

Conference Paper

## Diversity of Crustaceans in Intertidal Zone at Kukup Beach, Gunungkidul

Sri Setyaningrum, Azwa Yuliananda Pangestuti, Callista Nadya Noel Pasaribu, Ibnu Ainun Munajib, Naely Muna Camelia, Safaa Azahra, Tiara Putria Judith, Rury Eprilurahman\*

Faculty of Biology, Gadjah Mada University, Special Region of Yogyakarta, Indonesia

\*Corresponding author:  
E-mail:  
[rurybiougma@ugm.ac.id](mailto:rurybiougma@ugm.ac.id)

### ABSTRACT

Indonesian waters are famous for their diversity of marine biota. Crustaceans are one of the many marine biota found, especially in the coastal intertidal zone. The waters off the south coast of Java are characterized by large waves and currents. Kukup Beach is one of the beaches located in the area of D. I. Yogyakarta with a flat and undulating beach shape with a narrow intertidal zone. Crustaceans have an important role in coastal ecosystems as bioindicators and omnivore predators. However, not many studies have been conducted to determine the diversity of crustaceans in Kukup Beach. The purpose of this research was to study and determine the diversity of crustaceans in the intertidal zone of Kukup Beach. Sampling and collection were conducted on March 11, 2023, with a systematic sampling method through a belt transect approach. The results showed that 8 families of Crustacea were found in Kukup Beach, namely Alpheidae, Majidae, Pilumnidae, Grapsidae, Portunidae, Oziidae, Xanthidae, and Diogenidae. The result of the calculation of the species richness index (R) of Crustacea in the intertidal zone at Kukup Beach was 3,69.

*Keywords: Crustacea, diversity, intertidal zone, Kukup Beach*

### Introduction

Indonesian waters harbor the highest marine biodiversity in the world because it has the second largest coastline in the world which stretches for more than 80,000 km and is one of the countries in the coral reef triangle (Barber et al., 2006; DeBoer et al., 2008; Marfai, 2014). The waters off the south coast of Java generally have quite large waves and currents because they are connected to the Indian Ocean. This causes the coast in southern Java to become an extreme habitat for the biota that inhabit these waters. Gunungkidul Regency is one of the regions in D.I. Yogyakarta. D. I. Yogyakarta has various beaches, one of which is Kukup Beach. Kukup Beach is a flat and undulating beach with a narrow intertidal zone with coordinates 808'1" S and 110033'15" E. The waves at Kukup Beach are quite strong because there is a breakwater zone not too far from the shoreline. Wave energy at Kukup Beach reaches 69 m/s which is also influenced by wind (Damayanti et al. 2008; Pratiwi et al., 2023).

According to Coleman et al. (1999), the Intertidal Zone is a tidal zone that occurs periodically. Due to tides and waves, sandy beaches are dynamic environments with unstable sediments. Species on these beaches have evolved to cope with these environmental factors in terms of behavior and physiology, especially in the intertidal zone where periodic exposure to air also influences the existence and survival of organisms (Nucci et al., 2001). The intertidal zone is also a habitat generally inhabited by crustaceans, which includes coral rocks, muddy and rocky coastal zones, and sandy substrates. Crustaceans are important fauna in coastal ecosystems, which burrow into sediment to make nests (Ningrum et al., 2023; Jumeini et al., 2022).

Crustaceans are the largest subphylum in the phylum Arthropoda which consists of 50,000 to 75,000 species that are characterized by hard skin and segmented bodies (Ranz, 2021; Rangkuti

#### How to cite:

Setyaningrum, S. et al. (2024). Diversity of crustaceans in intertidal zone at Kukup Beach, Gunungkidul. *2<sup>nd</sup> International Conference of Biology for Student 2023*. NST Proceedings. pages 85-91. doi: 10.11594/nstp.2024.4609

et al., 2022). Crustaceans are the dominant arthropods in the ocean, where they occupy benthic, pelagic, planktonic, and intertidal niches and have motile, sedentary, sessile, or parasitic lifestyles (Ranz, 2021). Decapoda is an order of the largest subphylum of crustaceans, of which there are still around 17,500 species living in the sea, freshwater and semi-terrestrial (Briones-Fourzán & Hendrickx, 2022). Decapoda members include crabs, lobsters, shrimp, prawns, crayfish, and hermit crabs (Briones-Fourzán & Hendrickx, 2022; Madduppa et al., 2022). The Decapoda order can be found in various types of habitats, ranging from deep sea, shallow sea, sandy beaches, rocky beaches, and muddy beaches (Briones-Fourzán & Hendrickx, 2022; Ningrum et al., 2023). Members of the Decapoda order that are generally found on sand beaches are Pilumnidae, Xanthidae, Alpheidae, Majidae, Diogenidae, Oziidae, Grapsidae, and Portunidae. Decapoda has an important role in the food chain as predator and prey. This order is an omnivorous predator because it consumes phytoplankton, benthos (mollusks and benthic (mollusks and worms), algae, macrobenthos, and detritus (Rangkuti et al., 2022).

Decapoda in Indonesia has been studied at various scales and 1,502 species have been reported to originate from Indonesian seas. Species distribution is influenced by contemporary factors as well as evolutionary processes on a particular time scale. Within certain latitudinal ranges, variations in community richness and composition can depend on seafloor composition and topography (Madduppa et al., 2022). The physical, chemical, and biological characteristics of water can influence the species composition, diversity, productivity, and physiological conditions of local populations. The physicochemical characteristics of water and nearby substrates of habitation have a major impact on their occurrence and distribution. The survival of marine species is significantly influenced by temperature, dissolved oxygen, pH, and salinity (Walag & Canencia, 2016). This research aims to determine the abundance of the crustacean family based on physicochemical parameters at Kukup Beach, Gunungkidul, D. I. Yogyakarta.

## Material and Methods

### Study area

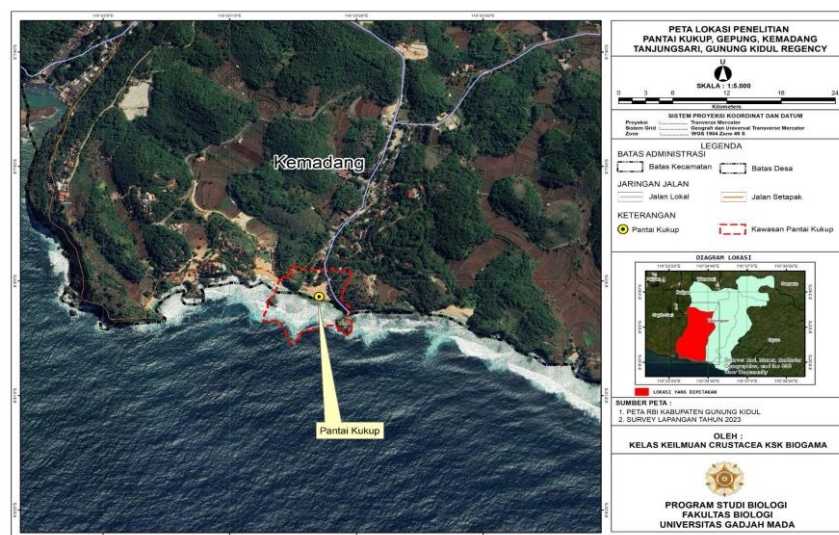


Figure 1. Map of Research Location in Kukup Beach, Gunungkidul

This research was carried out on Saturday, March 11, 2023, from 03.00 WIB to 05.00 WIB. The research was conducted at Kukup Beach, Kemadang Village, Tanjungsari District, Gunungkidul Regency, D. I. Yogyakarta, which is located at 8.1327° South Latitude, 110.5552° East Longitude.

## Procedures

The tools used in this research include transects, rolling meters, hammers, raffia ropes, pH meters, thermometers, refractometers (Kenko made in Japan), tweezers, hand nets, flashlights or flashlights, trays, millimeter blocks, bottles, cool box, scissors, gloves, digital camera, and stationery. The materials used are ziplock plastic, 70% alcohol, glycerin, and clove oil.

Crustacean data collection was carried out in the intertidal zone of Kukup Beach. The measured length of Kukup Beach is 81 meters with the width of the beach taken vertically being 15 meters. Four transects were created by drawing imaginary lines vertically along the width of the beach. In this study, transects were determined by dividing the length of Kukup Beach into four parts. On each transect, there are 6 sampling points. Crustacean data collection was carried out using a systematic sampling method with a belt transect approach. Determining the data collection area was carried out by paying attention to flooded and non-flooded areas in the intertidal zone. The total percentage of pool and non-pool areas used is 50% to obtain more crustacean data samples.

Crustacean data collection in each plot was carried out using nets and tweezers. Data collection on environmental factors was carried out in situ including air temperature using a thermometer, water temperature, salinity using a refractometer, pH, water depth, and substrate type. The Crustacean samples obtained are preserved for further sample documentation as data for identification. Crustacean samples were anesthetized using a mixture of clove oil and seawater samples. Next, sample documentation was taken from the front view, back view, dorsal view, and ventral view. Apart from that, documentation of important body parts such as the chelae and telson is also carried out.

## Data analysis

Crustacean species identification is carried out by observing the morphological characteristics of the specimen based on the Crustacean identification guidebook using the FAO Species Identification Guide for Fishery Purposes. The data that has been collected is then analyzed for the species richness index using the Margalef index equation (Margalef, 1958).

$$R = \frac{(S-1)}{\ln.N}$$

Explanation:

R = Margalef index

S = number of species

N = number of individuals

Ln = natural logarithm

## Results and Discussion

This research was conducted at Kukup Beach, Gunungkidul, D. I. Yogyakarta with 4 transects. Transect I contains 5 points, Transect II contains 3 points, Transect III contains six points, and Transect IV contains 6 points. It was found that the crustacean community at Kukup Beach consisted of 96 individuals from 8 families, namely one species from the Alpheidae, Majidae, Pilumnidae, and Grapsidae families. Two species from the families Portunidae and Oziidae. Apart from that, there are four species from the families Xanthidae and Diogenidae. Of these, 2 specimens were identified as *Charybdis annulata*, 4 specimens *Bountiana norfolcensis*, 1 specimen *Ozius truncatus*, 5 specimens *Pilumnus hirtellus*, 1 specimen *Xantho pilipes*, 3 specimens *Pachygrapsus marmoratus*, 1 specimen *Xantho hydrophilus*, 1 specimen *Paraxanthodes cumatodes*, 1 specimen *Calcinus elegans*, 1 specimen *Calcinus gaimardii*, 1 specimen *Calcinus hazletti*, 2 specimens *Aniculus ursus*, 9 specimens *Alpheus richardsonii*, 35 specimens *Charybdis helleri*, 28 specimens *Notomithrax minor*, and 1 specimen *Platypodia granulosa*.



Specimens Representing Kukup Beach Gunungkidul (dorsal and ventral views); (a) *Charybdis annulata*; (b) *Bountiana norfolcensis*; (c) *Ozius truncatus*; (d) *Pilumnus hirtellus*; (e) *Xantho pilipes*; (f) *Pachygrapsus marmoratus*; (g) *Xantho hydrophilus*; (h) *Paraxanthodes cumatodes*; (i) *Calcinus elegans*; (j) *Calcinus gaimardii*; (k) *Calcinus hazletti*; (l) *Aniculus ursus*; (m) *Alpheus richardsonii*; (n) *Charybdis hellerii*; (o) *Notomithrax minor*; (p) *Platypodia granulosa*

Figure 2. Examples of decapoda crustacean

**Portunidae.** Portunidae is a family of crabs which are also known as swimming crabs. This happens because members of this family have five pairs of legs that are flattened into wide paddles that are used for swimming. Crabs from the Portunidae family have a round or oval carapace with a serrated dorsal surface and a relatively basic to slightly convex shape. Apart from that, this crab has strong and sharp claws and can be a very fast and aggressive predator (Santhanom, 2018; Weis, 2012).

**Oziidae.** Oziidae is a family of crabs that can be found in mangrove ecosystems with sand substrates. Members of the Oziidae have characteristics, namely a wide, ovoid carapace, uneven posterior surface, and wide anterior part, with four small tubercles. Having short eye stalks, maxillipeds are square, covering the entire buccal cavity, and cheliped fingers are smaller and slender. In addition, walking feet are relatively small, without setae (Naderloo & Naderloo, 2017).

**Diogenidae.** Diogenidae is a family of crabs that can be found throughout the coral reefs and shallow waters of the Indo-West Pacific. However, some members can live on terrestrial soil. Members of this family have different colors and different color patterns to differentiate the species. Most members have 10 arthrobranches, two soft cuticles from each of five 3-7 thoracic somites. Apart from that, they also have pleurobranches on their exoskeleton. This crab has a body that curls to the left so it is also called "left-handed hermit crabs" (Poore & Ah Yong, 2023; Weis, 2012).

**Alpheidae.** Alpheidae are crustaceans commonly found in the sea. Most live in confined spaces such as rock crevices, burrows dug in sediment, or inside sessile invertebrates such as sponges or corals. Members of the Alpheidae family can grow to a length of 3–5 cm, have asymmetrical claws, and are disproportionately large. The claws are on both arms of the body and do not have pincers, but are shaped like a gun consisting of two parts (Anker et al., 2006).

**Majidae.** Majidae or spider crabs are a family of crabs that can be found in various waters, both shallow and deep. One species from the Majidae family is the largest crab in the world, namely the Japanese spider crab (*Macrocheira kaempferi*). Members of the Majidae family have morphological characteristics in the form of carapace size which tends to be longer with a pointed tip at the front. It has very long legs compared to other species, giving it the nickname "Spider Crabs". Apart from that, this crab has a wavy exoskeleton and is covered with hairs (Weis, 2012).

**Xanthidae.** Xanthidae is the largest family in the Brachyura infraorder. This family has 15 subfamilies and more than 600 species distributed throughout the world. The habitat of the Xanthidae family is sandy and rocky beaches and coral reefs. Coral reef ecosystems are ecosystems that have abundant food sources. This is very suitable for the Xanthidae habitat, so crabs from the



Xanthidae family are quite common. The body color of members of the Xanthidae family is generally brown with an oval carapace that forms narrow lines. All parts of its body have fine hairs and rough bumps. The anterolateral edge is divided into four inconspicuous denticles. Several species of members of the Xanthidae family can be poisonous (Amer et al., 2023; Syuhriatin et al., 2023; Weis, 2012).

**Pilumnidae.** The Pilumnidae family is a family of crabs that can be found in coastal waters throughout the world. This family generally lives in the intertidal zone, but several species can be found at a depth of 75 m. Characteristics of the Pilumnidae family include a carapace that tends to be wide, a dorsal with bristles and setae, an anterolateral edge with three sharp spinate teeth, and grained teeth. Supraorbital rim with two distinct depressions. This family has smooth maxillipeds and less flat chelipeds. The first male gonopod is cylindrical (Fahimi et al., 2021; Spivak & Rodriguez, 2002).

**Grapsidae.** This type of crab group is generally found on rocky beaches. This animal generally eats microalgae attached to rocks in its habitat. The color of crabs from the Grapsidae family is generally greenish-black, reddish-black, reddish dark green, and has white longitudinal stripes. Several species of members of this family sometimes have almost similar carapace colors. The differences and similarities in carapace color depend on the distribution of color pigments in the crab's body tissue. This type of crab has a pair of legs equipped with spikes and no legs. The first pair of legs is shorter and has hairs on the parapodia and a pair of small claws (Paransa et al., 2019).

Table 1. List of crustaceans species in Kukup Beach, Gunungkidul

No.	Family	Species	Total
1.	Portunidae	<i>Charybdis annulata</i>	2
		<i>Charybdis hellerii</i>	35
2.	Oziidae	<i>Bountiana norfolcensis</i>	4
		<i>Ozius truncatus</i>	1
3.	Diogenidae	<i>Calcinus elegans</i>	1
		<i>Calcinus gaimardii</i>	1
		<i>Calcinus hazletti</i>	1
		<i>Aniculus ursus</i>	2
		<i>Aniculus ursus</i>	2
4.	Alpheidae	<i>Alpheus richardsonii</i>	9
5.	Majidae	<i>Notomithrax minor</i>	28
6.	Xanthidae	<i>Platypodia granulosa</i>	1
		<i>Xantho pilipes</i>	1
		<i>Xantho hydrophilus</i>	1
		<i>Paraxanthodes cumatodes</i>	1
7.	Pilumnidae	<i>Pilumnus hirtellus</i>	5
8.	Grapsidae	<i>Pachygrapsus marmoratus</i>	3

Based on the results in Table 1, 96 individuals from 8 families were found in the intertidal zone of Kukup Beach, Gunungkidul. After calculating the family abundance index using the Margalef index, an abundance value of 3,69 was obtained for the family of the Crustacean phylum at Kukup Beach, Gunungkidul.

Based on Table 2, measurements of physicochemical parameters at Kukup Beach, Gunung Kidul resulted in an air temperature of 25°C, water temperature of 27.88°C, salinity of 38.25 ppm, and pH of 8.28. Measuring these parameters is important because the diversity and life patterns of crustaceans are greatly influenced by environmental factors, such as physicochemical factors. These physicochemical parameters are important factors because they influence oxygen consumption, metabolism, growth, molting, and survival of crustaceans. Temperature is an

important factor for the life of organisms in the ocean because temperature affects the metabolic activities and development of these organisms. The natural temperature of seawater ranges from temperatures below 0°C to 33°C. Salinity is the amount of substances dissolved in one kilogram of seawater. Salinity in the sea is influenced by various factors such as water circulation patterns, evaporation, rainfall, and river flow. The factor that reacts in the intertidal area is salinity which can cause osmotic pressure. A decrease in salinity may occur in intertidal areas due to heavy rainwater. The degree of acidity (pH) is a measure of the concentration of hydrogen ions. These conditions will indicate whether the water is reacting acidic or alkaline. The degree of acidity (pH) has a big influence on aquatic plants and animals, so it is often used as a guide to state whether water is good or bad for the environment.

Table 2. Environmental factors in the Kukup Beach Intertidal Area

No	Environmental factor	Measurement
1	Air temperature	25°C
2	Water temperature	27.88°C
3	Salinity	38.25 ppm
4	pH	8.28

Based on research results, the family with the largest number of individuals that can be found at Kukup Beach, Gunungkidul is the Portunidae family. This is because the environmental conditions at Kukup Beach are by the habitat of Portunidae, namely the intertidal area with a sandy bottom substrate and waters with warm temperatures. Warm temperatures are optimal conditions for Portunidae because, in warm conditions, Portunidae can move very actively compared to cold conditions. Members of the Portunidae family are also known to have a salinity preference in the range of 30-40 ppm. This value is the optimum value for Portunidae to grow and develop well. Therefore, the individuals most commonly found on Kukup Beach are members of the Portunidae family.

## Conclusion

In the intertidal zone of Kukup Beach, 96 individuals were found from 8 different families, namely Alpheidae, Majidae, Pilumnidae, Grapsidae, Portunidae, Oziidae, Xanthidae, and Diogenidae. The Portunidae family is the family with the most individuals found, namely 37 individuals. Based on measurements of physico-chemical parameters, temperature is the parameter that most influences Portunidae diversity. The intertidal zone of Kukup Beach has a sandy substrate and warm water temperatures, so these conditions are optimal for Portunidae so that their diversity is the most commonly found. The result of the calculation of the species richness index (R) of Crustacea in the intertidal zone at Kukup Beach was 3,69.

## Acknowledgments

Thank you to the Crustacean Science Class - Marine Study Group, Faculty of Biology, Gadjah Mada University, Faculty of Biology, Gadjah Mada University, and the reviewers for all their assistance so that this research can run smoothly and provide benefits to stakeholders.

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