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Coral health monitoring at Melinjo Island and Saktu Island: Influence from Jakarta Bay

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ABSTRACT

The status of coral ecosystems at two islands, Saktu and Melinjo, in Thousand Islands National Park was assessed based on three ecological indicators: percent coral cover, coral disease symptoms, and reef fish abundance. Coral cover in both Saktu Island and Melinjo Island was categorized as poor, with average percentages of 22.3% and 22.2%, respectively. Expressed as the percent of coral colonies exhibiting unhealthy coral, both the disease and bleaching occurrence numbers within a transect line were calculated. The disease prevalence at both locations was high, with an average value of 23.5% for Melinjo Island and 18.5% for Saktu Island; White syndrome (WS), Skeletal eroding band (SEB), Pigment response (PR) and bleaching were the predominant diseases. Several diseases may be a response of coral to environmental pressure, such as inland pollution from Jakarta Bay. In addition to the coral reef health assessment, we observed the presence of eight families of coral fishes, which consisted of Chaetodontidae, Pomacentridae, Lutjanidae, Cirrhitidae, Acanthuridae, Gobiidae, Sparidae and Muraenidae. Although the reef was considered unhealthy, the diversity of the fish community was as extensive as that found in healthy coral reef communities.

1. Introduction

Jakarta Bay is located in the waters of the Java Sea in the Province of Jakarta, where 13 rivers divide the Jakarta disemboguement (Nurruhwati et al., 2012). The water in Jakarta Bay receives heavy loads of pollutants in the form of domestic waste, organic contaminants, industrial waste, heavy metals and oil spills, and this pollution is likely to increase over time. The impact of the decrease in the quality of water in Jakarta Bay has even been felt in the waters of the Thousand Islands National Park located over 50 km away (Sachoemar and Wahjono, 2007). This represents an ideal area to assess the relative and interactive effects of multiple stressors on coral reef ecosystems (Baum et al., 2015). Coral reefs, for instance, are increasingly under pressure due to coastal development and resource use (Van der Meij et al., 2010). At least 19% of all reefs worldwide have been permanently lost, and of those remaining, over 60% are at immediate risk from direct human activities (Baum et al., 2015). Such degradation may reduce coral resilience to diseases, which generally occur as a response to biological stressors, such as bacteria, fungi and viruses and/or non-biological pressures, such as an increase in sea surface temperatures, ultraviolet radiation and pollution. Pollution plays a key role as a trigger of a number of coral diseases and may reduce the percentage of coral cover and healthy coral (Johan et al., 2015). The health of coral reefs can be evaluated using chemical and physical factors, as well as biological factors such as the presence of fish indicators. From this point of view, Chaetodontidae, Pomacentridae, and Ephippidae, which are closely associated with healthy coral reefs, may be good references of healthy ecosystems (Allen et al., 2003). Chaetodontids have been suggested as "indicator organisms" of coral reef conditions, with changes in population size or behavioral traits as potential

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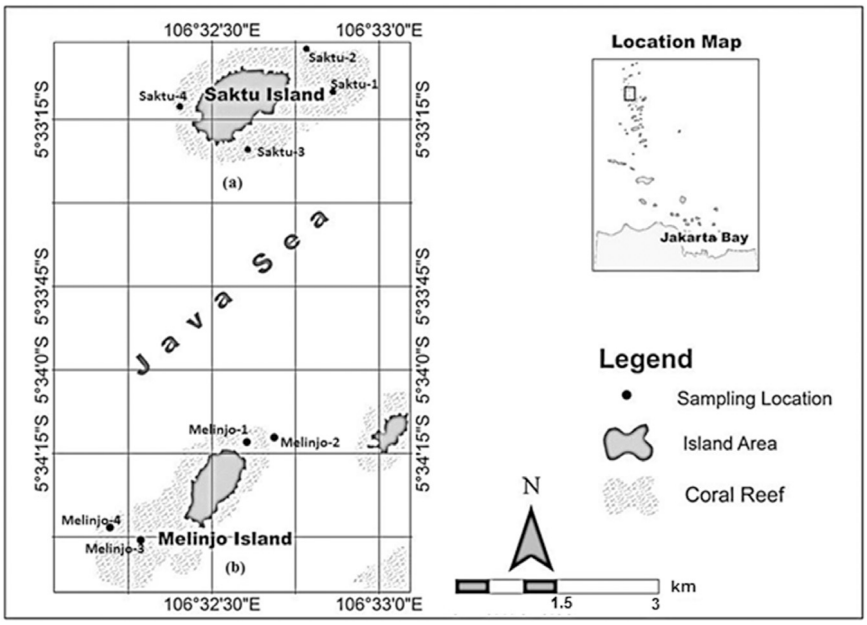

Fig. 1. Sampling locations near Saktu and Melinjo Islands.

indications of changing or stressful conditions in a coral reef (Shokri et al., 2005).

Saktu and Melinjo Islands are uninhabited islands within Thousand Islands National Park. Both islands are coral reef enclaves exposed to similar environmental stress from the distant source of Jakarta Bay, which is approximately 48 km away. Currently, there are no data presenting the conditions and status of the coral reef ecosystems at these islands. This study aimed to assess coral health based on three primary indicators: percent live coral cover, disease prevalence, and the occurrence of indicator fish families.

2. Material and method

2.1. Study sites

The Thousand Islands Marine National Park Archipelago is a representative of the marine conservation area in Indonesia, which is located 45 km north of Jakarta. There are 78 coral islands covering an area of 107,489 hectares. Geographically, the Thousand Islands is located between 5° 24′ and 5° 45′ latitude and 106° 25′ and 106° 40′ longitude. The Thousand Islands Park is composed of shallow sea with fringing reefs, mangroves and seagrass that grows despite the lack of nutrients or mud and in shallow depths at approximately 20–40 m.

Melinjo Island is located within the northern part of the Thousand Islands Park, which is between 05° 34′21″ latitude and 106° 32′29″ longitude (Fig. 1). The area of the island is 0.116 km^2 based on imagery analysis using a geographical information system (GIS). This coastline consists mostly of white sandy beaches with seagrasses, algae, and Rhizophora mangroves. Coral reefs surround almost every part of the island.

Saktu Island is located within Kelapa Island in the north of the Thousand Islands Archipelago, which is geographically located between 05° 33′10″ latitude and 106° 32′36″ longitude (Fig. 1). The area of the island is 0.172 km^2 based on GIS analysis. Saktu Island is occasionally used as a tourist attraction and is only occupied by a few island guards. The organisms that live along the Saktu Island coastline include seagrass, algae, tunicate and large coral reefs, and Rhizophora mangroves grow as barrier on this island (BTNKS, 2008). Two stations for each study site represent two types of environments, i.e., reef flat (<2 m) and reef slope (<10 m). At Saktu Island, the stations were located on the north and south sides (Fig. 1). At Melinjo Island, the stations were located on the northeast and southwest sides for the first and second stations, respectively (Fig. 1).

2.2. Data collection

2.2.1. Percent coral cover

To determine the percentage of live coral, a line intercept transect (LIT) method based on coral growth form (lifeform) was used (English et al., 1997). The method recorded the overall shape and morphology of live coral. The longest transect was 100 m. The study calculated the percentage of cover for each growth form category by comparing the total length of each coral category by the transect total length. Using different methods, the percentage of cover can be used as an index to determine coral reef conditions (Lam et al., 2006; Facon et al., 2016; Haywood et al., 2016). The conditions of a coral reef are classified as bad if the percentage of cover is 0%–24.9%, moderate if the percentage of cover is 25%–49.9%, good condition if the percentage of cover is 50%–74.9%, and very good if the percentage of cover is 75%–100% (English et al., 1997).

2.2.2. Coral disease symptom observation

The coral disease data collection was performed on the reef flat and reef slope at the two reef sites (Melinjo and Saktu Islands) with a belt transect method covering 2 × 10 m and conducted in triplicate. This method was assisted by using the line transect stretched along 70 m and then taking measurements at 0–10 m, 30–40 m and 60–70 m. The data collected at each station recorded the number of healthy coral colonies and the number of diseased coral colonies. The number of healthy and diseased coral colonies in the belt transect were manually counted. For infected coral, we performed documentation in the form of photographs; the pictures were verified using the Coral Disease Handbook, which contains the guidelines for coral disease assessment, monitoring & management (Abrar et al., 2012).

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