.

Conclusion

Briefly, a white syndrome in NR Pulau Sempu had related to anomaly of decreasing temperature that has been influenced by Austral winter. This study shows *E. lamellosa* was infected by WS and thought to be major of coral mortality in NR PulauSempu which high WS prevalence owing to depth and coral cover.

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