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Study of Decapod Diversity and Habitat in the Coastal Line Area of Bengkulu City Beach

Aprilia Chairunisa[1], Ariefa Primair Yani[1], Deni Parlindungan[1], Euis Nursa'adah[2], Aprina Defianti[1], Bhakti Karyadi[1*]
*e-mail: bkaryadi@unib.ac.id

[1]*Science Education Study Program, Faculty of Teacher Training and Education, Bengkulu University*
[2]*Postgraduate Science Education Program, Faculty of Teacher Training and Education, Bengkulu University*

ABSTRACT

This research aims to identify abundance, species diversity, dominance, and evenness and to determine the type of decapod habitat on the coast of Bengkulu City. The method used is the survey method. The sampling location was divided into three stations: Pasir Putih Beach, Panjang Beach, and Kualo Beach. The sampling technique used transects, at each station, an area of 300 m was taken. Decapod diversity was analyzed using the Shannon-Wiener formula, the dominance index (C) was analyzed using Simpson's dominance index, and the evenness index was calculated using Pielou. The results of the research show that on the coast of Bengkulu City, decapod species consisting of six families were found. The diversity index shows that at stations I (0.864/low), II (1.00/medium), and III (0.372/low). Dominance index at stations I (0.046/low), II (0.113/low), and III (0.003/low). Evenness index at stations I (0.415/height), II (0.466/height), and station III (0.92/height). The most common decapods found are the family Hippidae and the species Emerita emeritus, with a total of 18 individuals. The decapod habitat type on Bengkulu City Beach is a sandy beach type. Environmental parameters (DO, water pH, air humidity, light intensity, salinity, and temperature) are in conditions suitable for decapod life.

Keywords : Decapoda, Bengkulu City Beach, Bengkulu

INTRODUCTION

Bengkulu is one of the provinces in Indonesia, with the provincial capital being the city of Bengkulu. The area of Bengkulu City is more than 151.70 km2. Bengkulu City has an area of 151.70 km2 and is located at 30°45'–30°59' South Latitude and 102°14'–102°22' East Longitude) (Fachri et al. 2022) .

Geographically the beaches of Bengkulu City are sandy and sloping. The three major rivers of the Black River, the Bengkulu Water River (also called the Kualo), and the Jenggalu River are directly connected with the open sea, affecting the large ocean waves (Rainaldi et al., 2017)

Bengkulu City Beach is around 7 km long with a width of around 500 m from the high and low tide lines. Bengkulu City Beach has a slope of 3–8 degrees and is included in the sandy beach category (Revolina et al., 2020). Research conducted by (Tuaputty, Arini, et al., 2023) found several species of animals that live in sandy beach habitats, including *Anadara broughtonii, Ocypoda or, Emerita talpoida, Mytilus trossulus, Nerita polita, Diadema setosum, Emerita emeritus, Venerupis corrugate, Harpiosquilla raphidae, Ophiothrix fragilis, Pinctada radiate, Holothuria scabra, Conus* sp, *Tridacna* sp, *Lumbricus terrestris,* and *Strombus decorus*. The animals found include those belonging to the decapod order, such as

Ocypoda cursor, Emerita talpoida, and Emerita emeritus.

Tuaputty et al. (2023) stated that marine decapods are invertebrate animals that have quite a high abundance on sandy substrates along the coast. Decapoda comes from the words deka, which means ten, and poda, which means feet, so decapoda means ten-legged animals, consisting of 6,000 types of large and widely known crustaceans. The carapace covers the entire chest; there are three pairs of maxillipeds and five pairs of walking legs; the first pair is usually larger than the other pairs of legs, with clamping claws. Pincers are the second pair of limbs that function as feeding arms. and mostly live by the sea. Various types of decapods are commonly known, such as crabs, shrimp, and crabs (Ferona et al., 2022). According to Yudha et al., (2021), the decapod order consists of two large infraorders: the Anomura infraorder and the Brachyura infraorder. The Anomura infraorder has four limbs, while the Brachyura infraorder has five limbs.

Decapods have ecological benefits, namely their role as primary consumers and detritus feeders. Kamarullah et al., (2019) in their research, stated that the ecological function of decapods is as a detritus feeder or marine waste cleaner. In their ecological function, decapods also play a role as primary consumers, namely as a food source for other biota in the ecosystem food chain. One species of decapod, namely the sea turtle, can be used as a bioindicator for environmental waters. Several species of decapods can act as environmental bioindicators. According to Beru et al., (2019), sea turtles have a function as indicators of the aquatic environment, including bioindicators of pesticide pollution, oil spills, mercury, and indications of domoic acid content. This species is also used as an indicator species and model organism in studies of the impact of atomic power plant waste heat on the aquatic environment. Apart from providing ecological benefits, decapods can also be used by humans as a source of protein. The role of decapods as a source of protein is that their protein content is quite high. This statement is strengthened by research conducted by Beru et al., (2019) stating that decapods are very good for health because they contain lots of protein, omega-3 and omega-6, and can be used as a source of protein.

. Waisaley et al., (2019) have conducted research regarding the diversity of decapods in the coastal waters of Tongkaina Village, Manado City. The results of the research that has been carried out show that the number of decapods found was 15 types, and the environmental conditions were suitable for decapod life. Similar research was also conducted by Lauren & Sumarmin, (2020) in the Laguna Mangguang Mangrove Forest, Pariaman City, West Sumatra. The results of the research showed that eight types of decapod species were found and the environmental parameters were declared suitable for habitation. Based on what has been stated previously, Bengkulu City beaches are often used as tourist attractions and a source of livelihood for coastal communities. This activity will certainly have a positive or negative influence on the beaches in the city of Bengkulu. The positive impact resulting from the use of this beach is that Bengkulu becomes better known to local people and people from outside Bengkulu. Besides that, it can also improve the welfare of coastal communities. However, the negative impact that can arise is environmental pollution. strengthened by research conducted by (Akbar & Pratiwi, 2023) states that pollution of the coastal environment can result in damage to coastal marine ecosystems and disruption

of the food chain of marine biota, so it is very interesting to explore information related to decapod diversity and habitat studies on Bengkulu City beaches. This research aims to identify indices of abundance, diversity, dominance, and evenness and to determine the type of decapod habitat on the coast of Bengkulu City.

MATERIAL AND METHOD

Research Procedures This research uses a survey method. Sampling was carried out on the beaches of several beach locations in Bengkulu City. The beach locations chosen were Pasir Putih Beach, Panjang Beach, Bengkulu City, and Kualo Beach (Figure 1). This location determination uses a purposive sampling technique. This purposive sampling technique is a data sampling technique with certain objectives or considerations (Lenaini, 2021). For each station, an area of 300 meters was taken. The area chosen was one that had tidal areas and different characteristics for each beach.

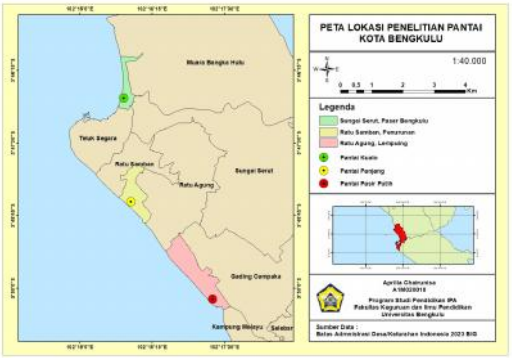

Figure 1. Research Sites (Sourch: Archgis 2023)

Decapod samples were collected by exploring each station for 300 meters, and then the station would be surveyed in a zigzag manner using the line transect method. The line transect route carried out can be seen in Figure 2.

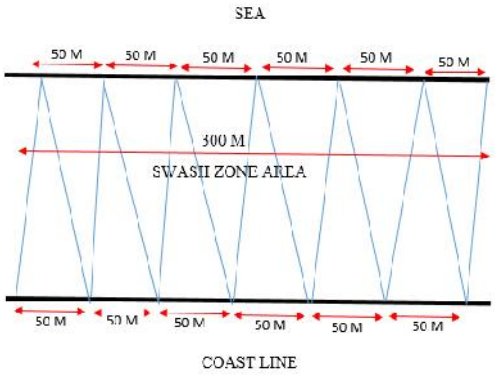

Figure 2. Transect route carried out

Sample capture using a tool in the form of a net designed to catch decapods and also by directly using the hands (Hand-picking), observing the characteristics of the presence of decapod animals on the beach, and then taking and collecting them. The decapod samples that were obtained were photographed and then identified or observed based on the morphological characteristics of the decapod using relevant books that are Marine Decapod Crustacea from (Poore & Ahyong, 2023), and the GBIF (Global Biodiversity Information Facility) website. Later, they will be grouped by type based on the similarities in morphological characteristics they share.

Abiotic data measurements are carried out by measuring DO (dissolved oxygen) using a dissolved oxygen meter DO9100, pH (potential of hydrogen) of water using an automatic digital pH meter, air humidity using a whirling hygrometer, light intensity using a lux meter, salinity using a salinity meter, and temperature using a thermometer. Other abiotic data measurements include measuring the substrate contained in beach sand at each station by taking sand samples in an area of 10x10 cm and a depth of 30 cm. The sand samples that have been collected will be carried out in a lab test to determine the concentration of substrate found at each station. The method used to determine this substrate is a hydrometer.

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The decapod data analysis used is the diversity index (H`), dominance index and evenness index analyzed using the following formula: The diversity index (H`) is calculated using the *Shannon-Wienner index,* the Dominance Index (C) was analyzed using the Simpson Dominance Index the Pielou Evenness Index.

RESULT AND DISCUSSION

The results of the identification of decapods on the beaches of Bengkulu City showed that there were 8 species in 6 families. The diversity of decapod species on the coast of Bengkulu City can be seen in Table 1. Species diversity

Table 1. Species Diversity.

No	Family	Genus	Species	Station			Individual Total
				1	2	3	
1.	*Portunidae*	*Portunus*	*Portunus sanguinolentus*	0	0	2	2
2.	*Albuneidae*	*Albunea*	*Albunea symmysta*	6	4	0	10
3.	*Hippidae*	*Hippa*	*Hippa adactyla*	2	2	1	5
		Emerita	*Emerita emeritus*	0	18	0	18
4.	*Ocypodidae*	*Ocypode*	*Ocypode cursor*	1	0	2	3
5.	*Matutidae*	*Astoret*	*Astoret lunaris*	1	1	1	3
		Matuta	*Matuta purnama*	1	6	0	7
6.	*Pinnotheridae*	*pinnotheres*	*Pinotheres* sp	10	0	0	10
Number of individuals				21	31	6	58
Total Number						58	

The total number of species found was 58 individuals; this number of individuals was spread across 3 research stations. At station 1, namely the Pasir Putih beach, the number of species found was 21 individuals, consisting of 6 families and 6 species; at station II, namely the long beach in Bengkulu City, the number of species found was 31 individuals, consisting of 5 families and 5 species; and at station III, the number of individuals found was 6 individuals, consisting of 4 families and 4 species. The species found at the three stations can be seen in Figure 3

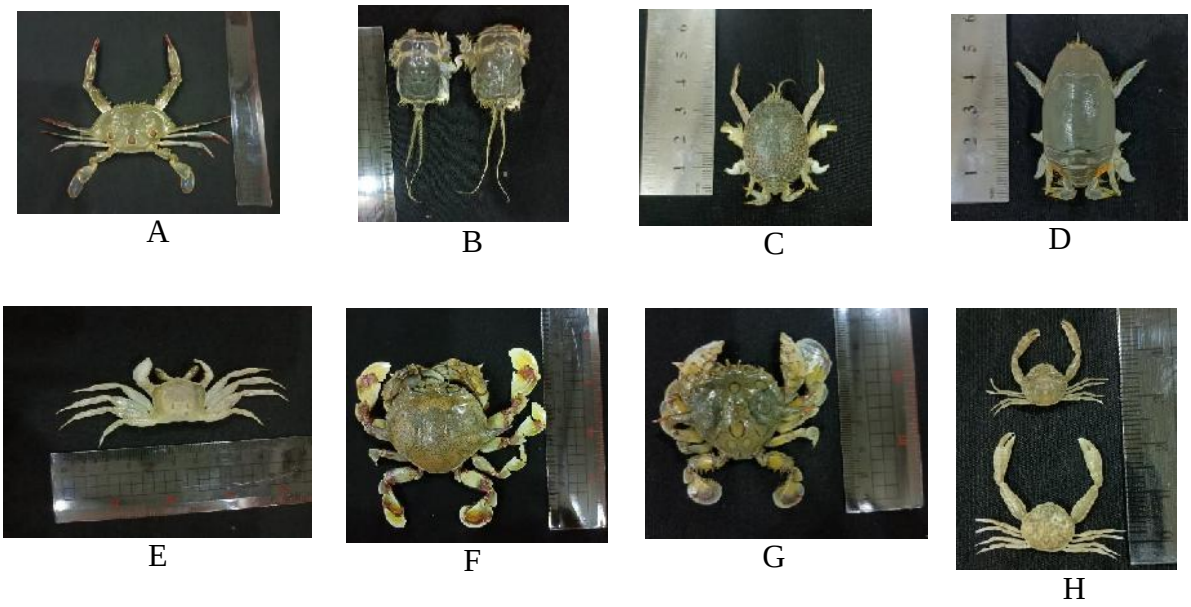

Figure 1. Decapoda species found; A. *Portunus sanguinolentus*, B. *Albunea symmysta*, C. *Hippa adactyla*, D. *Emerita emeritus*, E. *Ocypoda cursor*, F. *Ashtoret linaris*, G. *Matuta purnama*, H. *Pinnotheres* sp

Based on Table 1, shows that the most decapod species are in the family Hippidae, with the genus *Emerita* and the species *Emerita emeritus*. The number of species found was 18 at station II. *Emerita* sp. belongs to the Crustaceae group, which means it is related to shrimp, crabs, and lobsters. *Emerita emeritus* has a gray body. These animals have a unique body structure (morphology). *Emerita emeritus* usually has a carapace and two antennae, which look like "V"-shaped combs, which are used to capture food. Other unique traits include a very short and curved body; an abdomen bilaterally symmetrical, soft, dorsoventrally flattened or slightly rounded; a posterior end of the abdomen folded ventrally and anteriorly; a very well-developed cephalothorax with a small or reduced rostrum; and a telson that is under the thorax, elongated and wide (Nirmala et al., 2020).

The large number of decapod species, *Emerita emeritus*, is due to the type of beach at station II, which is a sandy beach, which is the habitat of this species. According to Nirmala et al., (2020), *Emerita emeritus* lives in the wetlands between the highest high tide and the lowest low tide, especially on black sand beaches. *Emerita emeritus* lives in the swash zone of the interdal region. Tidal areas that are alternately submerged and exposed to waves are called washout zones

. Other decapod species found came from different families and genera, including the Portunidae family with the Portunus sanguinolentus species with 2 individuals, the *Albunidae* family with the *Albunea symmysta* species with 10 individuals, and the *Hippidae* family. Apart from the *Emerita emeritus* species, the *Hippa adactyla* species was also found with 10 individuals. 5 individuals, the family *Ocypodidae* found only 1 species, namely *Ocypoda cursor*, as many as 3 individuals; the family *Matutidae* found 2 species, namely *Astoret lunaris* and *Matuta purnama*, of which 3 and 7 individuals were found,

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respectively; the last decapod discovered was the family *Pinnotheridae* species *Pinnotheres sp,* which were found in 10 individuals; these species were spread across the three stations. The variation in species found at the three stations is because these stations are habitats that can be said to be suitable for the decapod order to inhabit. The results of the ecological parameter analysis showed that the abundance of decapods at each station was 21, 31, and 6 respectively. This abundance can be seen in Table 2 below:

Table 2. Ecological Parameters of Decapod Diversity on the Beaches of Bengkulu City

Ecological Aspects	Station I	Station II	Station III
Abundance	21	31	6
Diversity Index H '	0.864 (Low)	1.00 (Currently)	0.372 (Low)
Dominance Index	0.046 (low)	0.113 (low)	0.003 (low)
Evenness Index	0.415 (tall)	0.466 (tall)	0.92 (tall)

Based on the results of the analysis, the highest abundance of decapods was found at station II, namely Long Beach. This station is a type of sandy beach that is used as a tourist attraction. The large number of tourists who visit causes various activities to occur, which indirectly causes an increase in organic matter in the beach environment. This organic material is a food source for decapods, which is one factor in the large number of decapods found at the station. The quantity of species present in a particular area can be influenced by the amount of organic matter present in the waters (Hafish et al., 2022).

The lowest abundance of decapods is at station III, namely Kualo Beach. This is thought to be because the substrate concentration at this station is more clay than sand, which makes it difficult for decapods, especially the *Albunidae*, *Hippidae,* and *Matutidae* families, to dig into the sand when the waves are low. Apart from the condition of the substrate, the content of organic marine waste, which is the food of decapods on Kualo Beach, is less than organic waste. In Kualo Beach, inorganic marine debris is higher than organic marine debris, with a percentage value of 62.06%, while organic marine debris is only 37.94% (Yunisti et al, 2020).

Based on Table 2, the diversity of decapods on the coast of Bengkulu City is generally in a condition of low to moderate ecological pressure, as indicated by the H' value ranging from 1-0.37 with a dominance index between 0.113-0.003 and an evenness index ranging from 0.92-0.415. The highest diversity index was at station 2, namely 1.00, with a dominance index of 0.113 and an evenness index of 0.466. Station 2 has a habitat that supports the survival of decapods; namely, it has a sandy habitat and is a tourist spot that indirectly contains a lot of organic waste material, which becomes food for decapods. The results of the dominance index analysis at the three stations are in the low category, which means there are no dominant species at the three stations, while the evenness index values obtained from the three stations are in the high category. In line with research conducted by (Fikriyanti et al., 2018) the relationship between the dominance index (C) and the evenness index (E) is opposite; if the evenness index is low, then dominance is high, and if the evenness index is high, then dominance is low.

The results of the laboratory test analysis that has been carried out show that there are differences in the substrate contained at each station, which can be seen in Table 3.

Table 1. Substrate Concentration at each Station

STATION	TEXTURE		
	% SAND	% LOOK	% DUST
(I)	89.32	8.75	1.93
(II)	89.68	8.46	1.87
(III)	75.90	17.69	6.40

The data from the table above shows that there are differences in the percentage of substrate concentrations from each station. Station I and Station II have almost the same substrate percentage, namely the concentration of sand is greater than the concentration of clay and dust, thus both stations are habitats for decapods, in line with (Waisaley et al., 2019) which state that decapods are one of the benthic animals that eat suspended material (filter feeders) and usually live in sandy and muddy substrates. Station III has significant differences in substrate; the substrate at Station III has more clay substrate compared to other stations.

The environmental parameters measured include DO, water pH, light intensity, salinity, temperature, and ordinate point. Environmental parameters at each station can be seen in Table 4 below:

Table 4. Environmental Data

Station	DO	Water pH	Light intensity	Salinity	Temperature
I	6.2mg/L	7.4	1463 Cds	33 ‰	29 ^{o}C
II	7.2mg/L	7.79	625 Cds	32 ‰	26 ^{o}C
III	5.7mg/L	7.79	643 Cds	29 ‰	26 ^{o}C

Based on Table 4 above, the DO values at the three stations range between 7.2-5.7mg/L. The highest DO value was at station II, namely 7.2 mg/L, and the lowest was at station III, namely Kualo Beach, with a value of 5.7 mg/L, while at station 1, the DO value was 6.2 mg/L. The DO value at each station can be said to be good because it is >5 mg/L. The DO value categories that have been obtained are strengthened by research conducted by Akbar, (2019). Aquatic organisms use oxygen in water to carry out respiration. Microorganisms break down organic substances into inorganic ones. Reduced life activity in waters will be caused by a decrease in dissolved oxygen levels. For marine biota, the dissolved oxygen threshold must be more than 5 mg/l.

. The pH value of the water obtained at the three stations ranged from 7.79 to 7.4, which indicates that the pH level on the beaches of Bengkulu City is in the low category. However, even though it is low, the pH value obtained at each station is still a reasonable and ideal value for marine biota. In line with research conducted by Akbar, (2019) stating that the ideal pH for marine biota is 6.5–8.5, this statement is reinforced by the quality standards of the State Minister for the Environment regarding seawater quality standards, which are in the range of 6.5-8.5. The lowest pH value was obtained at station III, namely Kualo Beach. In water, the pH value usually ranges between 8.0 and 8.3. Water masses at several river estuaries, rainfall, and oxidation processes may contribute to the decrease in pH values (Akbar, 2019)

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The light intensity at the three stations ranges from 1463-625 cd. The highest light intensity is located at station I, namely Pasir Putih Beach. This is caused by the absence of plants growing close to the beach, so the light intensity is high. The light intensity at stations II and III is almost the same, namely at 625 cd and 643 cd. From Table 4, it can be seen that the lowest light intensity is at station II, namely Panjang Beach, where the beach is often visited as a tourist attraction. Light intensity measurements were carried out at different times, causing differences in light intensity at each station. Which states that weather conditions, measurement time, suspended solids, and turbidity, as well as measuring accuracy, greatly influence the brightness level of Long Beach waters (Apriliansyah et al., 2018).

. According to the data above (Table 4), the three stations have salinity values of 33–29. The salinity values at stations I and II, respectively, are 33 ‰ and 32. These values indicate that the salinity at these two stations is included in the good category. Station III has a lower salinity value than the other two stations, namely at 29 ‰, which can be said to be low. The low salinity value at station III is due to its location close to the Hitam River estuary. The presence of freshwater input at river mouths can reduce sea surface salinity (Tanto et al., 2018). Research conducted by Apriliansyah et al., (2018) states that evaporation (evaporation) of seawater, rainfall, and water mixing affect the salinity of waters. According to (Patty et al., 2020), in Indonesian maritime waters, salinity is generally between 28 and 33. This salinity value is still suitable for the lives of other sea creatures.

The temperature values that have been measured from the three stations range from 26 to 29^{o}C. The highest temperature is at station I, namely the Pasir Putih beach, with a value of 29^{o}C, while at stations II and III the temperature is the same, namely 26^{o}C. Apriliansyah et al., (2018) stated that the ideal coastal water temperature is between 23 and 35 degrees Celsius, with a tolerance limit of between 36 and 40 degrees Celsius. Based on the temperatures at the three stations and the statements above, the temperatures at the three stations are included in the good category.

CONCLUSION

The decapods found at the three research stations consisted of 6 families and 8 species, for a total of 58 species. The highest abundance was at station II, namely the long beach of Bengkulu City, with *Emerita emeritus* species totaling 31 species, and the lowest abundance was at station 3, namely the *Ashtoret lunaris* and *Hippa adactyla* species with the same abundance, namely 1 species. Environmental parameters (DO, water pH, air humidity, light intensity, salinity,

and temperature) are in conditions suitable for decapod life.

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