Diversity and Abundance of Chlorophyta in Krakal Beach, Gunung Kidul, Yogyakarta

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Abstract. Chlorophyta plays an important role in energy flow as the main producer in marine food chain, material circulation, bioaccumulation, and bio-indicator in the intertidal zone. Several genera of Chlorophyta have been used by local society around coastal area of Gunung Kidul, Yogyakarta as local product, but the research about diversity and abundance information of Chlorophyta in Krakal beach was not yet understood. The aim of this study is to gain the information about diversity and abundance of Chlorophyta in Krakal Beach, Gunung Kidul, Yogyakarta. This research was conducted in March 11th 2017. This research utilizes Line Transect and Stratified Random Sampling method which is used 1x1 m plot. There are six genera of Chlorophyta have been identified in this research, such as Chaetomorpha sp.; Boergesenia sp; Ulva sp.; Cladophora sp.; Enteromorpha sp.; and Halicystis sp. From 6 genera of Chlorophyta, the highest genera coverage is Enteromorpha sp. (9.88%). This research is expected to record data of macroalgae abundance especially Chlorophyta, in Krakal Beach. By this research, monitoring of macroalgae could be done and supported by government and local people to maintain the sustainability of Chlorophyta.

1. Introduction

Indonesia is an Archipelago country, with the sum of the island about 13,466, according to toponymy survey “Tim Nasional Pembahuan Nama Rupabumi” at 2007-2010. Based on Badan Informasi Geospasial (B.I.G.) data, Indonesia had a total beach line 99,933 km. Krakal Beach is one of beach in Indonesia which located in Gunung Kidul, Yogyakarta, exactly in Ngéstirejo, Tanjungsari, Gunungkidul, Yogyakarta, Indonesia (S8°8′44″ E110°36′0″). Krakal beach had a big diversity potential of the marine organism. The ecosystem of Krakal beach is rocky, with this kind of ecosystem can be found a lot of coral flora and fauna communities, some of them are Algae, Bivalves, Coral Reefs, Fishes, and other marine organisms [1]. Macroalgae (seaweed) is eukaryotic organism capable of performing photosynthesis. This organism mostly found in the sea as primary producers in the ecosystem [2]. Macroalgae also provide shelter (habitat) for various types of marine life such as Mollusca, Crustacea, Echinodermata and coral fish [3]. Whereas in the economy, macroalgae are often made various products that have high selling value and wide market [4]. Some examples of macroalgae products which useful, look like food, medicine and important matter in industries [5]. Macroalgae can be divided into three divisions based on its color pigment: Chlorophyta (green algae), Rhodophyta (red algae), and Phaeophyta (brown algae) [6]. Green algae or Chlorophyta is abundant in warm (trophic) waters and recorded at least 12 genera of green algae [7].
According to many utilization of macroalgae, the conservation and development of it were very needed for the sake of macroalgae utilization sustainable and for to keep the marine ecosystem conservation. Therefore, the information of macroalgae diversity on the beach in particular on the Krakal beach, Gunung Kidul, Yogyakarta is needed.

2. Methodology

2.1. Materials
Chlorophyta that found in the intertidal zone of Krakal Beach was used as samples by purposive random sampling. Each sample was taken completely from the substrate for identification.

2.2. Instrumentations
Instrumentations, which were used in this research, were quadrat plot 1 m x 1 m with sub-plot 10 cm x 10 cm for measured the abundance and diversity of Chlorophyta, zip-lock plastic for storage, digital camera for documentation, FAO Species Identification Guide For Fishery Purpose for identification [9]. Thermometer and pH meter for measuring the environmental parameters such as temperature and acidity of seawater.

2.3. Sampling and Preparation
Sampling was done on March 11th, 2017 in Krakal Beach, Gunung Kidul, D.I. Yogyakarta (Figure 1) at 2 pm when it was minimum tides.

Figure 1. The study site, Intertidal zone of Krakal Beach (Source: Google Maps)

2.4. Measured of Seaweed Abundance
Chlorophyta diversity and abundance was determined in the intertidal zone of Krakal Beach by 1 m x 1 m quadrat plot with sub-plot 10 cm x 10 cm (figure 2). Four transects line were designed by differences in depth, transect A at the seaside, transect B and C in the middle, and transect D at the end of the zone. Then each transect was divided into five sampling areas. The distance between transects is 15 m and the distance of each sampling point is 20 m (figure 3). In each plot, environmental parameters were measured, temperature by thermometer and acidity of seawater by pH meter.
Percent cover of seaweed calculated using the following formula [9].

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P_i = \frac{a_i}{A}
\]

**Description:**
- \( P_i \) = covered species \( i \) (%)
- \( a_i \) = the total cover species \( i \) (%)
- \( A \) = the total area covered macroalgae (%)

2.5. **Identification**

Samples (Chlorophyta), which take by purposive random sampling in each quadrat plot stored in zip-lock plastics. Then, samples were cleaned and photographed in millimeters block paper for identification. The identification results show the seaweed diversity.

3. **Result and Discussion**

Based on a field study in Krakal Beach Gunung Kidul, obtain the percent cover (figure 4) and the abundance of Chlorophyta genera in Krakal Beach, Gunung Kidul, Yogyakarta. In figure 4, there are 6 genera of Chlorophyta found in Krakal Beach, they are Ulva sp., Halicystis sp., Enteromorpha sp., Cladophora sp., Chaetomorpha sp., and Boergensenia sp. The highest percent cover is owned by Enteromorpha sp. (9.88%) and the lowest coverage is owned by Halicystis sp. (0.14%).

Among the six Genera of Chlorophyta which is found in Krakal Beach, the highest abundance is owned by Enteromorpha sp. (34.85%), and the lowest coverage is owned by Halicystis sp. (0.49%). The diversity of Chlorophyta in Krakal beach consists of six genera they are Boergesenia sp.; Chaetomorpha sp.; Cladophora sp.; Enteromorpha sp.; Halicystis sp.; Ulva sp.
In this study, the most found Chlorophyta genera in each transect are different. Enteromorpha sp. is mostly found in transect A and Chaetomorpha sp. is mostly found in transect B and transect D. In transect 3, Cladophora sp. is the most found. The number of genera found in each transect is also different. In transect A and B there are six genera of Chlorophyta found (Boergesenia sp.; Chaetomorpha sp.; Cladophora sp.; Enteromorpha sp.; Halicystis sp.; Ulva sp.). In transect three there are four genera of Chlorophyta found (Boergesenia sp.; Chaetomorpha sp.; Cladophora sp.; Ulva sp.) and three genera in transect 4 (Chaetomorpha sp.; Cladophora sp.; Ulva sp.)

![Figure 4. Percent Cover of Chlorophyta Genera in Krakal Beach](image)

Air temperature, water temperature and pH of the water are measured. The average of air temperature is 35°C and air temperature is 31.6°C. The pH of the water is seven (neutral).

![Figure 5. The Abundance of Chlorophyta Genera in Krakal Beach](image)

There are six genera of Chlorophyta found in Krakal Beach that has been identified. They are Ulva sp., Halicystis sp., Enteromorpha sp., Cladophora sp., Chaetomorpha sp., and Boergesenia sp. The highest percent cover Chlorophyta in Krakal Beach is Enteromorpha sp. as much as 9.88% among the others six genera. Enteromorpha grew on rocky substrate in the lower intertidal to shallow subtidal zones or in shallow tide pools and exposed to air during low tide [9]. This genus is mostly found in transect A
which has rocky and sandy substrate. Although Enteromorpha sp. has the highest coverage among six genera, this genus is only found in transect A. Suitable environmental conditions are the main reason Enteromorpha sp. grows well along transect A.

Followed by Chaetomorpha sp. 9.85% coverage, Chaetomorpha sp. has wider tolerance limit. Chaetomorpha sp. is found in every transect from the shoreline (transect A) up to 45 meters to the sea (transect D). Chaetomorpha sp. has thallus in the form of a lumpy thread. The percent cover of Cladophora sp. is as much as 6.79%. Thallus of Cladophora sp. is green-dark green, forming compact cushions. It has 3-14 cm in diameter and up to 2 cm high, composed of entangled, stiff, often incurved axes [10]. Cladophora sp. is also found in each transect from transect A to D.

Halycistis sp. has the lowest percent coverage as much as 0.49%. Halycistis sp. is only found in transect A and transect B in low density. In those transect, Enteromorpha sp. and Chaetomorpha sp. are dominating.

Ulva sp. has the percent cover about 0.65%. Ulva sp. is in the bottom two of the lowest percent cover. Among the six genera, Ulva sp. is mostly used by local people. The local people in Krakal beach often take it to make a seaweed chips (“keripik Ulva”) as a commodity trading. The condition of Krakal beach is damaged by human activity and the exploitation of natural resources now [1]. Macroalgae are vulnerable to changes and ecological pressures that occur in their environment. People activities can affect the existence of macroalgae [11].

Also, this research was conducted in March that is the rainy season. Rainwater can disrupt the salinity of seawater that causes macroalgae cannot grow well [12]. According to the previous research the highest coverage and density of seaweed in Krakal beach around July-August (Summer)[13].

4. Conclusion
Based this field study, six genera of Chlorophyta were inventoried in Krakal Beach; they are Ulva, Enteromorpha, Boergesenia, Halycistis, Cladophora, and Chaetomorpha. Among the six genera, Enteromorpha has the highest percent coverage as much as 9.88%. While Halycistis has the lowest coverage as much as 0.14% from 28.35% coverage of Chlorophyta genera in total.

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