

Invertebrate Diversity at Gunung Kidul Beach Yogyakarta as an Effort to Conserve Aquatic Ecosystems

Anggun Wulandari^{1*}, Angela Mara Mardiana²

^{1,2}Biology Education, Universitas KH. A. Wahab Hasbullah

*Email: anggun.4w@gmail.com

ABSTRACT

Marine invertebrates are animals that do not have a spine, which live almost throughout the marine water area, but most species of marine invertebrates are numerous in coastal areas such as coral reef areas. This study aims to determine the type of invertebrates, diversity index, aquatic ecosystem conservation efforts. This research was conducted at Krakal Beach and Kukup Beach Gunung Kidul Yogyakarta. Data retrieval is carried out 2 times with a time differentiating system. The method used is a survey method with 3 stations on each beach, the total number of the two beaches is 6 stations. The results of the data collection of invertebrate types found were from the phylum Coelenterata, Arthropods, Mollusca, and Echinodermata. The diversity index on Krakal Beach in the morning is around 1.82 and at noon it is around 1.9 while at Kukup Beach in the morning it is around 1.72 and at noon it is around 1.71 so on both beaches it is still classified as a moderate diversity index, for ecosystem conservation efforts on both beaches are almost the same, namely by cleaning the beach, planting sea pandanus trees and sea cypress trees and establishing POKDARWIS security for the care of animals classified as almost extinct.

Keywords: Aquatics, Ecosystems, Invertebrates, Conservation, Krakal and Kukup Beaches

INTRODUCTION

Krakal Beach and Kukup beach are the mainstay attractions of Gunung Kidul Regency, Yogyakarta. The location of the tourist attraction is on the south coast of the Yogyakarta Special Region. The characteristics of Krakal Beach and Kukup Beach are known for their rocky beaches and large waves so that there is no view of boats passing by (Nugroho et al., 2014). However, each beach has different characteristics of the beach environment (Nasirudin & Yuliana, 2020). Differences in environmental characteristics, especially in differences in beach shape and sediment grain diameter, this difference must also be known in relation to wave conditions, ocean currents, temperature, salinity, and sea pH on each of its beaches (Damayanti & Ayuningtyas, 2015).

Animal diversity is organisms that do not have chlorophyll, are able to move or at least move the body by constricting fibers, and are multicellular, the animal world is generally divided into approximately 25-30 different phyla. Animals that have the above traits but do not have a spine, are generally called invertebrates based mostly on anatomical and embryological criteria (Fitri, 2016). According to the KBBI (Big Dictionary Indonesian) (2005:155), "biota is the entire flora and fauna contained in the sea. Meanwhile, marine life is a biota contained in the sea". From several understandings of marine life and life listed in the KBBI, marine life is a group of living things in the form of flora and fauna or plants and animals contained in the sea (Diyanti, 2017; Susanti et al., 2022).

Marine invertebrates are animals that do not have a spine, which live in almost all marine water areas, but most species of marine invertebrates are abundant in coastal areas such as coral reef areas. Until now, the cultivation of marine invertebrates has not been carried out intensively like other marine fish farming, even though these organisms also have economic value which is quite high (Gani et al., 2017). Invertebrate animals are spineless animals, invertebrates are divided into 8 phyla namely as follows: Porifera, Coelenterata, Platyhelminthes, Nematyhelminthes, Annelids, Arthropods, Mollusca, and Echinoderms (Murwanti et al., 2019). Based on the above review of the cultivation of animals located in marine waters and conservation of coral reefs needs conservation (Hakim et al., 2020).

Conservation is the maintenance and protection of these resources in order to survive for future generations. This includes maintaining the diversity of species, genes, and ecosystems, as well as

environmental functions, such as the nutrient cycle. Conservation is similar to preservation, but although both are related to the protection of nature, they seek to solve this task in different ways. Conservation seeks the sustainable use of nature by humans, for activities such as hunting, logging, or mining, while preservation means protecting nature from human use (Theodurus et al., 2021). The aquatic system is a living system in which the dominant medium occupied by organisms in that system is water. The presence of water in this environment can be free or open water or water that is in the presence of particles in a substrate. As the main medium of life in the aquatic system, the existence and nature of water will be the main determinants of existing life (Kurniawan, 2018).

Based on the statement from the interview of the father of the coast guard and the head of security of POKDARWIS on Krakal Beach and Kukup Beach Gunung Kidul Yogyakarta that on both beaches have made efforts to conserve aquatic ecosystems, namely by planting trees, cleaning the beach and strict guarding by POKDARWIS to protect endangered animals due to damaging human hands and bringing protected animals without knowing the threat of animals carried and based on previous interviews there has never been a research on the diversity of invertebrates of Krakal Beach and Kukup Beach Gunung Kidul Yogyakarta as an effort to conserve aquatic ecosystems with the interview statement above the researcher wants to know the diversity that is still stored in the area by conducting research that includes invertebrate diversity, invertebrate diversity index and aquatic ecosystem conservation efforts to be able to provide information to readers, the public, and researchers about the diversity that is still maintained on Krakal Beach and Kukup Beach in the form of invertebrate diversity, invertebrate diversity index and aquatic ecosystem conservation efforts that have been carried out by security on Krakal Beach and Kukup Beach.

METHOD

This research is a study that aims to determine the types of invertebrates, the index of invertebrate diversity and efforts to conserve aquatic ecosystems. This research was conducted in a descriptive quantitative manner. Quantitative descriptive research is a research method used to examine samples and collect data by explaining analytical data. It is hoped that this research can determine the diversity of invertebrates located in Krakal Beach and Kukup Beach. Data collection is carried out 2 times with a time differentiating system for the first day at Kukup Beach on March 16, 2022, morning at 07.00 WIB and noon at 14.00 WIB, the second day at Krakal Beach on March 27, 2022, morning at 05.00 and noon at 12.37 WIB. Materials and tools used raffia ropes, stakes, pH measuring devices, formalin, alcohol, jars, scissors, water temperature gauges. The data collection method used includes primary data which is the data that is used as the object of study. The method used is the survey method, namely observation and purposive determination of sampling stations, namely sampling techniques using quadrants by recording the presence of invertebrate diversity types (Amir, 2021).

The data collection technique in this study was carried out by collecting data by making 3 square-shaped station plots measuring 3 m x 2 m on both Krakal Beach and Kukup Beach the same size, the distance between one station and another station on Krakal Beach was 833.4 m and the distance between one station and another station on Kukup Beach was 76.66 m. At each station taken are the name of the animal, the pH of the water, the temperature of the water and each type of animal species to determine the shannon diversity index (H'), the total individual of the entire Genera (N), the number of individuals of each species (P_i), the number of individuals successfully caught (s). The data obtained are then entered in the table.

The diversity index is calculated using the diversity index formula from (Shannon Wiener, 1963) in (Fachrul, 2012) with the following formula:

$$H' = \sum_{i=1}^s P_i \ln P_i$$

Information:

Where:

H' : Shannon-Wiener Diversity Index

P_i : Number of individuals of a species/total number of all species

n_i : Number of individuals of i -th species

N : Total number of individuals





The diversity index figures are further assessed as follows: $H' < 1.0$ = Low diversity; $1.0 < H' < 3.322$ = Moderate diversity; $H' > 3.322$ = High diversity.

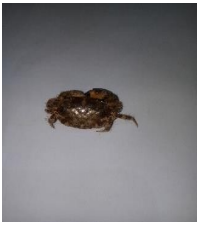



RESULT AND DISCUSSION

Result

The results of research on the types of invertebrate animals found on the coast of Krakal Gunung Kidul Yogyakarta as an effort to conserve aquatic ecosystems, found the diversity of marine invertebrates in the form of 4 phylums, namely Filum Coelenterata, Phylum Echinodermata, Phylum Arthropoda and Phylum Mollusca with a total of 8 species found. The list of species of invertebrate diversity found in the intertidal area of Krakal Beach Gunung Kidul Yogyakarta is the phylum Coelenterata including *Anthopleura xanthogrammica*, the phylum Echinodermata including *Echinometra lucunter* and *Echinometra mathei*, the phylum Arthropods including *Brachyura*, *Pilumnus* and *Ophiocoma erinaceu* and Phylum Mollusca including *Melanoides tuberculata* and *Conus textile*. Types of invertebrates found on Krakal Beach, as for the data can be seen in the following table:

Table 1 Spesies Invertebrata di Pantai Krakal






No	Filum	Spesies	Picture	Sum		PilinPi	
				Morning	Noon	Morning	Noon
1	Coelenterata	<i>Anthopleura xanthogrammica</i>		56	44	-0,328914603	-0,26462
2	Echinodermata	<i>Echinometra lucunter</i>		8	15	-0,105954775	-0,13769
		<i>Echinometra mathei</i>		4	7	-0,328914603	-0,07994
3	Arthropoda	<i>Brachyura</i>		34	23	-2,049588579	-0,1822

		<i>Pilumnus</i>		80	89	-0,361794687	-0,35085
		<i>Ophiocoma erinaceus</i>		25	40	-0,223207697	-0,25177
4	Mollusca	<i>Melanoides tuberculata</i>		35	55	-,207075554	-0,29467
		<i>Conus textile</i>		35	67	-0,267882714	-0,32007

The results showed that the number of invertebrates found on the beach of Krakal Gunung Kidul Yogyakarta in the morning was 264 individuals, which was found during the day which was 340 individuals. The invertebrate that dominates in the morning and during the day is the Mollusca Phylum. Mollusca is the second largest phylum in the animal kingdom (kingdom animalia) after the Arthropod phylum. Today it is estimated that there are 75 thousand types of mollusca, plus 35 thousand types in fossil form. Mollusca lives in marine, freshwater, brackish, and land (Gani et al., 2017). The invertebrate diversity index in the morning and during the day based on tables 1 using the summation of the shannon winner formula obtained ranged from 1.82 while during the day, the diversity index value ranged from 1.9. The value of the invertebrate diversity index obtained both in the morning and during the day is still relatively moderate. At Krakal Beach, efforts have been made to conserve aquatic ecosystems where a security is formed, namely POKDARWIS where the task is to secure the beach and participate in maintaining the sustainability of the coastal ecosystem and security to form activities, namely clean beaches carried out by the local community, planting sea cypress trees and sea pandanus, and security always provides strict protection for visitors who bring too many animals and bring protected animals or animals which is on the verge of extinction.

The results of research on the types of invertebrate animals found at Kukup Beach Gunung Kidul Yogyakarta as an effort to conserve aquatic ecosystems, found the diversity of marine invertebrates in the form of 2 phylums, namely Phylum Arthropoda and Phylum Mollusca obtained 6 species found, List of species of invertebrate diversity found in the intertidal area of Kukup Beach Gunung Kidul Yogyakarta from the Arthropod phylum including *Brachyura* and *xanto* and Filum Mollusca among others *Urosalpinx cinereal*, *Cominella glandiformis*, *Nerite plicata*, *Nerita polita*. Types of invertebrates found on Kukup Beach, as for the data can be seen in the following table:

Table 2 Spesies Invertebrata di Pantai Kukup

No	Filum	Spesies	Picture	Sum		PilmPi	
				Morning	Noon	Morning	Noon
1	Mollusca	<i>Urosalpinx cinereal</i>		70	44	-0,31129	0,27975
		<i>Nerita plicata</i>		57	44	-0,28421	-0,27975
		<i>Cominella glandiformis</i>		99	75	-0,35018	-0,34528
2	Arthropoda	<i>Xanto</i>		72	76	-0,17416	-0,34657
		<i>Brachyura</i>		24	20	-0,31486	-0,17903

The results showed that the number of invertebrates found on the beach of Kukup Gunung Kidul Yogyakarta in the morning was 381 individuals and those found during the day were 304 individuals. The invertebrates that dominate in the morning and during the day are the phylum Mollusca. Mollusca is one of the constituents of marine ecosystems that have high species diversity and are widespread in various marine habitats. Mollusks can be found ranging from coastal to deep sea areas, occupying many coral reef areas, some immersing themselves in sediments, some can be found attached to marine plants (Triwiyanto et al., 2013). The diversity index of invertebrates in the morning and during the day based on table 2 using the summation of the shannon winner formula obtained ranged from 1.72 while during the day, the value of the diversity index obtained ranged from 1.71. The value of the invertebrate diversity index obtained both in the morning and during the day is still relatively moderate. At Kukup Beach, efforts have also been made to conserve aquatic ecosystems almost the same as Krakal beach where a security is formed, namely POKDARWIS which is in charge of securing the beach and participating in maintaining the sustainability of the coastal ecosystem and security forms activities, namely clean beaches carried out

by the local community, planting sea cypress trees, sea pandanus and coconut trees, and security always provides strict protection for visitors who bring animals too many and bring protected animals or endangered animals, on Kukup Beach there is also a preservation of fish and seaweed.

Discussion

The results of the research conducted in the location of Gunung Kidul Yogyakarta regency which includes Krakal Beach and Kukup Beach, the two beaches are 3 km apart. Krakal Beach and Kukup Beach have similarities in terms of geological conditions, genesa, and the process of coastal morphological formation. However, for each beach has different characteristics, especially in the conditions of waves, ocean currents, temperature, sea pH on each coast and ecosystem conditions on the beach, the ecosystem of Krakal Beach and Kukup Beach is a coral reef coastal ecosystem and is located in the tidal area of seawater thus many animals can be found, especially invertebrate animals from the results of research on the number of invertebrates found on the coast of Krakal Gunung Kidul Yogyakarta in the morning is lower at 264 individuals while during the day it is 340 with a total invertebrate diversity of 8 species consisting of the phylum Coelenterata including *Anthopleura xanthogrammica*, the phylum Echinodermata including *Echinometra lucunter* and *Echinometra mathei*, the phylum Arthropoda including *Brachyura*, *Pilumnus* and *Ophiocoma erinaceu*, and Phylum Mollusca including *Melanoides tuberculata* and *Conus textile* and the number of invertebrates found in Kukup Beach Gunung Kidul Yogyakarta in the morning was higher by 381 individuals compared to noon, namely 304, invertebrate diversity there are a total of 6 species consisting of Phylum Mollusca including *Urosalpinx cinereal*, *Cominella glandiformis*, *Nerite plicata*, *Nerita polita*, and phylum Arthropods including *Brachyura* and *Xanto*, from the results of the study that the Invertebrates that dominate in the morning and during the day on Krakal Beach and Kukup Beach are Filum Mollusca, the phylum Mollusca found on Krakal Beach is *Melanoides tuberculata* and *Conus textile* while on Kukup Beach, the Mollusca found are *Urosalpinx cinereal*, *Cominella glandiformis*, *Nerite plicata*, *Nerita polita*. Mollusca is one of the constituents of marine ecosystems that have high species diversity and are widespread in various marine habitats, mollusks can be found ranging from coastal areas to deep seas, occupying many coral reef areas, some immersing themselves in sediments, some can be found attached to marine plants (Triwiyanto et al., 2013), from the statement of the results of the type of invertebrate animals that dominate in the morning and during the day from Krakal Beach and Kukup Beach is the Mollusca phylum judging from the diversity index of the two beaches is different, namely on Krakal Beach is higher, namely the invertebrate diversity index in the morning is around 1.82 while the diversity index value during the day is around 1.9 with this statement Krakal Beach the diversity index is classified as moderate, on Kukup Beach the invertebrate diversity index in the morning is around 1.72 and during the day the diversity index value is around 1.71 and both are still relatively moderate, the diversity index of Krakal Beach is higher than that of Kukup Beach, why is this because on Krakal Beach local residents cultivate coral reefs for daily income thus there is a preservation of the coral reef many animals are still hiding and attached to each coral reef while on Kukup Beach the cultivation is more prominent to the cultivation of seaweed, algae and ornamental aquarium fish for daily income.

The temperature at Krakal Beach in Gunung Kidul Yogyakarta in the morning at station 1 is around 24.5°C, station 2 is around 25°C, station 3 is around 25.9 while during the day at station 1 it is around 38°C, station 2 is around 37°C, and station 3 is around 37.5°C. Temperature is a factor that can affect the life of marine organisms directly or indirectly, water temperature has a role in the speed of metabolic rate and respiration of aquatic biota as well as the metabolic processes of aquatic ecosystems (Gani et al., 2017), while the temperature on the beach of kukup gunung kidul Yogyakarta in the morning at station 1 ranges from 25 °C, station 2 ranges 27 °C, station 3 ranges 27.9 while during the day at station 1 ranges 36 °C, station 2 ranges from 37°C, station 3 ranges from 37.5°C. In general, Mollusca can tolerate temperatures between 0°C - 48.6°C and is active in the temperature range of 5 °C - 38 °C the influence of temperature results directly or indirectly (Maretta et al., 2019). The results of the temperature research on Krakal Beach and Kukup Beach did not exceed the limit of tolerating temperatures, therefore there are still many Mollusca phylum found on Krakal Beach and Kukup Beach and become animals that still have high potential to be found on both beaches.

Invertebrate animals in the Mollusca phylum in this study were stated to be the highest on Krakal Beach and Kukup Beach were not denied by the calculation of the measurement of the degree of acidity (pH) thus the measurement of the degree of acidity (pH) of water at Krakal Beach in Gunung Kidul Yogyakarta in the morning ranged from 7.4-7.7 and during the day ranged from 7.6-7.7 while the results of measurements of the degree of acidity (pH) at Kukup Beach Gunung Kidul Yogyakarta in the morning

ranged from 6.8-7.4 and during the day ranges from 7.6 to 7.7. The value (pH) indicates the degree of acidity or alkalinity of the waters, the value (pH) ideal for the life of aquatic organisms is generally between 7-8.5. Water conditions that are very alkaline or very acidic will endanger the survival of organisms, because it will cause metabolic disorders and respiration, measurements of the degree of acidity (pH) that supports molluska life range from 5.7 -8.4 (Maretta et al., 2019). The results of the measurement of the degree of acidity (pH) on Krakal Beach show that it does not exceed the ideal limit of measuring the degree of acidity (pH) for the life of aquatic organisms in general, while on Kukup Beach the results of the measurement of the degree of acidity (pH) have not reached the ideal limit for the life of aquatic organisms generally because the waters are alkaline with this statement further corroborating why the animal diversity index is higher on Krakal Beach than on Kukup Beach.

Efforts to conserve aquatic ecosystems on Krakal beach and Kukup Beach Gunung Kidul Yogyakarta where the two beaches are mangrove forests because there are still many plants that live on the beach or around the beach, including plants such as sea cypress, sea pandanus and coconut trees. Mangrove ecosystem is a transitional ecosystem between land and sea which is known to have a very large role and function, ecologically mangroves have a very important function in playing a role as a food chain in a water, which can hitch a ride on the lives of various types of fish, shrimp and mollusca. It should be noted that mangrove forests not only complement food for aquatic biota, but can also create a climate atmosphere that is conducive to aquatic biota life, and has a contribution to the balance of biological cycles in a water (Karimah, 2017). Thus, the aquatic ecosystem at Krakal Beach and Kukup Beach is still relatively moderate because judging from the results of the medium invertebrate diversity index, it means that animals are still found on both beaches, especially invertebrates so the ecosystem is still balanced, there has not been a big damage, it's just that there is a need for constant warnings, punishments and socialization of the community to participate in maintaining and preserving it, One form of preservation on Krakal Beach and Kukup Beach is the formation of a security, namely POKDARWIS which is in charge of securing the beach and participating in maintaining the sustainability of the coastal ecosystem and forming activities, namely clean beaches carried out by the local community, planting sea cypress trees, sea pandanus and coconut trees. Security always provides strict protection for visitors who bring too many animals and bring protected animals, but many people still do not care about the preservation of Krakal Beach and Kukup Beach because the level of problems on the two beaches is almost the same, namely in the state of beaches that are landau, white sand, and have a diversity of marine life that is not an attraction for tourists the many human activities on the beach can be a threat to the diversity of marine life on the coast as well as local communities who often take marine life when the coast recedes for consumption, for example sea urchins, ornamental okan, to other types of Mollusca that can be consumed and the lack of maintaining the preservation of coral reefs that reduce the diversity of marine life.

CONCLUSION

The results of the study concluded that invertebrate diversity, invertebrate diversity index and efforts to conserve aquatic ecosystems in Krakal Beach and Kukup Beach in Gunung Kidul Yogyakarta as follows:

- The types of invertebrates found on Krakal Beach and Kukup Beach, namely the diversity of invertebrates on Krakal Beach in the form of 4 phylums, namely Phylum Coelenterata, Phylum Echinodermata, Phylum Arthropoda and Phylum Mollusca with a total of 8 species found while the diversity of invertebrates on Kukup Beach found 2 phylums, namely Arthropods and Mollusca phylum obtained 6 species.
- The diversity index value on Krakal Beach in the morning is 1.82 and at noon it is around 1.9 while at Kukup Beach in the morning it is 1.72 and at noon it is around 1.71 and states that the diversity results at Krakal Beach and Kukup Beach Gunung Kidul Yogyakarta are classified as moderate.
- The efforts to conserve aquatic ecosystems that have been carried out at Krakal Beach and Kukup Beach Gunung Kidul Yogyakarta are almost the same, namely by forming a beach security organization, cleaning the beach by local residents, protecting certain animals, conserving seaweed and coral reefs and maintaining the ecosystem of Krakal Beach and Kukup Beach by planting strong sea pandanus trees and sea cypress trees by planting sea pandanus trees and sea cypress trees strong with water.

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