Coral Reefs Condition Assessment in East Waters of Panaitan Island, Ujung Kulon National Park

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Abstract. Coral reefs ecosystem is a complex and special coastal resources in a tropical area. The characteristics of this ecosystem are high in productivity and diversity. Panaitan island is one of the island located in Ujung Kulon National Park area with various coral reefs. This area has multi attractive potencies which can be exploited by everyone depending on personal or group interests. Coral cover data were collected using Line Intercept Transect method and mortality analysis using mortality index method. Data collection was carried out in 4 different stations with 2 different depths. The results showed that at the depth of 5 m the highest damaged area is on 1st station, with 50% damaged coral reefs. Mortality rate at the depth of 5m and 10m found at 1st station with mortality index 0.4 point and 0.44 point respectively. It is estimated that station 1 is a good area compared to the previous study that shows condition so that many exploitation by destructive.

1. Introduction
Panaitan Island, is a one among 13.466 of Indonesian Island located in the west edge of Java Island. Having been surrounded by Hindia Ocean and Sunda Strait, Panaitan Island consist of many living ecosystem that is separated by two different types of ecosystem which are land base ecosystems and marine base ecosystems. As it is covered by a lot diversity inside of it land, Panaitan Island has been legally statuted by Ministry of Environment and Forestry as a National Park.

Panaitan Island has been known of its marine base ecosystem that contain of potential and diversity. Panaitan Island surrounded by coral reefs ecosystem that has been known since 1987 [1]. According to [1] [2] research data, coral reefs composition in Panaitan Island has shown in a good condition. Coral reefs has taken an important activity through coastal protection and its source of nutrition [3]. Panaitan coral reefs ecosystem is a primary living ecosystem that needs to be monitored periodically [4].

Knowing of it high productivity fishing ground and many trade marine organisms found such as Giant Clam (Tridacna sp.) [1], coral reefs statue in Panaitan Island has been damaged. Negative impact has been recorded due to ecosystem in Panaitan Island, such illegal fishing, destructive fishing method, and anthropologic activity [5]. Several destructive fishing activity that have been frequently
occur in Panaitan coastal territories and make a huge impact of coral reefs ecosystem [6]. Due to it is high diversity of it is marine life ecosystem, Panaitan Island is registered as Taman Nasional Ujung Kulon that well known about its coral reefs diversity around the Island.

To know the latest information about coral reefs existence, monitoring assessment is needed to obtain the current status of coral reefs [7]. Furthermore, monitoring assessment is a part of management that can be used to determine how much the impact of ecosystem activities to the sustainability of coral reefs ecosystems [8]. Ecological monitoring of coral reefs ecosystem in Panaitan Island that provides empirical data of its current coral cover is still rare and there is no such periodically assessment monitoring was ever published. Coral reefs status in Panaitan Island last recorded in 1988 by researcher, [1], shown low percentage of coral cover in two different depths, which are 18,82% in 3 meters below sea surface and 11,16% 10 meters below sea surface.

2. Research Methods
2.1 Research Station
This research was conducted in May 15th – 22th, 2014 on Panaitan Island located in Ujung Kulon District, West Java Province, Indonesia (Figure 1). Four different stations were targeted as primary location to determine coral cover of its station in Panaitan Island.

2.2 Physical Environment Data Collect
Each station was measured using Water Quality Checker Device type: AZ 8603; Brand: AZ Instrument. Each parameter collect by its pH, salinity, conductivity, dissolved oxygen and temperature.

2.3 Coral Monitoring Technique
Purposive Sampling Method was used to determine the site sample of Coral reefs monitoring. Monitoring was conducted by Line Intercept Transect (LIT) by lying the transect with 100 meters long on coral cover each station. Each organism underlying the transect was recorded. Assessment was conducted in four different stations which are divided on to two different depths which in 5 meters and 10 meters below sea surface.

Life form of Coral Colonies were collected each station at different depths. Documentation of life form coral cover monitoring was done by Canon G1X underwater camera. Coral cover data was analyzed by using [9] by divided total cover length of transect with life form length each station:

$$\%\text{Coral Coverage} = \frac{\text{Total length of lifeform}}{\text{Total length of Transect}} \times 100\%$$ (1)

After analyzing data, classification of coral cover each station was determined using [10] coral cover condition measurement.

| Percent of Cover Coral (%) | Criteria     |
|--------------------------|--------------|
| 0 – 25                   | Bad          |
| 25 - 50                  | Average      |
| 50 - 75                  | Good         |
| 75 - 100                 | Very Good    |

Index of Mortality was calculated using method by [10]:

$$\text{Mortality Index} = \frac{\text{Death Coral Percentage}}{\text{Death Coral Percentage} + \text{Live Coral Percentage}}$$ (2)
3. Results and Discussion

3.1 Physical Condition of East Panaitan Waters, Ujung Kulon

Physical data collected at the each study site while in the same time as observing the condition of the coral reefs. Physical parameters that are measured include water temperature, water depth, water brightness, DO, salinity, and water PH. The result shown in table 2 and 3.

Water temperature on sampling site shown between range of 29°C - 31°C at a depth of 5m and 29°C - 30.7°C at a depth of 10m. Coral reefs have a optimum required temperature limit that tolerance at ranging from 25°C - 30°C [5] with a extreme condition can be tolerance up to + 6°C at maximum temperatures and -7°C at minimum temperatures. Highest temperature occurred in the 5 meters depth at station 1 and 10 meters in station 2. Temperature degree that was recorded can be categorized as a optimum condition and susceptible to the coral reefs. Due to it is range at the maximum limit of tolerance temperature, still it has not optimized yet for coral to gain its metabolic process. However, when significant temperature directly changed, it would reduce the coral feeding behavior at temperatures above 33.5°C [11].

Visibility of waters in the sampling site referred in optimum required of sea water clear visibility. It is shown as a clear visibility and low sedimentation level by measured using sechidisc that shown 100% clear visibility both of 3 and 5 meters depth. It showed that the current condition of the Panaitan sea water was clear and there was no significant effect that affected the living conditions of coral reefs.

The Salinity and pH in the two depths of sampling site shown normal phase at great condition. [12]’s statement states coral animal can grow well in salinity level between 32‰ - 35‰. The Data shown that the level of Salinity and it pH shown in optimum grade.
3.2. Coral Coverage Condition

The Coral cover will be classified into several categories, five categories are recorded (hard corals *acropora* and *non-acropora*), dead corals, other organism (algae, sponges, soft corals, etc.) and abiotics (water, sand, rock, etc.). The depth of 5m (Figure 2), for live coral cover ranged from 29.96% - 61.33% with the lowest cover was station 1 and the highest cover of station 3 was 61.33% respectively, the second highest and third positions were stations 2 and 4 are 53.85% and 52.19%.

Based on the categories seen from the results of graph 2, it can be mentioned in Station 1 that the coral cover conditions are categorized as moderate and in stations 2, 3, and 4 are categorized as good conditions. At a depth of 5 meters (Figure 2) the percentage of dead coral cover in station 4, which was 23.50% followed by stations 1, 2 and 3, each with a value of 15.11%, 5.64%, 1.60%. The other highest other organism cover is located at Station 1, which is 7.20% and the next is followed by stations 2, 3, and 4 respectively 5.36%, 0.99% and 0%.
Abiotic cover (Figure 2) at this depth ranged between 24.31% - 47.73% with the highest cover at station 1 and the next followed sequentially stations 3, 1, and 4 at 36.09%, 35.15%, and 24.31%. At a depth of 5 meters (Figure 2), station 1 is a bad cover with healthy coral cover of 29.96%. The presence of abiotic components consisting of (sand, rubble, rock, water, and so on) is 47.73%. The presence of other biota which is quite small and coral mortality rates are categorized large indicate that station 1 is often the place of human activity interaction with bad behavior. It often occurs so that the presence of high abiotic components and mortality rates, supported by the condition of small live coral compared to coral conditions in other stations.

While the best conditions at 5 meters deep locate in station 3 with a coral cover level of 61.33% and a very small coral mortality rate of 1.60%. Supported by the presence of other organism such as algae contains by 0.99%. Different type of contour each depths (Figure 3) shown different composition of coral reefs cover. Variant characteristics and tolerance factor of coral reefs life are quite varied as well. The highest cover of live coral reefs at a depth of 10 meters (Figure 3) is owned by station 4 with a percentage of live coral cover as much as 60.14% and then successively reduced to stations 3, 2, and 1 with each percentage of coral reefs cover owned by 50.01%, 29.43%, 7.19%.
Figure 3. Map of Substrate composition in 10 meters depth. ■ Coral life, □ Coral death, □ Biotic, □ Abiotic

Each station has a coral reefs condition category. Station 3 and station 4 have good coral reefs conditions and at station 2 the condition of coral reefs including conditions being continued at station 1 the condition of bad coral reefs is only 7.19%. The highest condition of dead coral reefs was found at Station 3, which can be seen in Figure 3, which was 20.87% and the next Station 4 was 13.24%, followed by Station 2 at 11.87% and Station 1 5.8%.

Other biota categories consisting of algae, soft corals, etc. were the largest in Station 4 with a coverage of 7.18% and Stations 2, 1 and 3, respectively 5.84%, 1.06% and 0%. Abiotic conditions at each station at a depth of 10 meters are quite varied with quite high values. The forms are quite diverse ranging from rubble, rock, sand, and so on. Station 1 is an abiotic component with the highest percentage of 85.95% and the next Stations 2, 3, and 4 respectively in the order of 52.85%, 29.12% and 19.45%.

The same condition at 10 meters depth is similar to the conditions at a depth of 5 meters. Station 1 has the worst condition with a live coral cover value of 7.19% with dead coral at 5.8% and the highest abiotic component at 85.95%. This indicates the ability of coral reefs recruitment does not exist in the optimum phase.

This major decreasing factor both in 10 meters or 5 meters depth caused by destructive fisherman activity. It is seen in the high amount of rubble scattered found while collect the data. This evidence strengthened by statement of an interview with a local ranger supervisor who stated the use of explosives material for fishing around Panaitan coastal.

This condition can lead to recruitment for life and very small coral growth. This is consistent with the statement expressed by [13] the practice of fishing with destructive behavior such as bombing is the main cause of coral reefs degradation in the Indo-Pacific. The resulting coral fractures cannot survive and create rubles unstable coral that are not suitable as new recruits.
3.3 Hard Coral Composition

Results of analysis of hard coral to all stations at each depth, showed there were 13 forms of life (lifeform) consists of hard coral hard coral 5 *Acropora* and 8 non-<i>Acropora</i>. *Acropora* consists of Acropora branching (ACB), Acropor digitate (ACD), Acropora encrusting (ACE), Acropora submassive (ACS), and Acropora tabulate (ACT). Non-<i>Acropora</i> consists of Coral branching (CB), Coral encrusting (CE), Coral foliouse (CF), Coral massive (CM), Coral sub-massive (CS), Coral mushroom (CMR), Coral meliopora (CMR), and Coral heliopora (CHL).
The analysis results at 5 meters depth (Figure 4) for all observation stations showed that hard corals were dominated by lifeform non-acropora with the largest percentage of coverage at station 3 within 36% of the presence of hard hard corals at 61%, but station 1 showed different things by presence of coral acropora as dominance with a total presence of 22% from 29% of the total presence of live corals.

At a depth of 10m (Figure 5) the dominance of the presence of live corals in each station is the dominance of hard corals non-acropora with the largest dominance appearing at station 4 with a percentage of 31% in the total presence of hard corals by 60%, but station 2 shows a different situation with 29% presence 17% live coral is dominated by coral Acropora and 12% cover is occupied by non-Acropora coral. This shows the growth of non-Acropora corals are rapid and consequent shown an increasing size of colonies recruitment.

The composition and percentage of coral cover produced for hard Acropora corals, 5 meters depth (Figure 6) were found in Acropora branching. The attendance appeared for each station, but the highest percentage was obtained at station 2 with a percentage of 12.69% of the total living coral at 53.84%.

![Coral coverage and composition of Acropora at 5 meters depth](image)

**Figure 6.** Coral coverage and composition of Acropora at 5 meters depth.

The lowest presence of Acropora digitate (Figure 6) was found at station 3 at 0.28%, and the highest occurrence was at Station 4 by 8.63%. Acropora encrusting total attendance for all stations is 18.66% with the highest presence at Station 3 with 7.68% and the lowest presence is at Station 4 which shows no presence at all.

Acropora submassive as shown in Figure 6 appears in each station with various percentage values that vary, the lowest percentage of occurrence is at Station 2 at 0.28%. Acropora digitate appears on all stations with values ranging from 1.98% - 2.25% with different values of each cover. At 10 meters depth as it is shown in Figure 7. The appearance of life coral looks the same as the 5 meters depth, the presence of Acropora branching still dominates the presence of all stations with a value of 12.33% at station 4 which is the highest attendance station.

The presence of the lifeform smallest appears in station 1 (Figure 7), with 2 types of lifeforms appearing, which is branching and digitate form. Station 2 has a live coral cover percentage for Acropora by 17.5% with the highest presence is Acropora branching 9.83% and the lowest is Acropora encrusting 0.09%.
Station 3 can be seen in Figure 7 the total appearance of coral cover for Acropora is 21.39% with acropora branching occupying the highest dominance of 10.59% and the smallest acropora digitate is 1.61%. Station 4 as shown in Figure 7 has ancover acropora of 28.9% with the largest cover as explained. Acropora branching is 12.33% and the smallest is acropora tabulate of 0.7%.

The results of the analysis as shown in Figure 7 show branching acropora dominating the presence of any other living form coral in every station at a depth of 5m and 10m. This indicates that recruitment, of Acropora branching is shown optimum process compared to the other lifeforms. This also shows that branching Acropora can dominate by high demand of abundance in every depth. This result is in line with the research conducted by [14] conducted at Pulau Tegal, Lampung, showing coral Acropora branching has a higher life rate and dominates most areas of aquatic substrates, besides the ability of Acropora branching to recovery itself.

Categories of non-Acropora life form at a depth of 5 meters as shown in Figure 8 shows the station 1 is dominated by the presence of massive coral of 5.83% and the presence of coral Meliopora be domination smallest of 0.28% of the total attendance of coral types of non-Acropora 7.35 %. Station 2 shown 4 types of non-acropora living coral which are coral massive, coral branching, submassive and Meliopora. The biggest dominance is coral massive of 15.90% and coral Meliopora being the smallest presence with a percentage of 0.14% of the total attendance of 27.35% for non-acropora. Station 3 shown 5 types of non-acropora with a total presence of all live corals is 36.46%. The highest cover was coral massive at 16.34% followed by cover at encrusting coral 11.07%, coral branching at 7.46%, coral foliouse at 0.88%, and submassive coral at 0.71%.

Station 4 can be seen in Figure 8 and has a percentage of coral cover for non-acropora of 35.82%. Five different non–acropora coral was recorded in this station such as branching 24.09%, massive 8.75%, Meliopora 1.73%, coral Foliouse 0.63%, and Heliopora 0.63%.

The 10 meters depth shown in the picture shows the dominance and different characteristics, this shows the depth of the water gives a factor influencing the variations in the lifeform of the dominating coral reefs. The non-acropora species found in Station 1 contained 3 types of non-acropora namely Coral meliopora 3.19%, Coral foliouse1.73%, and Coral massive 0.21%.
Station 2 has 5 types of non-Acropora, which was dominated by the percentage of massive coral by 3.92% followed by submassive coral at 7.11%, Coral branching at 0.63%, Coral meliopora at 0.53%, and Coral encrusting amounting to 0.50% with the total presence of all non-Acropora corals at 12.97%. Station 3 had the presence of non-Acropora coral at 25.92% with 4 types of coral that appeared, among others, Coral massive of 14.78%, Coral branching of 5.84%, Coral submassive 3.96% and Coral meliopora 1.34%.

Figure 8 Coverage and composition of non – Acropora corals at 5 meters depth.

Figure 9. Coverage and composition of non – Acropora corals at 5 meters depth.

Station 4 as shown in Figure 9 is the presence of coral cover non-acropora that is quite high at a depth of 10 meters, which is 31.63% and with the most types of life forms is also 6 species. The appearance of types and percentages of cover are follows; coral massive at 11.95%, coral mashroom at
5.94%, coral foliouse at 5.54%, coral encrusting at 4.38% coral branching% and 2.35% submassive coral by 1%.

The depth of 5m and 10ms as shown where non-acropora corals more dominated by coral massive and coral branching. Both of these types do have high susceptibility to damage, coral massive has a solid and solid shape, making it not easy to break, break, crack, and so on. Coral massive and coral branching are coral species with high tolerance to the physical dynamics of the waters.

### 3.4 Coral Mortality Index

The results coral mortality index data show the level of negative impact occur. The results of the mortality index are presented in Figure 10a for a depth of 5 meters and Figure 10b for a depth of 10 meters. From Figure 10a can be seen the appearance of the mortality index value of each station at a depth of 5 meters. Station 1 has the highest mortality index of 0.34, followed by Station 4 by 0.31, Station 2 by 0.09, and the mortality index at Station 3 is 0.03.

![Figure 10. Coral mortality index a) 5 meters depth; b) 10 meters depth](image)

The same conditions were found at a depth of 10 meters which is shown in Figure 10b for all stations, the similarity is found in stations that have the highest mortality index value of station 1. Station 1 has a damage index value of 0.44, the smallest damage is station 4 at 0, 18, station 2 and station 3 have a mortality index value of 0.28 and 0.29 respectively.

The results of observations at the location of the study and interviews that have been carried out to Ujung Kulon National Park (TNUK) officers and Banten coastal communities who work as fishermen and utilize the eastern coastal waters of Panaitan Island, damage to coral reefs occurs a lot due to the destructive effects of fishing activities (destructive fishing) such as the use of bombs for reefs fish [14] [15]. Besides that, fishing boat activities that throw anchors are prohibited from places when fishing and tourism activities are carried out. In terms of the behavior of the tourists who arrived, showed their contribution to the increase in damage in several locations in the eastern waters of Panaitan, but relatively small given the tourist visits to Panaitan Island were not too large compared to tourists visiting Peucang Island (another island in the National Park cluster), Ujung Kulon.

### 4. Conclusion

Coral reefs in Panaitan Island have shown number of decreasing. Each sampling site shown a number less than 60%. More over this proof of major decreasing of living coral has been cross checked by local ranger that shown and destructive fishing method that take an huge impact in coral damage. Thus, this monitoring result can be used for a reference to take a policy to conserve coral reefs ecosystem around Panaitan Island.

**Acknowledgements.** We would like to thank to Balai Taman Nasional Ujung Kulon, West Java who support and give accommodation to conduct this research, DWIPANTARA III “Ujung Kulon - Pulau Panaitan” Expedition team (Tonny Adam-U19, Amalia Aninnur-U20, Mujahidin Akbar-U20, Adinda Rizki-U20, Davis Pramayudha-U21, Izzudin Rajab-U21, Rifqi Adzani-U21, Aji Bagus-U21, Dio
Dirgantara-U20, Hendry Siagian-U18), and UKSA-387 UNDIP Diver keep stick together to finish this expedition.

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