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Research Article

Potential of Coral Resilience Post Bleaching in 2016 in the Water of Ujong Seuke East Coast of Weh Island Indonesia

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Abstract.
Mass bleaching occurred in 2010 in Southeast Asia waters such as Thailand, Malaysia, and Indonesia. One of the Indonesian waters that experienced bleaching was Weh Island area, which then underwent bleaching again in 2016 and had impacts on the coral ecosystem. Substrate changes and coral cover conditions are noteworthy to determine the potential for coral recovery after bleaching. Therefore, the study aims to measure the condition of coral cover and the potential for coral resilience after bleaching in 2016. Benthic data collection used the Point Intercept Transect method while measuring coral resilience potential used the resilience index through coral cover indicators, fleshy seaweed, and rubble. The observation showed that the coral cover in the waters of Ujong Seuke was 34%, fleshy seaweed by 2.83%, and rubble by 21.17%. This research concludes that the condition of coral reef ecosystems after the bleaching phenomenon in 2016 was in moderate condition, and it has a high potential for resilience.

Keywords: coral, bleaching, water, ujong seuke, east coast, Weh Island

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1. INTRODUCTION

Weh Island is located in Aceh Province, Indonesia. It is geographically borders with the Strait of Malacca and the Andaman Sea to the north, the Strait of Malacca to the east, then the Indian Ocean to the south and west [1]. This island is one of the outermost islands that is the starting point of 0 kilometers of Indonesia. Aceh has a coral reef ecosystem [2]. Rudi et al. [3] reported that coral reefs in Aceh waters are a mixture of species from the Indo Pacific, Indian Ocean, and Andaman Sea.

Coral ecosystems are the most complex and productive habitats, but they can be threatened by global pressures such as climate change, overexploitation, coral disease,

and changes in water quality that can result in large scale mortality [4–7]. In addition, the impact of human activities such as pollution, sediment overflow, coastal development, and overfishing can also threaten the survival of coral reefs [8, 9]. Coral reef ecosystems in Weh Island had experienced very severe bleaching of about 80% in 2010 due to increased temperatures [10, 11], and there was bleaching again in the period of 2015 and 2016 in some Indonesian waters [12] so that it also impacted the condition of hard coral cover in the waters of Weh Island. One of the areas that have an impact on bleaching events is the Ujong Seuke water area.

Ujong Seuke waters are located in the conservation area of *Suaka Alam Perairan* (Aquatic Nature Sanctuary) at the east coastal waters of Weh Island. Apart from Weh Island, a conservation area has also been established in the waters of Aceh Besar [13]. Marine conservation provides benefits to coastal communities in terms of fisheries productivity, biodiversity, and habitat protection [14], then regulates the utilization of coastal marine resources [15]. Efforts to establish a conservation area by *Panglima Laot Lhok* together with the Sabang City Government are certainly expected to make the coral ecosystem in Ujong Seuke better and have resilience potential after bleaching.

Resilience is the system ability to recover from disruptions and changes, while maintaining its functions and services for a certain period of time [16, 17]. Several coral resilience studies have been conducted in Indonesian territorial waters, such as in the city of Padang West Sumatra with cases of mass coral deaths in 1997 due to bleaching so that it is reported to have caused coral cover to 0% [18]. Then in the *Kawasan Konservasi Laut Daerah/KKLD* (Regional Marine Conservation Area) of Indramayu Regency at Biawak Island, the coral conditions have not shown better changes since the establishment of conservation areas [19]. Therefore, the purpose of this study is to measure coral conditions and potential coral resilience after bleaching in 2016 in the waters of Ujong Seuke at Weh Island, Indonesia.

2. RESEARCH METHODS

The study was conducted at conservation area of Ujong Seuke East coast at Weh Island Indonesia (Fig. 1), between coordinate 5°48’29,9”N and 95°22’ 34,7”E from August to September 2021. Coral resilience was measured based on three indicators, i.e coral cover, fleshy seaweed, and rubble by looking at the percentage of cover [20]. Substrate data collection was carried out by the Point Intercept Transect (PIT) method with a length of 50 meters as much as six subtransects placed at a depth of 2-10 meters. Types of coral, fleshy seaweed, and rubble that offend transects were recorded every

50 centimeters. Water conditions were observed by *in situ*, namely measuring: the temperature with the thermometer; the salinity with the refractometer; the pH with the pH meter; the visibility with the Secchi disk; and the current with current meter. The measurement of water condition was carried out three times looping.

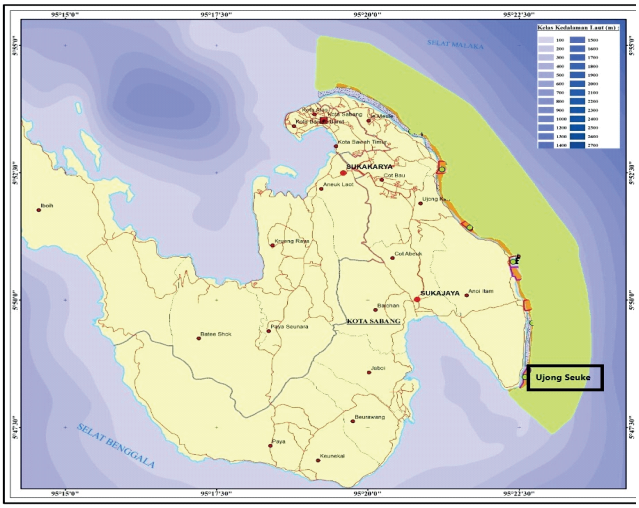

Figure 1: The map of Ujong Seuke (in square), Sabang, Weh Island Aceh, Indonesia.

2.1. Data Analysis

The resulting data was analyzed using the percentage formula by Manuputty and Djuwariah (Ref. 21) as follows.

% Component cover = (Number of component)/ (Total component) x 100% (1)

The calculations showed the condition of coral cover value and the level of coral resilience in the waters of Ujong Seuke at Weh Island, Indonesia, as shown on Table 1 and Table 2 [21].

TABLE 1: Category of coral condition.

Coral Cover Value	Category
< 19%	Poor
19% ≤ coral cover ≤ 35%	Fair
> 35%	Good

3. RESULT AND DISCUSSIONS

Table 2: Category of coral resilience.

Component Cover Value	Category
Fleshy seaweed ≥ 3% Rubble > 60% Hard coral ≤ 5%	Low
Fleshy seaweed < 3% Rubble ≤ 60% Hard coral > 5%	High

3.1. Coral Resilience

The results of the study found 11 coral genera in the waters of Ujong Seuke namely Acropora, Diploastrea, Favites, Fungia, Goniastrea, Heliopora, Leptastrea, Millepora, Montipora, Porites, and Psammocora (Fig. 2). Figure 2 shows Porites to be the most widely found genus in transect sites, and Acropora being the only one to belong to the branching group. Acropora found at transect sites was only 1.47%. The existence of Acropora colonies in the waters of Ujong Seuke was recorded only 3 points. According to Masucci et al. (Ref. 22), the average coral cover in the Ryukyu Islands, southern Japan was only around 7.2%, then branched corals of the genus Acropora were almost not found at all in observation transects. This condition is believed to be due to bleaching phenomena leaving massive corals such as Porites rather than branching corals such as Acropora. This indicates that Porites is a genus that tends to have better resistance than a genus with a branched form [22, 23]. A similar case also occurred in Tanzania's Pemba Channel conservation area that Porites dominates the waters and has good resistance to environmental conditions [24].

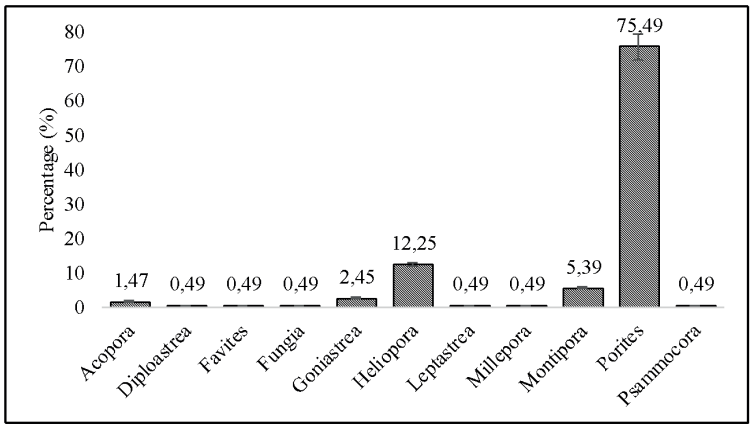

Figure 2: Composition of coral genus in waters of Ujong Seuke, Weh Island Indonesia.

Coral resilience in the waters of Ujong Seuke was observed based on coral cover, fleshy seaweed, and rubble. Hard coral cover is the most commonly used indicator to measure the condition of coral reefs in general [25]. Meanwhile rubble is considered unsuitable for natural recolonization or regeneration of coral larvae because the success

of attachment requires a stable and consolidated substrate [26]. If the rubble exposed to waves, it becomes turned back so that coral larvae can be detached from the substrate [27]. Based on these conditions, rubble is an important indicator in looking at coral resilience and becomes one of the strategies to minimize damage to coral ecosystems in the future.

Referring to the category of coral conditions by Giyanto et al (Ref. 20), coral conditions in the waters of Ujong Seuke were in moderate condition with an average cover of 34±15.22%. The percentage of hard coral cover in 2015 in the waters of Ujong Seuke was reported at 48% [28]. There was a decrease of 14% over the last 6 years. The observation showed the percentage of rubble cover was 21.17±18.59% and the fleshy seaweed was 2.83±2.71% (Figure 3). The high percentage of rubble that exceeds the fleshy seaweed cover is a condition that needs to be considered because rubble is an unsuitable and unstable substrate for regeneration. Biondi et al. [29] suggest that excessive accumulation of coral ruins can have an impact on living coral colonies.

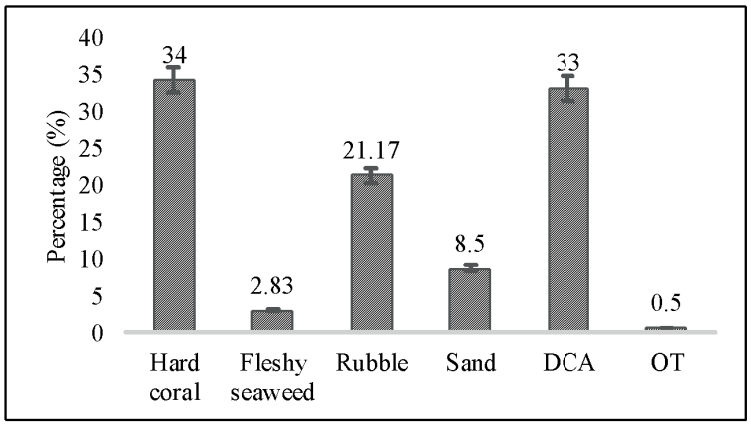

Figure 3: Percentage of benthic components in the waters of Ujong Seuke, Weh Island Indonesia. (DCA: Dead coral with algae, OT: Others).

Fleshy seaweed was found to consist of Halimeda, Padina, and macroalga from articulated red algae. The observation showed very little amount of Halimeda and Padina was found at the sample location, while articulated red algae were found in particular growing in the gaps between Porites colonies. Rubble cover was found in a condition covered in algae filament, then it spreaded to healthy corals and covered the surface of coral colonies. This condition was found in many Porites (Figure 4). This is particularly worrisome because the thick turf matrix of algae can degrade corals [30], inhibit in the process of coral recruitment, experience space competition, and inhibit coral recovery [31]. The ability of the turf algae that growing fast adversely impacts corals whose growth

is slow, then the lost or damaged by one coral colony can increase macroalgae cover by about 20% [32].

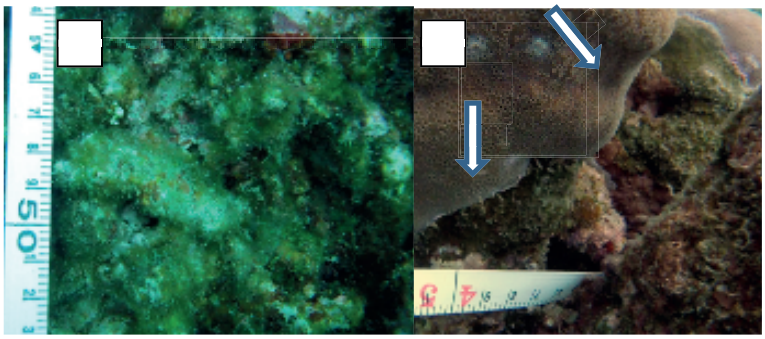

Figure 4: a) Rubble covered with turf algae, and b) turf spreaded to the surface of Porites sp colony (see arrow).

The study result concluded that the coral ecosystem in the waters of Ujong Seuke has a high resilience potential based on the category of hard coral cover, fleshy seaweed, and rubble. Despite of the high level of resilience, the formation of conservation in the waters of Ujong Seuke does not make coral cover better (no more than 50%) and there is not much community activity is carried out. This condition is correspond with the statement of Bruno et al. [33] that aquatic conservation areas do not fully improve coral resilience despite other benefits, such as habitat protection and the possibility of coral recovery.

There needs to be further research related to coral conditions in the waters of Ujong Seuke based on the results of high DCA cover, which is 33% (only 1% different from hard coral). In addition to the formation of aquatic conservation, things that can be done to suppress the high value of rubble and DCA are to transplant corals and monitor coral resilience using different indicators.

3.2. Water Conditions

The average of temperature in Ujong Seuke waters was good, which is 30±1.000°C. It is very good for coral growth and development because high temperatures can make corals lose tissue. This is in accordance with the statement of Saptarini et al. [34] that the optimal temperature is good for coral growth in Indonesia ranges from 25°C to 30°C, while the minimum and maximum temperature limit ranges from 16-17°C and about 36°C [35]. Then, the average of salinity is in good condition which is 32.66±0.577ppt, this number is still within the normal range limit of 26 ppt to 35 ppt [36].

The range of pH values also indicates a normal number suitable for coral growth, i.e. 8.1±0.057. According to the Decree of State Minister for The Environment about the Sea Water Quality Standards [37], the pH range is good for coral reef growth which is in the range of 7 - 8.5. In addition to temperature, salinity, and pH, penetration of sunlight is also necessary for coral polyps to perform calcification and photosynthesis [38]. The brightness level at the study site reached 100% with a depth of between 3-7 meters, which suggests that coral reefs in the waters of Ujong Seuke can grow optimally in shallow waters to a depth of 10 meters. This is in accordance with Saragih's statement [39] that rapid coral growth occurs at a depth of 2-15 meters.

The current of the waters of Ujong Seuke were relatively strong at 0,11±0,037 m/s, while the ideal current range for coral growth ranges between 0.20 and 0.28 m/s [40]. This is supported by Najmi research (Ref. 28) that the current at Ujong Seuke has a strong movement because it is influenced by inflows and outflows at high tide. Overall, the waters at Ujong Seuke are in good condition for the growth and development of coral ecosystems. The hope for the future is that there will be no more temperature increases that can lead the bleaching phenomenon happens again.

4. CONCLUSION

The result of this research concludes that the condition of coral reef ecosystems after the bleaching phenomenon in 2016 in the Ujong Seuke water conservation area was in moderate condition, and it has the high potential of resilience.

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