# Community Structure of Decapods in the Coastal Waters of Rupat Utara District

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**Abstract**

Decapods are one of the macrozoobenthos consisting of the Taxonomy of the last five pairs of the eight thoracic appendages. This study aimed to determine the structure of the decapod community in the waters of Rupat Utara District Beach, including abundance, diversity, uniformity, dominance index, distribution pattern, and community similarity index in Rupat Utara waters. The survey method was used in the study. Determination of observation stations was carried out purposively. The species found consisted of 8 (eight) species from Rupat Utara waters. The abundance of decapods was 1,326 ind/Ha. The diversity index value (H'= 1.48) is included in the medium category. The value of the uniformity index (E = 0.83) is included in the high category. The dominance index (C = 0.31) and similarity index of decapod community I to II is 83%, I to III 77%, and II to III 93%.

## 1. Introduction

The coastal area is a productive marine environment that can be utilized directly or indirectly. Over 60% of Indonesia's coastal communities depend on the wealth of Indonesian marine and coastal products (Pratiwi & Wijaya, 2013). As an ecosystem, coastal and marine areas provide natural resources, one of which is the diversity of decapods, which have ten walking legs (deca); their bodies are protected by a thick outer skeleton attached to their flesh, including crabs, crabs, shrimp, and lobster.

Rupat Utara has a ±12 km stretch of white sand beach located in Tanjung Punak Village to Teluk Rhu and also faces the Malacca Strait, which is the passageway for international ships and also a marine tourism area (Putra et al., 2017). Many activities endanger marine biotas' lives, including oil pollution, illegal mining, and tourist activities, which are limiting factors in the life of biota. The importance of the role of decapods in the food chain of organisms that live in the surrounding environment so that further research is needed on the community structure of decapods in the coastal waters of Rupat Utara District, as information for related parties, especially decapods. This research was conducted to know the structure of the decapod community, which consists of an abundance, diversity index, uniformity index, dominance index, distribution pattern, and community similarity in the coastal waters of Rupat Utara District.

## 2. Methodology

### 2.1. Time, Place, and Materials

This research was conducted in September 2022. Data collection was located in the waters of Rupat Utara Beach, to be precise, on the beach of Tanjung Medang Village, the beach of Teluk Rhu Village, and the beach of Tanjung Punak Village.

### 2.2. Method

The method used in this study was a survey method, namely direct observation of the research area and sampling of decapods, sediments, and measurements of aquatic environmental quality parameters in the field from morning to evening; then, samples were identified and analyzed at the Department of Marine Biology Laboratory Marine Science, Faculty of Fisheries and Marine, Universitas Riau.

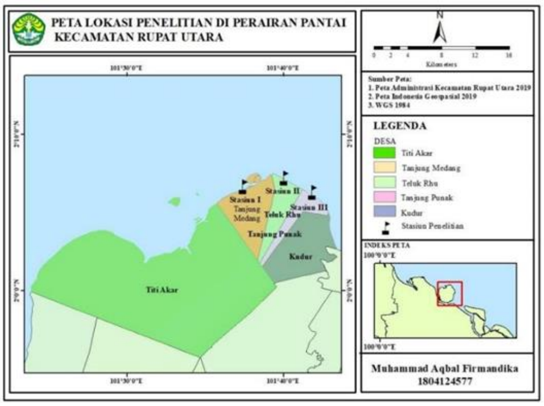


**Figure 1. Research Location Map**

## 2.3. Procedure

### Determinate Research Stations

Research stations were determined using a purposive sampling method, namely, the determination of stations based on the characteristics of the aquatic environment. The research location is divided into 3 (three) stations: station I is in Tanjung Medang Village with the characteristics of a sandy beach close to community settlements; Station II is in Teluk Rhu Village with characteristics of sandy beaches close to community settlements, and there are tourist activities, station III is in Tanjung Punak Village with the characteristics of a sandy beach, and there are tourist activities.

### Decapod Sampling Procedure

To determine the community structure of Dekapods in Pantai waters of Rupat Utara District, at each research station, 3 (three) transects were drawn that crossed the intertidal zone and were divided into three subzones, namely: 1) upper intertidal zone, 2) middle intertidal zone, and 3) lower intertidal zone by dividing the intertidal zone perpendicularly to the coast (Aritonang, 2018). Each research station has three transects, and each transect consists of 3 plots and five subplots, with each plot size 10 x 10 m squared and a subplot measuring 2 x 2 $m^{2.}$ The distance between the zones depends on the intertidal zone's width in the Rupat Utara District's coastal waters. Each decapod sample found on the surface in each subplot was collected and scooped up using a net, while those in the hole were excavated using a spade to a depth of ± 10 cm. After that, the samples were put into labeled plastic (stations, transects, plots, subplots) using 10% formalin to be preserved and then put into an ice box and brought to the laboratory for analysis.

### Analysis of Decapod Samples

Decapod samples obtained in the field were brought to the laboratory and then cleaned, grouped, counted, and identified based on the shape obtained. The identification of decapods was done visually by observing their morphology. Identification was carried out to the species level with the help of the book Biodiversity of Singapore and the Species Identification Guide for Fishery Purposes, The Living Marine Resources of The Western Central Pacific. Volume 2. Cephalopods, Crustaceans, Holothurians and Sharks, Rome, FAO (Carpenter & Niem 1998).

### Abundance Decapoda

The abundance formula can be calculated using the Shannon-Wiener equation according to Fachrul (2007) as follows:

$$K = \frac{ni}{A}$$

Information:

K = abundance of decapod types (ind/$m^2$)
ni = total number of individuals for species i (ind)
A = Total area of the sampled area ($m^2$)

### Diversity

Decapod diversity is calculated using the Shannon-Wienner index as follows:

$$H' = -\sum_{i=0}^{s} pi \, \mathrm{Log}_2 \, pi$$

Information:
H' = Shannon-Wiener diversity index
pi = ni /N (proportion of i-th type)
ni = number of individuals of each i-th type
N = total number of individuals

### Uniformity

The uniformity index can show an even distribution of biota species (Amalia et al., 2017). The uniformity index is calculated using the formula Evness (Odum, 1993)

$$e = \frac{H'}{Log_2 S}$$

Information:

e = population Evenss index
H’ = diversity index
S = number of species

**Dominance**

The dominance index is calculated using the equation (Fachrul, 2007), namely:

$$C = \sum (pi)^2$$

Information:

C = dominance index
pi = ni/N
in = number of individuals of the i-th species
N = total number of individuals

**Distribution Pattern**

The distribution pattern of decapods was calculated using the Morisita index calculation method (Abaraham, 2009):

$$Id = N \frac{\sum x^2 - \sum x}{(\sum x)^2 - \sum x}$$

Description:

Id = Morisita dispersion index
Σx = number of individuals per plot
$x^2$ = squared number of individuals per plot
N = number of sampling plots

**Community Similarity**

Community similarity between stations is calculated using the community similarity index based on the Sorensen formula (Banjarnahor, 2010) as follows:

$$S = \left(\frac{2C}{A+B}\right) \times 100\%$$

Information:

A = number of species at location 1
B = number of species at location 2
C = number of the same species at both locations
S = Index of similarity between two communities of community similarity index.

**Total Organic Matter Content of Sediment**

Calculation of organic matter content using the formula Loss on Ignition (Mucha et al., 2003).

$$BOT = \frac{(Wt - C)(Wa - C)}{Wt - C} x\ 100\%$$

Information:

Wt = total weight (aluminum foil+ sample) before burning (g)
Wo = total weight (aluminum foil+ sample) after burning (g)
C = Sediment type (g)

The handling of sediment samples followed the procedure referred to (Rifardi, 2008). Namely, the wet sieving method for the sand and gravel fractions for the silt fractions was analyzed using the pipette method, and then the percentage values of sediment particles were plotted into Sheppard's triangle (Figure 2).

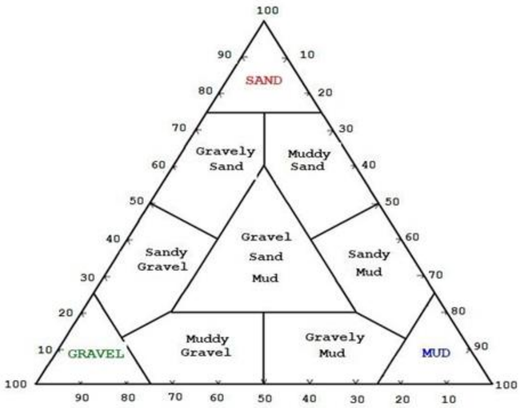


**Figure 2. Sheppard's Triangle**

**Sediment Sampling**

Sediment samples were taken at the same time as the decapod samples, i.e., from morning to evening. Sampling was carried out using a PVC pipe with a diameter of 10 cm. Sediment samples were taken by plugging a pipe into the substrate to a depth of 10 cm. Sediment samples were taken ± 500 g, and then the samples were put into plastic bags labeled with stations, transects, and plots.

## 3. Result and Discussion

**Water Quality Parameters**

The parameters measured are physical and chemical. Physical parameters include temperature and salinity, while pH measures the chemical parameters. The results of measuring water quality parameters can be seen in Table 1.

**Table 1. Measurement of the Quality of Rupat Utara Coastal Waters**

| Station | Temperature ($^0$C) | Salinity (ppt) | pH |
|---|---|---|---|
| I | 28 | 30 | 7 |
| II | 27 | 30 | 7 |
| III | 28 | 29 | 6 |
| Average | 27,6 | 29,6 | 6,6 |

The temperature at the study site is around 27-28$^o$C. This is thought to be caused by the weather at the study site, which is experiencing the rainy season, and observations are made from morning to evening. According to Slamet et al. (2017), the temperature in the North Rupat Beach area is usually average for crustacean life. In general, crabs (decapods) can live at a temperature range of 27-32$^{o}$C (Murniati & Pratiwi. 2015), while shrimp (decapods) are generally less active when the water temperature drops below 18$^{o}$C, and at a temperature of 15$^{o}$C or lower will cause shrimp stress (Slamet et al., 2017).

Salinity is an environmental parameter affecting biological processes and will directly affect organisms' lives, including growth rate, amount of food consumed, food conversion value, and survival power. Salinity at the study site ranges between 29-30 ppt. At stations I and II, the salinity value is 30 ppt, and station III is 29 ppt, which is considered good. At station III, there is the lowest salinity with a value of 29 ppt, and this is because the location is close to residents' houses and the estuary. Overall, the average salinity is around 29.6 ppt. According to Lekatompessy & Tutuhatunewa (2010), The optimum salinity for the survival of aquatic organisms is around 15 to 35 ppt.

The pH value of the water is influenced by several factors, including salinity, photosynthetic activity, biological activity, temperature, oxygen content, and the presence of cations and anions in the water (Handayani, 2004). The pH values obtained at the study sites ranged from 6-7, averaging 6.6. Overall, the observation locations did not have a drastic difference in pH. Natania et al. (2017) explained that pH can affect the level of fertility of water because it is related to the life of microorganisms.

**Organic Matter Content and Sediment Type**

Organic matter content and sediment type in the coastal waters of Rupat Utara District (Table 2).

**Table 2. Percentage of Total Sediment Organic Matter in Rupat Utara Coastal Waters**

| Station | Plot 1(%) | Plot 2(%) | Plot 3(%) | Average(%) | SD(±) |
|---|---|---|---|---|---|
| I | 0,64 | 0,66 | 0,51 | 0,60 | 0,07 |
| II | 0,71 | 0,94 | 1,67 | 1,11 | 0,41 |
| III | 0,53 | 0,63 | 0,47 | 0,54 | 0,07 |

**Table 3. Sediment Fraction and Sediment Type in Rupat Utara Coastal Waters**

| Station | Transect | Average Sediment Franction % | | | Type Sedimen |
|---|---|---|---|---|---|
| | | Gravel | Sand | Mud | |
| I | 1 | 7,13 | 88,63 | 4,24 | Sand |
| | 2 | 1,69 | 89,82 | 8,49 | Sand |
| | 3 | 3,14 | 90,94 | 5,92 | Sand |
| II | 1 | 37,29 | 58,20 | 4,50 | Pebble Sand |
| | 2 | 32,15 | 60,39 | 7,46 | Pebble Sand |
| | 3 | 33,47 | 58,04 | 8,49 | Pebble Sand |
| III | 1 | 6,52 | 87,62 | 5,86 | Sand |
| | 2 | 2,06 | 89,30 | 8,65 | Sand |
| | 3 | 4,99 | 90,86 | 4,15 | Sand |

**Types and Abundance of Decapoda**

The Decapod species obtained consisted of 6 (six) families, 7 (seven) genera, and 8 (eight) species. The decapods found at 3 (three) study stations consisted of the families Diogonidae, Ceonobitidae, Dotillladae, Palaemonidae, Matutidae, and Panaedae. The most commonly found species are species *S. globosa* of the Dotillidae family (Table 4).

The average abundance value of Dekapods in Rupat Utara waters had the highest abundance value at station II, namely 6,889 ind/ha, while the lowest average abundance was at station I, namely 6,333 ind/ha. The standard deviation of decapod abundance values from stations I to III is 506-833 (Figure 3).

The results of calculating the abundance value of Decapods in the waters of Rupat Utara Beach show varying values for each station. The average value of decapod abundance in the waters of Rupat Utara Beach is 6,630 ind/Ha. The highest abundance value was found at station II, 6,889 ind/ha, and the lowest at station I, 6,333 ind/ha. While at station III 6,667 ind/ha, the high abundance value at station II is thought to be due to the physicochemical factors of the waters, namely the type of sand substrate favored by decapods and temperature, pH, salinity are still relatively average to support decapod life. The low abundance of decapods at Station I is due to social factors, namely the activities of tourists. Sinyo & Idris (2013) state that organisms with the highest abundance value indicate that these types of organisms can adapt to their environment. Several studies on the community structure of macrozoobenthos, including decapods, among others, were conducted by Rusadi et al. (2018) on Rangsang Island, Meranti Islands Regency, stated that the macrozoobenthos community structure was affected by changes in environmental factors such as salinity, temperature, and pH (Apriliana et al., 2021).

**Table 4. Decapod species found in the Rupat Utara Coastal Waters**

| Family | Genus | Species |
|---|---|---|
| Diogenidae | Cilibanarius | *Cilibanarius longitarsus* |
| Ceonobitidae | Ceonobita | *Coenobita regasus* |
| Dotillidae | Dotilla | *Dotilla myctiroides* |
| | Scopimera | *Scopimera globosa* |
| Matutidae | Matuta | *Ashtoret lunaris* |
| Palaemonidae | Macrobrachium | *Macrobrachium rosenbergii* |
| Panaedae | Paneus | *Penaeus indicus* |
| | | *Penaeus monodon* |

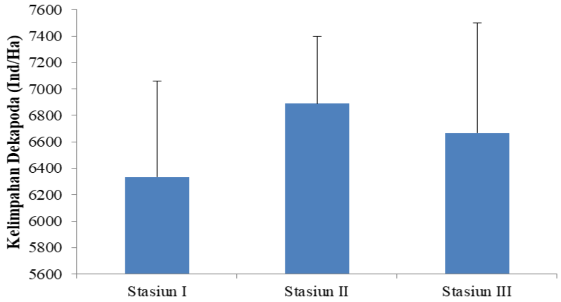


**Figure 3. Decapod Abundance at Each Observation Station in Rupat Utara Coastal Waters**

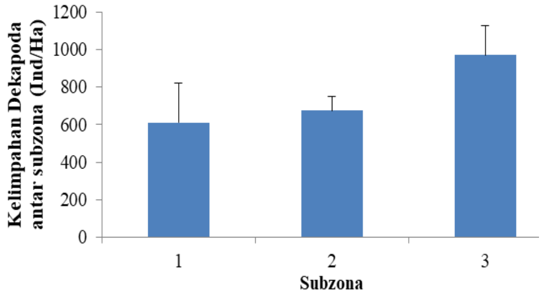


**Figure 4. Decapod Abundance for Each Intertidal Subzone in Rupat Utara District Coastal Waters**

Figure 4, it can be seen that the abundance of decapods in each subzone has the highest abundance value in Subzone 3, namely 969 ind/Ha, while the lowest abundance is in Subzone 1, namely 611 ind/Ha, and the abundance of Subzone 3 is 673 ind/Ha. The results of calculating the decapod abundance values for each subzone have varied values.

**Community Index**

In this study, the values of diversity index, uniformity index, dominance index, and similarity index were presented in Table 5.

**Table 5. The value of H', E, C, and Decapod Community Similarity Index**

| Observation Location | H' | E | C | % |
|---|---|---|---|---|
| | Diversity Index | Uniformity Index | Dominance Index | Similarity Index |
| Station I | 1,22 | 0,59 | 0,40 | I Against II 100 |
| Station II | 1,51 | 0,72 | 0,30 | I Against III 80 |
| Station III | 1,72 | 0,83 | 0,23 | II Againts III 80 |
| Subzone 1 | 0,49 | 0,24 | 0,51 | |
| Subzone 2 | 0,77 | 0,37 | 0,31 | |
| Subzone 3 | 0,78 | 0,37 | 0,17 | |
| Research Sites | 1,48 | 0,83 | 0,31 | |

The highest diversity index is found at station III, with a value of 1.72, due to the large number of decapod species that can be consumed and are in great demand by the community. In addition, the area at station III is in estuaries and beaches, which stretch widely, while the value with the lowest diversity index at station I with a value of 1.22 due to the low organic matter content in the area, causing a lack of reproductive processes that occur between species in the area. The index of diversity of decapods in Pantai waters of Rupat Utara District, with a value of 1.49, indicates that the diversity of decapods is moderate in the distribution of individuals in stable waters and moderate communities. Meanwhile, the diversity of decapods between subzones ranged from 0.49 to 0.78. Putra et al. (2017) state that the level of diversity is influenced by many factors, one of which is the number type and quality of the environment, and the greater the number of species with balanced proportions, the higher the diversity.

The results of the uniformity index analysis obtained at the three observation stations varied. Uniformity index values range from 0.59 to 0.83. The highest uniformity index was found at station III, which was 0.83; station II, 0.72; and station III, 0.59. The high activity of fishermen and tourists influences low subzone decapod diversity, which can result in degraded decapod diversity. From the measurement results of a high uniformity index, it can be concluded that the research location is still stable. The high value of uniformity at station III was because the number of individuals found in the waters was found to be more, and also the capture of decapods, especially *Ashtoret lunaris* and *Dotilla mythyroides,* very abundant and the location is very supportive of decapods living in these places with sandy substrates.

According to Zulfiqri *et al*. 2020 if the uniformity index value is between 0.4 and 0.6, the place is in an unstable condition and has moderate uniformity. In contrast, this ecosystem is stable and uniform if the uniformity index value is above 0.6. The smaller the value of a uniformity index, the smaller the species uniformity within the community, meaning that the distribution of the number of individuals is not the same, and there is a tendency to be dominated by certain species (Saleh et al., 2017).

Dominance index values in the coastal waters of Rupat Utara District obtained at each observation station ranged from 0.23 to 0.40. The highest dominance index was found at station I, which was 0.40, while at station II, it was 0.23, and at station III, it was 0.23. The dominance index value for decapods at the study site was 0.31, whereas the dominance index value was close to 0, meaning no species dominated the three stations. According to Hamidy (2010), a dominance index with low criteria indicates that no dominating species and decapods adapt well to environmental conditions. A low dominance index suggests an even distribution of each species, so the uniformity and diversity indexes are high. The dominance index determines the extent to which a group of biota dominates another group. The decapod dominance index in the Rupat Utara District's coastal waters shows no Decapod dominance in certain species.

The decapod community similarity index value in coastal waters of Rupat Utara District, stations I to II, was 88%, stations I to III, and stations II to III was 80%; this shows that the types of decapod communities are very similar. According to Odum (1993), if a similarity index value of 0-25% has a different meaning, 26-50% means less the same, 51-75% is said to be quite the same, 76-95% is almost the same and 90-100% is the same. This means that the similarity indices at the research sites are very similar because the research locations are ideal for decapod life. According to Werdiningsih (2005), the number of species in a community and the abundance of each species causes the number of species to decrease. In addition, variations in the number of individuals of each species or several individuals who are more significant in number also cause the diversity of an ecosystem to decrease.

The species morbidity index value obtained at the study site was 6.67. The pattern of distribution of decapods in coastal waters of Rupat Utara sub-district Id > 1 shows the distribution pattern clumped or group. The species morbidity index value in the coastal waters of Rupat Utara sub-district, station I was 3.54, station II was 2.66, and station III was 2.01 (Table 6).

The clustered distribution pattern is caused by good research environmental conditions with water quality standards, substrate types, and good habits that facilitate reproduction in an ecosystem. This distribution pattern aligns with the research of Dinda et al. (2022) regarding the community structure of gastropods in the coastal waters of Rupat Utara, namely grouping with a comparison of values that are not much different. Like the largest species, the decapod species with a uniform distribution pattern are globose Scopimera and *Dotilla mythyroides*, so many of these species dominate and spread evenly.

The distribution pattern depends on several factors, including spawning season, each age's survival rate, and the relationship between crabs and environmental changes (Gunarto, 2004). As benthic animals, Crustaceans depend on the substrate as a place to live and find food in the form of detritus. With disturbing conditions in their habitat, species that cannot adapt will disappear, while resistant species will dominate (Pratiwi, 2002).

**Table 6. Distribution Pattern of Decapods in Coastal Waters of Rupat Utara District**

| Observation Location | Id | Spread Pattern |
|---|---|---|
| Station I | 3,54 | Group |
| Station II | 2,66 | Group |
| Station III | 2,01 | Group |
| Research Sites | 6,67 | Group |

## 4. Conclusion

Based on research that has been conducted in the coastal waters of Rupat Utara District, the types of decapods that have been found in the coastal waters of Rupat Utara District consist of eight species, namely *C. longitarsus, C. regasus, D. myctiroides, S. globosa, A. lunaris, M. rosenbergii, P. indicus*, and *P. monodon*. The uniformity index value (E) is high, the dominance index value (C) is that no species dominates, the community similarity index is very similar, and the distribution pattern in each station is grouped.

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