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Disease description of *Scleractinian* Coral by Visual Method at Prigi, Bay, East Java

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Abstract

Coral disease recently became the main factor for degradation of coral reef in Indo-Pacific area. The coral disease becomes hot issues due to the complex of etiology between the host, agents, and environment. This research has purposed to find out the description of coral diseases in south Java sea area. This research was conducted from March-May 2017 in three different stations in Prigi Bay, Trenggalek, East Java, Indonesia. The coral data obtained by using belt transect 1 x 100m in each station. We were classified diseased coral into tissue loss predation and tissue loss non-predation. The coral tissue loss may be coming from predator or bacteria consortium activities. Fish byte made coral tissue loss and left scars that can be an evidence the species of fish. Six types of diseases were found in Prigi Bay, they were: black band disease, atramentous necrosis, ulcerative white spots, white spots, trematodiasis and growth anomalies. The coral disease prevalence in Prigi Bay was 10.87%.

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Introduction

A recent study by LIPI (2016) states that the coral reef condition in Indonesia was very good around 6.39%, good condition was 23.4%, the moderate condition was 35.06% and poor condition was 35.15%. The cause of coral damage in Indonesia due to natural factors and anthropogenic factors. The disease is one of the natural factors of declining percentage of live coral cover in Indonesia, although the presence of coral diseases was strongly influenced by unhealthy environmental conditions. Coral disease is one factor in accelerating the degradation of coral reefs in some regions of the world (Lamb and Willis, 2011). According to Weil *et al.* (2012), coral diseases and coral organisms are more commonly found in the tropics, where their impact has increased in recent decades. Over the last 30 years, coral diseases have made significant deaths and changes in coral community structures in the Caribbean and Indo-Pacific tropical reefs. Hazrul *et al.* (2016), stated that some researchers have been conducted in Wakatobi waters, Southeast Sulawesi, Pulau Seribu Jakarta, and Pulau Panjang in Central Java. According to Delpopi *et al.* (2015), in the south of Java precisely on the island of Pari found the disease of black band disease, Soenardjo (2013), also found pink blotch disease in Sambangan Island Karimunjawa, in the waters of Sempu Nature Reserve found competition and sediment damage (Luthfi *et al.* 2016).

The coral definition of the coral disease still unstable, the researchers now have been trying to bring standardized name or nomenclature of coral disease. Since first-time Antonious (1973) found the black band disease the term of disease in coral is still unclear, Work *et al.* (2008) have approached the describe of disease using biomedical and veterinary science. The other confusing among scientist is the difference the disease and syndrome, and Roger (2010) give the clear explanation on that problem. The naming of coral disease to date also still unstandardized due to the absence of standard or nomenclature or lack of authorized body that responsible for coral disease name. The ideal standard of coral disease description should base on field diagnosis, morphology diagnosis, and etiology diagnosis. To simplify that problem, in this research we used the Coral Disease Handbook (Raymundo *et al.*, 2008) to describe our visual photograph of diseased coral in Prigi Bay.

The Prigi Bay administratively under Trenggalek regency, East Java Indonesia, since 1982 the government builds a small fisheries port (Pelabuhan Perikanan Pantai) and in 2001 the status became Nusantara Fisheries Port (Pelabuhan Perikanan Nusantara) that officially under Ministry of Marine and Fisheries Affairs. The Prigi Bay expand on 9,855 ha that surrounded by rocky shore. Combined difficulty accessibility in Prigi Bay, rough sea condition (high wave and strong current) and heavy mystical believe of the goddess sea (Nyai Roro Kidul) derived the fisheries activities not growth well until the modern era 1980s (Kendrick, 1993). The coral reef in Prigi Bay laid on several areas such as in Pantai Watu Lajer (8°20'40.05" S – 111°44'41.00"E), Pantai Pasir Putih Karanggongso (8°18'51.08"S – 111°44'28.36"E), Pantai Karang Pegat (8°17'59.44"S – 111°44'4.24"E), and Guo Boto (8°19'15.00"S – 111°42'57.65"E) (Siska, pers. comm., 2015). The characteristics of Prigi Bay waters have high waves and coastline to the mainland with sandy or rocky beach conditions. Coral in the waters of the Prigi Bay may suffer from diseases because it there was the input of nutrient from the river and fisheries port activities that resulted in other organic and inorganic waste. The aim or main focus of this research was to describe types of coral diseases in Prigi Bay using morphological view or photograph.

Material and methods

Study site

The research was conducted on Prigi Bay, Trenggalek, East Java from March 2017 to May 2017, the taking data location was on Fig. 1. The samples location was determined by purposive sampling; this was based on various considerations such as the coral existence, accessibility, time and budget (Sarwono, 2006). Before decided three stations of research we observed some of the locations recommended from the

previous study, informal information and satellite image by snorkeling in predicted locations. The location of the study is presented in Fig. 1, based on consideration of coral reef condition and presence of coral diseases in Prigi Bay waters. Station 1 (ST1) was located in the eastern part of Prigi Bay (8°19'17.00 "S; 111°44'32.00" E), this location not far from the coastline and adjacent to the beach for tourism which can only be accessed by boat. Station 2 (ST2) was located adjacent to ST1 located at coordinates 8°19'1.00 "S; 111°44'40.00" E that was a conservation area. While station 3 (ST3) was located in the West of Prigi Bay (8°19'23.00 "S; 111°41'45.00" E) that was next to the mangrove ecosystem.

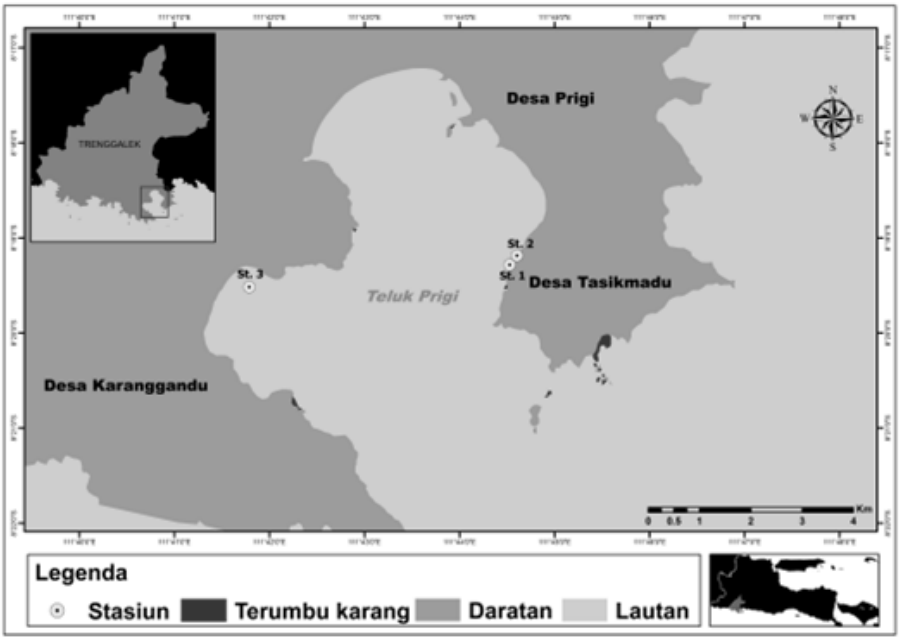


Fig. 1. Map showing the study sites where survey on coral disease was conducted in Sempu Island, East Java.

Coral disease survey

The coral survey was conducted by using belt transect 1 x 100m in 3-5m depth, where coral commonly found. Coral disease data obtained by using a 1x1 meter quadrant transect that was divided into 4 sub-quadrant with 50 x 50cm of size. Coral images were taken on each sub-quadrant using the underwater camera Nikon AW-130, once found a lesion the data detailed by using macro images mode (Agustiadi and Luthfi, 2017). The coral disease data was obtained from the identification of the image or photo capture by examining one by one visually the lesions present on the coral and then identified in accordance with Beeden *et al.* (2008).

Analysis of disease prevalence

Coral disease prevalence calculated using this formula (Raymundo *et al.*, 2008):

$P = \frac{a}{A} \times 100\%$ (1)

Where P= coral prevalence; a= diseased coral and A= total colony coral was surveyed.

Result and discussion

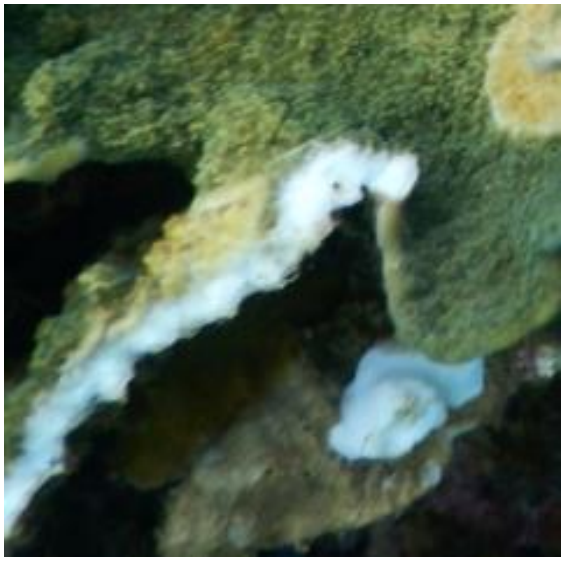
Description of diseases coral

Tissue Loss Predation (TLP)

TLP on corals is characterized by bite marks or wounds such as white streaks on corals (Fig. 2). From the scars left on coral that the predator is Drupella and reef fish. Based on Fig. 3 can be seen that there is two type of coral families that suffer predation, they were Acroporidae and Poritidae. The corallivorous predators seem prey selectivity that can be seen the more suffering then Acroporidae.

Tissue Loss Predation (TLP) is a loss of coral tissue due to predation by annelids, arthropods, fish, echinoderms, and mollusk (Work and Aeby, 2006). Drupella, one of the corallivorous gastropods, are known as agents that destructive of coral reef ecosystem.

Three species of Drupella has caused coral harm in Indo-Pacific area, they were *Drupella cornus, D. fragum* and *D. rugosa* (Cumming, 1999). In the Red Sea the *D. cornus* prey on Acropora and Porites with feeding rates 1.31 ± 0.19cm^2 day^{-1} individual^{-1} (Al-Horani *et al.*, 2011), they also reported that increasing sea temperature up to 30^{o}C lead increasing the grazing rates of *D. cornus* five-time fold. The feeding rate Drupella in Great Barrier Reef higher, it was 1.806cm^2 of coral tissue/ snail/ night (Cumming, 1999).

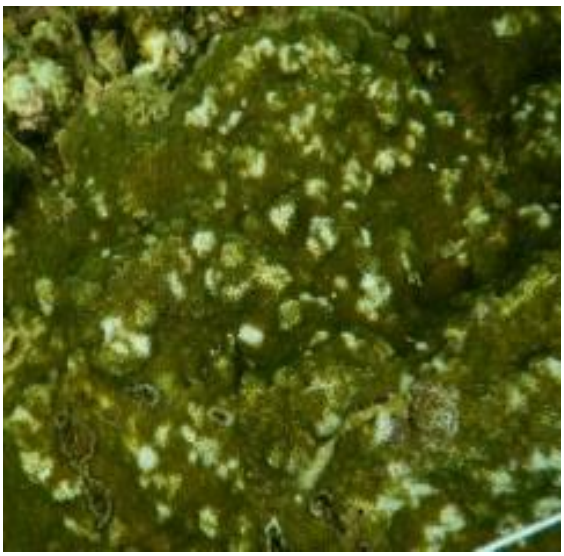


Fish bytes were found in all stations; fish had eaten the surface of the coral colonies with its teeth that would leave specific scars. There are about 128 species of corallivorous fish that originating from 11 different families: Chaetodontidae, Labridae, Tentradontidae, Monachantidae, Pomacentridae, Balistidae, Scaridae, Gobiidae, Blennidae, Ostraciidae, and Pomancanthidae. Parrotfish, pufferfish, triggerfish, and butterflyfish are common species that prey on the surface of the coral colony that called as Epilithic (Glynn, 1997).

Four types strategies on corallivorous fish feeding, they were mucus feeders (consume only coral mucus), browsers (consuming coral tissue without damage the coral skeleton, excavators (removing tissue with skeleton damage dominant), and scrapers (removing coral tissue with small impact on coral skeleton) (Work and Aeby, 2006).

Tissue Loss Non-Predation (TLNP)

TLNP that have been found in Prigi Bay can be caused by several types of coral diseases. The first coral disease is the black band disease (BBD) in Fig. 4a which is characterized by the presence of black bands on the coral as a barrier between the dead skeleton and living tissue. The second is atramentous necrosis (AtN) in Fig. 4b characterized by a gray color on a white skeleton, the third is ulcerative white spots (UWS) and the fourth is white syndromes (WS). UWS (Fig. 4c) has small white patches or less than 1 cm while in white spots spreads with larger size (Fig. 4d).



The distribution of TLNP in all coral families in Prigi Bay is described in Fig. 5.

Fig. 1. TLNP yang ditemukan di Setiap Stasiun (a) Black Band Disease; (b) Atramentous Necrosis; (c) Ulcerative White Spots; (d) White Syndromes.

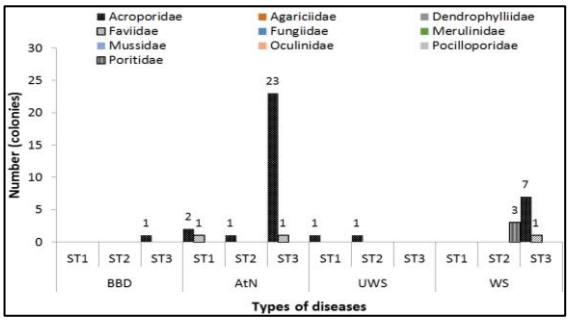


Fig. 2. Jumlah TLNP yang ditemukan.

Fig. 4. *TLP yang ditemukan* (a) akibat *drupella*; (b) akibat gigitan ikan karang

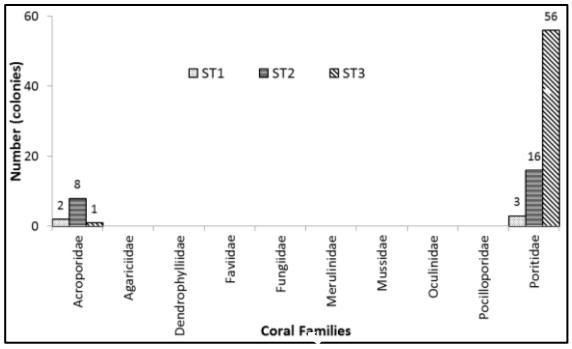


Fig. 5. Jumlah TLP yang ditemukan.

Black Band Disease (BBD)

BBD is one type of coral disease caused by the synergies of some bacteria or bacteria consortium such as *Phormidium corallyticum*, *Desulfovibrio* spp, *Cyanobacterium* sp and *Cytophaga* sp (Frias-Lopez *et al*., 2003). The BBD characterized by the presence of black band about 5-30 mm wide in the surface of the coral colony and killing the coral tissue that caused the skeleton visible and naked, immediately the death coral will have occupied by brown algae (Frias-Lopez *et al*., 2003).

BBD only found in ST3 was infected Montipora colony from family Acroporidae (Fig. 4a and Fig. 5). BBD was affected by 45 species coral in Indo-Pacific and most of them from Acroporidae (Sutherland *et al*, 2004). In another report by Sato *et al*., (2009) that 57 scleractinian was infected by BBD with progression rate about 2cm/ day, and 3mm/ day in coral *Montipora hispida* (Sato *et al*., 2011). The increasing of BBD has a positive correlation between temperature and environmental condition (Harvell *et al*., 2007).

Atramentous Necrosis (AtN)

Atramentous Necrosis (AtN) was found in Acroporidae colonies with 2 colonies in ST1, 1 colony on ST2 and 23 colonies on ST3 (Fig. 5). Beeden *et al*., (2008) states that the AtN usually affected on Acroporids and Montiporiids corals (Acroporidae family) other reported said that AtN also be found on Porites corals, showing gray layers followed by spots white (Joshi *et al*., 2017). The gross lesions of AtN are characterized by typically small spots of exposed <1cm diameter that merge to create larger network gaps.

The final stage, wounds can develop a black coat on top of a black sediment that will be grayish (Fig. 4b). AtN is the new disease that was reported by Great Barrier Reef (Anthony *et al*., 2008).

Ulcerative white spots (UWS)

Ulcerative White Spots (UWS) found in ST1 and ST2 was infected with colony Acroporidae. The UWS first report of was infected of Porites corals in Philippines (Raymundo *et al*., 2003) but can also be affected on *Porites* spp., *Goniastrea minuta*, *Echinopora lamellosa*, *Heliopora coerulea*, *Favia stelligera*, *Favia* sp., *Montipora grisea*, *M. malampaya*, *M. turtlensis*, *M. digitata*, *M. vietnamensis* and *M. turgescens* coral species (Raymundo *et al*., 2005). The UWS is characterized by small white lesion (3-5mm in diameter), after several periods the tissue of coral will be lost and polyp underneath will death. *Vibrio* sp (*V. natriegens* and *V. parahaemolyticus*) are the causative agent of this disease (Arboleda and Reichardt., 2010).

White Syndromes (WS)

WS was found in ST2 and infected 3 colonies of Poritiidae and in ST 3 was infecter 7 Acroporidae and 1 Faviidae (Fig. 4d; Fig. 5). WS reported infected in 15 genus coral and mostly in Acropora coral (Montano *et al*., 2016; Raymundo *et al*., 2008).

WS is characterized by acute of tissue loss without show border or line between health and diseased coral tissue (Sussman *et al*., 2008). WS disease is most commonly found to infect coral in Indo-Pacific, including Indonesian. The pattern of the spread of WS disease in the Great Barrier Reef was found to be correlated with thermal stress and coral cover, with infectious disease rates in warmer seasons of higher than 50% (Bruno *et al*., 2007).

Growth Anomalies (GA)

GA disease is the most easily distinguishable disease from others. The disease is characterized by a morphologically different enlargement of coral tissue from surrounding tissues (Work *et al*., 2015). GA is divided into 2, which are explained growth anomalies (EGA) and unexplained growth anomalies (UGA). EGA can be caused by invertebrates that manifest in the coral (Fig. 6a), while UGA can be caused by many factors, some previous research showed environmental factors such as UV radiation, environmental degradation and infectious agents such as viruses, bacteria, and fungi (Work *et al*., 2015). About 192 colonies were found infected by EGA in ST1 they were from Faviidae (100 colonies), Acroporidae (86 colonies), Ocullinidae (1 colony) and Poritiidae (5 colonies) (Fig. 7).

The EGA was found in ST2 viewer than ST1, 1 colony Acroporidae, 1 colony Agariciidae, and 9 colonies Poritidae. In ST2 showed 21 colonies of Faviidae infected by EGA and 4 colonies of Poritidae. UGA infected of Acroporidae and Poritidae (Fig. 7).

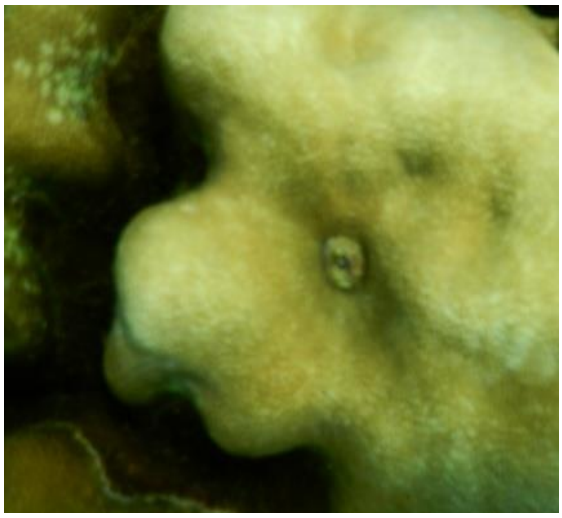


Fig. 6. GA yang ditemukan di Setiap Stasiun (a) Explained Growth Anomalies; (b) Unexplained Growth Anomalies.

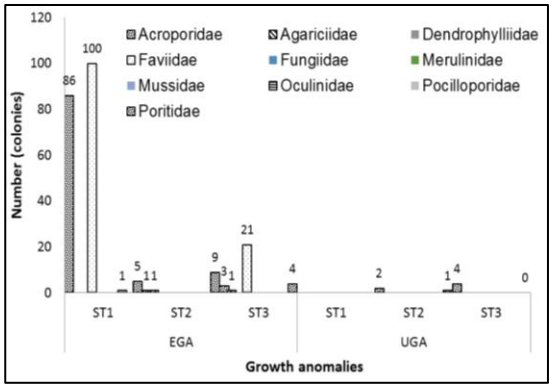


Fig. 7. Jumlah GA yang ditemukan.

GA well documented in several corals such as Acropora, Porites, Fungia, Pavona, and Pocillopora (Work *et al.*, 2015), Massinai *et al.*, (2017) also reported that GA was infected Acroporidae, Pocilloporidae, Faviidae and Poritidae in Salemo Island. The mean prevalence of GA can range 5-7% (Work *et al.*, 2015). The major infected coral in Indo-Pacific area was Acropora and Porites (Aeby *et al.*, 2011). In general, can affect on colony fitness in coral, reduced colony growth, partial mortality, and decrease the reproduction of coral (Stimson, 2011; Aeby *et al.*, 2011).

Conclusion

There are 2 types of diseases found in Prigi Bay, Tissue Loss Predation and Tissue Loss Non Predation. TLP is caused by predation such as invertebrates or reef fish. TLNP is usually caused by infectious agents that can lead to diseases such as black band disease, atramentous necrosis, ulcerative white spots, white syndrome and growth anomalies. The prevalence of coral disease in each station ie ST1 is 20.9% in ST2 is 6.5% and ST3 is 5.2%.

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