Macroinvertebrates Diversity in Sundak Beach, Gunung Kidul, Yogyakarta

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ABSTRACT

Macroinvertebrate diversity is one of the biologicals and ecological indicators that allow it to become a reference in determining water quality. This study aimed to inventory and study the diversity of macroinvertebrate species using the 1 x 1 m^2 transect method along the Sundak Beach, Gunung Kidul, Yogyakarta. The research was conducted on Sunday, October 13th, 2019, with a quadratic transect method of 10 stations from the lowest low tide to the middle of the sea. The data obtained in this study was the result of macroinvertebrates species inventory in each sampling point and the number of individuals of each species. The data was then analyzed using the Shannon-Weiner diversity index (H'). The results showed 45 macroinvertebrate species with 2590 numbers of individuals were found on the Sundak Beach. The most common species were Gastropods with 16 species, while the most individual species were Ophiuroidea (730 species). The diversity index of 1.28351 indicates that the diversity of macroinvertebrates in Sundak Beach is categorized as medium diversity.

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Introduction

As the largest archipelago country in the world, Indonesia has a coastline length of 95.181 km. Beaches in Indonesia offer a variety of beauty and abundant biota. Karst beaches in Gunung Kidul have similarities regarding geological conditions and the process of forming beach morphology (Ramadani *et al.*, 2019). One of the beaches is Sundak Beach. Sundak Beach is one of many beaches in the southern part of Java Island. This beach is located in Sidoharjo, Gunung kidul, Yogyakarta Special Region Province. Sundak Beach is situated between two rock cliffs on the left and right. In the middle of the beach, the substrate is white sand with relatively coarse size with a little rocky shape, while near the cliffs, the substrate is coral. Characteristics Sundak Beach is known for its rocky shores and big waves so that no boats can be seen passing by (Nurmiyati, 2013).

Sundak Beach has an undulating topography with steep slopes. On the east side of this beach, a cave is formed from a rock, which is ± 12 km. Another uniqueness of this beach is that apart from the existence of coral cliffs, there are also

underground river channels that have freshwater flow and there is a basin between the stretch of the beach. The marine life that can be found on this beach is very diverse, including Gastropods, Crustaceans, Echinoidea, Malacostraca, Ophiuroidea, Bivalvia, Polychaeta, Anthozoa, Anopla and Polyplacophora. In one part of the coast, there is a low density of seagrass and algae growth (Nugroho *et al.*, 2014).

Common macroinvertebrates are very sensitive to changes in the environment they occupy so that they can be used as biological and ecological indicators of a species of an aquatic ecosystem (Tjokrokusumo, 2011). The number of species, the number of individuals, and diversity in the macroinvertebrates community can be used as references in determining water quality.

Species diversity in a community is defined as a group of organisms that establish a community (Campbell *et al.*, 2008). Furthermore, Brower *et al*., (1998), specified that species diversity is a manifestation of community structure. A community is stated to have high species diversity if the number of each species is the same as a whole.

The species diversity index is used to determine the diversity of species in waters. Species diversity is a characteristic at a community level based on its biological organization. Species diversity can be used to express community structure and measure community stability, namely the ability of a particular community to maintain its environment to remain stable despite disturbance to its components (Rusdi *et al*, 2020).

Research to take inventory and find the diversity of macroinvertebrate species at Sundak Beach Gunung Kidul, Yogyakarta.

Materials and Methods

This research was conducted on Sunday, October 13th, 2019 at Sundak Beach, Yogyakarta. Macroinvertebrates sampling was taken at 10 stations using the "quadratic transect" method using a 1x1 m cylindrical pipe frame (Loya, 1978). Transects are drawn perpendicularly from the lowest tide point to the middle of the sea and observations are made every 10 meters (10 plots total) along the line transect. Placement of quadratic every 10 m along the transect is considered to be representative of the locations where macroinvertebrate samples are present. In each plot, all macroinvertebrates were observed, recorded, photographed, and counted on the number of individuals of each species in the quadratic transect.

Data obtained to determine the diversity of species. The diversity of macroinvertebrate species found is interpreted in the diversity index calculated using the Shannon Wienner index calculation (Brower *et al*., 1998).

$$H' = -\Sigma Pi \ln Pi$$

Note :

H' : Diversity index
Pi : Proportion of species-I (ni / N)
ni: Number of individuals of type I
N: Total number of individuals of all types

Diversity index analysis follows Fatiqin (2019), namely: $H' > 3$ indicates high diversity, $1 \leq H' \leq 3$ indicates medium diversity, and $H' < 1$ indicates low diversity.

Diversity is determined by the number of species and evenness of the abundance of each individual species obtained. The greater the value of a diversity, the more species obtained and this value is highly dependent on the total value of the individual of each species. The diversity (H') has the greatest value if all individuals come from different genus or species, while the

smallest ones come from a genus or species only (Odum, 1994).

Results and Discussion

Inventory of Macroinvertebrates at Sundak Beach

The results of the macroinvertebrates inventory at Sundak Beach found 45 macroinvertebrate species. The total number of individuals found was 2590 individuals. Among the 45 species found, the five species with the highest numbers were *Ophiomastix annulosa* (730), *Ophiomastix elegans* (488), *Ophiomastix vaiabilis* (361), *Echinometra mathaei* (111), and *Echinometra calamaris* (79). The identification of Ophiuroidea species was carried out with the help of the literature of Clark and Rowe (1971) and Arnold and Birtles (1989).

Studies on the diversity of Echinoderms on Sundak beach have been conducted by Yusron (2015), Firmandana *et al.*, (2014), and Nugroho *et al.*, (2014). Most of the Ophiuroidea groups are found in certain places or have zoning. If grouped according to classes, the number of macroinvertebrate species in Sundak Beach is presented in Table 1.

Table 1. Group of Macroinvertebrates in Sundak Beach

Class	Σ species	Σ individuals
Ophiuroidea	3	1579
Gastropoda	16	344
Echinoidea	4	292
Malacostraca	4	153
Crustacea	9	149
Bivalvia	2	34
Polychaeta	2	17
Anthozoa	2	17
Anopla	2	3
Polyplacophora	1	2

Based on Table 1, it is known that if seen from the number of species, the most species from the Gastropod class were found, namely 16 species, whereas when viewed from the number of individuals, the species from the Ophiuroidea class had the most number of individuals, namely 1579 individuals.

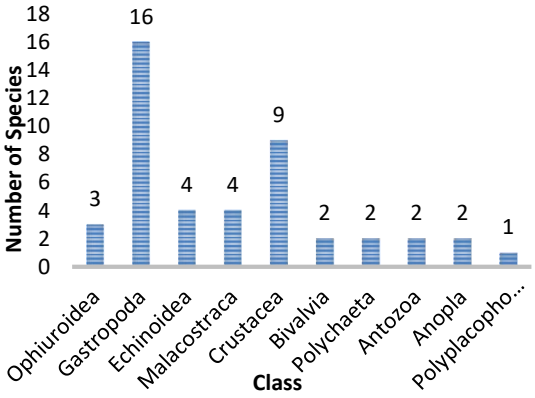

Figure 1. Composition of a Number of Species Based on The Class of Macroinvertebrates in Sundak Beach

The results of the macroinvertebrates inventory at Sundak Beach showed there were 10 classes identified. According to Basuki (2015), macroinvertebrates found in waters have properties such as very sensitive to water quality changes, relatively many species with different responses and limited movement, making it easier to observe and identify.

Observations show some several species or classes are abundant compared to other species or classes. If the number of individuals is observed, the most species are Ophiuroidea, while the most species found are from the Gastropods classes. This is related to the conditions and characteristics of the habitat around Sundak Beach. Sundak Beach, a type of sandy beach, allows many species in the Gastropods to occupy it. Gastropods are one of the key groups in the food web. Besides that, the reproduction of Gastropods is also influenced by environmental factors such as light, turbidity, temperature, salinity, and pH. According to the statement Odum (1994), stated that an ecosystem's physical, chemical, and the biological environment will affect its biota.

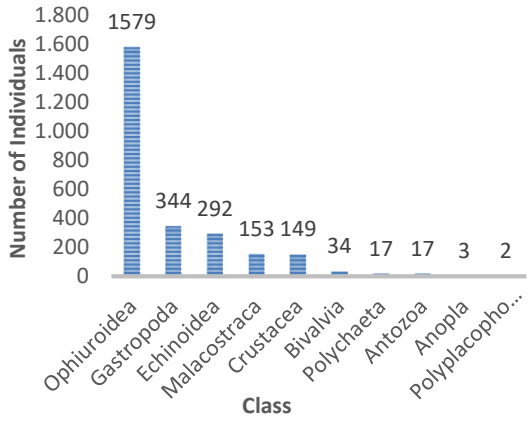

Figure 2. Composition of a Number of Individuals Based on The Class of Macroinvertebrates in Sundak Beach

Table 1 shows two groups of aquatic worms found on the Sundak Beach, namely Anopla and Polychaeta. At the lowest tide point, Sundak Beach is an area with a sand substrate making it suitable as a habitat for aquatic worms (Saputra *et al.*, 2015). This is stated in the research of Siahaan, *et al*., (2012), that marine worms are often found in sandy or muddy habitats in both fresh and seawater.

Diversity of Macroinvertebrate Species in Sundak Beach

From the analysis, the H' result is 1.28351, which indicates that the diversity of levels of the Sundak Beach macroinvertebrates is medium. This condition is caused by several factors, including species composition, number of individuals for each type, and substrate characteristics between stations. The lack of a diversity of substrates on the Sundak Beach causes the macroinvertebrates' diversity index to be classified as medium. The diversity of seagrass and seaweed is influenced by various topographic zones of the coast, such as sand zones, growth zones of seagrass and seaweed, coral reef zones and tubir zones (Yudasmara, 2013). Besides, the high and low diversity index can also be caused by various factors, including the number of individuals found, the dominance of certain species, and the substrate's homogeneity.

Diversity index (H') can be interpreted as a systematic description of a community structure and can facilitate analyzing information about the type and number of organisms. Magurran (1988) stated the diversity index value (H') is related to species richness at a particular location but is also influenced by the abundance distribution of each species. The higher the diversity of value, the higher the ecosystem's productivity, the pressure on the ecosystem and the stability of the ecosystem. This is confirmed by Krebs (1989) that the more and evenly the number of individual members in an ecosystem, the greater the diversity index (H') will be.

If the analysis of each macroinvertebrates class is found in Sundak Beach, the analysis of the diversity index for each class can be presented in Table 2.

Table 2. Results of Diversity Index Calculations for Each Class of Macroinvertebrates in Sundak Beach

Class	Σ Sp	H'	Σ in
Ophiuroidea	3	0.30169	1579
Gastropoda	16	0.26813	344
Echinoidea	4	0.24607	292
Malacostraca	4	0.16711	153
Crustacea	9	0.16427	149
Bivalvia	2	0.05688	34
Polychaeta	2	0.03299	17
Anthozoa	2	0.03299	17
Anopla	2	0.00783	3
Polyplacophora	1	0.00553	2

Note: Sp (Spesies); in (individuals)

The results of the analysis in Table 2 show that the class with the highest diversity index value (H') is Ophiuroidea, since its very high number of Ophiuroidea individuals, namely 1579 individuals. The high dominance of a species will affect the diversity of other species in the research location (Supratman *et al.*, 2018). The high

dominance of a species can be caused by several factors, such as the contaminated habitat condition with the amount of garbage observed around the coast and exploitation by the surrounding community. So the species that can live in this habitat are only species that are tolerant of pollution. Besides, the availability of abundant food sources is only for certain species, so that other species cannot compete. The diversity of marine life is strongly influenced by the condition and quality of the coral reef ecosystem on the coast (Alexander, 2011).

Conclusion

The results showed that at Sundak Beach, Yogyakarta there were found 45 macroinvertebrate species which were grouped into 10 classes. The number of individuals macroinvertebrates animals found was 1579 individuals. The highest number of individuals found was *Ophiomastix annulosa* with 730 individuals. The analysis of the diversity index showed that the Shannon-Wienner index of macroinvertebrates at Sundak Beach was 1.28351. These results indicate that macroinvertebrate diversity is in the medium category.

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