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Ecological Study of Mangrove Crabs (*Scylla* spp.) on Jambu Beach, Dompu Regency: Diversity and Abundance in the Mangrove Ecosystem

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Abstract: This study aims to analyze the abundance and diversity of mangrove crabs (*Scylla spp.*) in the mangrove area of Jambu Beach, Pajo District, Dompu Regency, West Nusa Tenggara. The research was conducted from October to December 2024 using a quantitative descriptive survey method. Sampling was carried out purposively at three stations with different substrate types: mud, clay, and black mud. Specimens were captured using collapsible traps for eight hours with three replications. The identification results revealed three species of *Scylla spp.*, namely *S. serrata*, *S. paramamosain*, and *S. tranquebarica*. The total abundance ranged from 0.36 to 0.48 ind/m², with the highest found at Station 2 (0.48 ind/m²). The diversity index (H') ranged from 0.349–0.995, the evenness index (E) from 0.318–0.906, and the dominance index (D) from 0.037–0.089. The highest diversity (H' = 0.995) and evenness (E = 0.906) were recorded at Station 3, while the highest dominance occurred at Station 2 (D = 0.089). Statistical analysis using one-way ANOVA showed significant differences in abundance among stations (F = 24.818; p = 0.001). These results indicate that variations in substrate, salinity (30–32 ppt), temperature (28–29°C), and soil pH (7.1–7.3) influence the abundance and community structure of *Scylla* spp. in the mangrove ecosystem. The findings provide baseline data for the sustainable management of mangrove crab populations and conservation of coastal ecosystems in the Dompu region.

Keywords: Biodiversity index, species abundance, crustacean ecology, mangrove habitat, population structure, West Nusa Tenggara

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1. Introduction

Mangrove crabs (*Scylla* spp.) are fauna that inhabit coastal and shallow water ecosystems, particularly in areas dominated by mangrove forests (Gita, 2016). Mangrove forests provide various essential ecosystem services (Pambudi *et al.*, 2019), including the supply of nutrients such as organic matter, nitrate, and phosphate. The organic matter content plays a role in determining sediment characteristics, including pH, fertility levels, and the rate of litter decomposition (Puspitasari, 2014; Citra *et al.*, 2020).

The biological activities of mangrove crabs, such as burrowing and foraging on the substrate, influence sediment structure by enhancing oxygen and nutrient circulation, thereby supporting ecosystem fertility (Murniati *et al.*, 2016). In addition, microorganisms in the sediment also play a role in nutrient cycling and energy flow (Widyastuti, 2016).

Various studies have examined the ecological roles and abundance of *Scylla* spp. in several regions of Indonesia. For example, Pambudi *et al*., (2019) reported high abundance in the mangrove forests of Pasar Banggi, Rembang. Research conducted in the waters of North Lingga also showed high diversity and evenness values (Widyastuti, 2016). Apart from their ecological importance, *Scylla* spp. also have high economic value. Since the 1980s, this commodity has become one of the leading export products to various countries such as Singapore, Thailand, Taiwan, Hong Kong, China, as well as the United States and Europe (Dewi & Setiawina, 2013; Sulistiono *et al*., 2016).

Scylla spp. is classified under the class Crustacea, order Decapoda, family Portunidae, and consist of four main species found in Indonesian waters: *Scylla serrata*, *Scylla olivacea*, *Scylla tranquebarica*, and *Scylla paramamosain* (Gita, 2016; KKP, 2016). Their distribution varies, such as three species found along the northern and southern coasts of Java, four species in Papua, two in Asahan, North Sumatra, and in East Kalimantan (Pane & Suman, 2018; Aisyah *et al*., 2019).

However, research on *Scylla* spp. in Dompu Regency, West Nusa Tenggara, remains limited to date. Existing studies have primarily focused on mangrove vegetation rather than faunal biodiversity (Sentosa & Nastiti, 2012). The West Nusa Tenggara region has extensive mangrove forests, covering approximately 39.000 hectares, which serve as critical nursery grounds for various aquatic species, including mangrove crabs.

In recent years, these mangrove ecosystems have faced increasing pressures from land conversion, sedimentation, and coastal exploitation. Despite their ecological and economic importance—particularly as a source of livelihood for local communities, the scientific data on the abundance and diversity of *Scylla* spp. in this area are still lacking. Therefore, this study aims to examine the abundance, diversity, and community structure of *Scylla* spp. in the mangrove area of Jambu Beach, Pajo District, Dompu Regency. The findings are expected to provide essential baseline data to support mangrove conservation, sustainable management of coastal resources, and the development of local community-based fisheries in the Dompu region.

Therefore, this study aims to examine the abundance, diversity, and community structure of *Scylla* spp. in the mangrove area of Jambu Beach, Pajo District, Dompu Regency. The findings are expected to provide essential baseline data to support mangrove conservation, sustainable management of coastal resources, and the development of local community-based fisheries in the Dompu region.

2. Materials and Methods

2.1. Time and Location of Study

This research was conducted in the mangrove area of Jambu Beach, located in Pajo District, Dompu Regency, West Nusa Tenggara (Figure 1). The study was carried out from February to March 2025, encompassing the stages of preliminary observation, sample collection, and subsequent laboratory and statistical data analysis. Jambu Beach represents one of the main mangrove ecosystems in Dompu, characterized by extensive muddy and clay substrates that serve as suitable habitats for mangrove crabs (*Scylla* spp.). This spatial design allowed a comprehensive representation of environmental variation across different substrate types, ensuring that the collected data accurately reflected the ecological diversity of *Scylla* spp. in the mangrove ecosystem of Jambu Beach.

2.2. Tools and Materials

The tools used in this research included collapsible traps measuring 35 × 25 × 20 cm, knives, plastic buckets, raffia string, measuring tape, a GPS for recording station coordinates, a digital camera, and an identification guidebook for *Scylla* spp. The materials used included fresh fish bait, field data forms, and 70% alcohol for temporary fixation of specimens.

2.3. Population and Sample

The research population consisted of all individuals of *Scylla* spp. found in the mangrove forest area of Jambu Beach. The observed samples were *Scylla* spp. individuals caught within observation plots at three stations using collapsible traps, selected through purposive sampling.

2.4. Research Design and Data Collection

This study is quantitative descriptive research using a field survey approach, starting with environmental observation and brief interviews with officers from the local Marine and Fisheries Department. The research location was divided into three stations based on substrate characteristics: Station 1 with mud substrate, Station 2 with clay substrate, and Station 3 with black mud substrate. Each station was spaced 200 meters apart and consisted of three transects, each with two plots measuring 10 × 10 meters, which were used as sampling areas for *Scylla* spp (Figure 2A and Figure 2B).

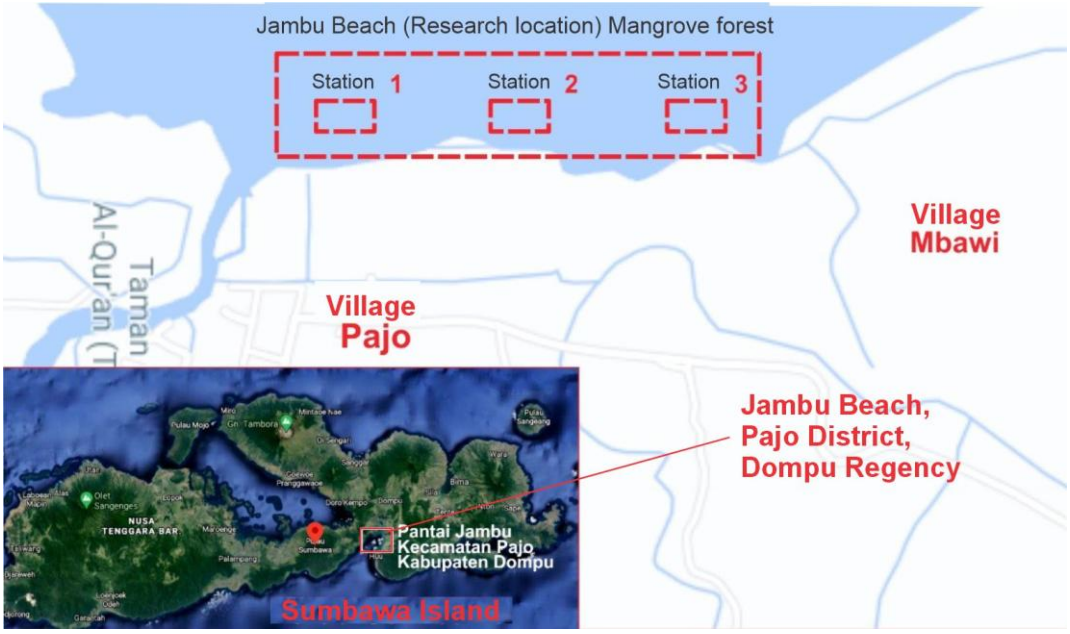

Figure 1. Map of the research location in the mangrove area of Jambu Beach, Pajo District, Dompu Regency (Google Maps). The red dashed boxes indicate the mangrove forest area where the three observation stations were established.

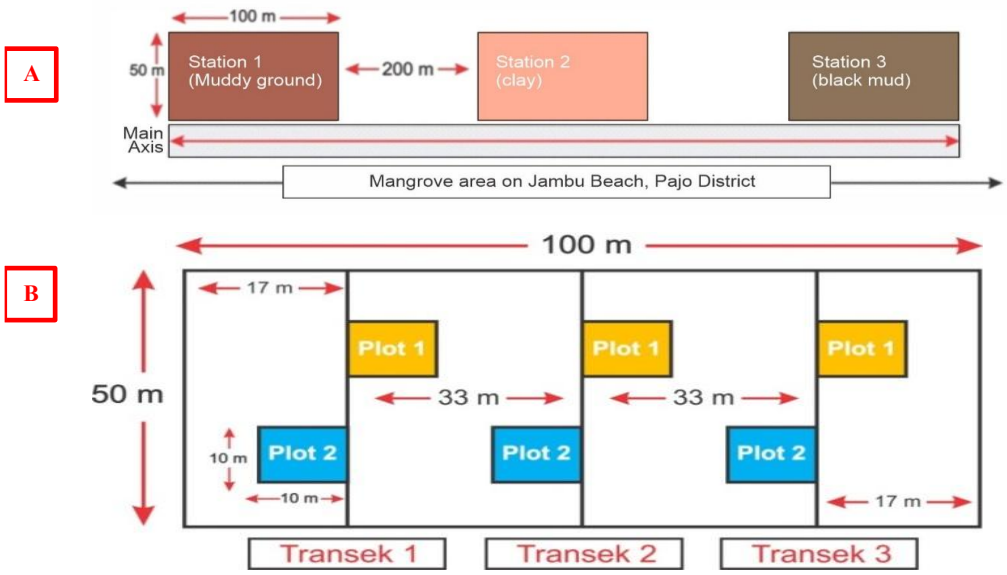

Figure 2. (A). Location of Stations 1–3. (B) Layout of Transects 1–3, each consisting of two plots.

2.5. Capture and Identification of *Scylla* spp.

At each plot, six traps were set up for eight hours of observation (08:00–16:00 Central Indonesia Time) with three repetitions on different days. Captured *Scylla* spp. were collected and morphologically identified based on carapace tooth shape and claws, referring to Sulistiono *et al*., (2016) and Carpenter *et al*., (1998) in Murniati *et al*., (2016).

2.6. Observed Parameters

The observed parameters in this study included the number of individuals per species, the identified *Scylla* spp. species, their distribution and abundance at each station, and environmental characteristics such as soil pH, temperature, salinity, and substrate composition. Environmental parameters were measured directly at each sampling site using standardized field instruments: a portable thermometer for temperature (°C), a digital pH meter for soil acidity, and a hand refractometer for salinity (ppt).

Substrate samples were collected from each station at a depth of 0–10 cm and analyzed for texture composition (sand, silt, and clay fractions) using the pipette method (Hadiyanto *et al*., 2018). These data were used to describe the environmental conditions influencing the distribution and abundance of *Scylla* spp. in the mangrove ecosystem.

Table 1. Observed Parameters

No	Observed Parameter	Description
1	Number of individuals per species	Total count of *Scylla* spp. individuals captured at each station
2	Species of *Scylla* spp.	Morphological identification to determine species
3	Distribution and abundance per station	Determination of the spread and relative number of individuals at each station
4	Environmental parameters	Measurement of temperature (°C), soil pH, and salinity (ppt) using thermometer, pH meter, and refractometer
5	Substrate composition	Analysis of sand, silt, and clay fractions using the pipette method

2.7. Data Analysis

Captured and identified *Scylla* spp. were analyzed to measure abundance differences between stations using one-way ANOVA. Data were processed using SPSS version 22. According to Ghozali (2015), ANOVA is used to compare the means of several populations. If the test result shows a significant p-value less than 0.05 ($\alpha < 0.05$), it indicates a significant difference in means; otherwise (p-value > 0.05), there is no significant difference (Laila et al., 2020). Following ANOVA, data were further analyzed by calculating the diversity index, dominance index, and density index. These data were presented descriptively to provide a comprehensive overview of the ecosystem conditions and *Scylla* spp. abundance at the study site.

2.8. Abundance of *Scylla* spp.

The abundance of *Scylla* spp. was calculated using the formula (Siringoringo *et al*., 2017):

$$N = \frac{\sum \mathrm{ni}}{A}$$

Where:

N = abundance of mangrove crabs of species *i* (individuals/m²)
∑ ni = total number of individuals of species *i*
A = area of observation plot (m²)

2.9. Diversity Index

The *Scylla* spp. data were then analyzed using the Shannon-Wiener diversity index (H') as follows (Santosa *et al*., 2008):

$$H' = -\sum P_i \ln (P_i), \text{ where}$$

$$Pi = \frac{ni}{N}$$

where:
H'= Shannon-Wiener diversity index
ni = number of individuals of species *i*
N = total number of individuals of all species
Criteria for the Shannon–Wiener diversity index (H') are as follows:
H' < 1 : Low diversity
1 ≤ H' ≤ 3 : Moderate diversity
H' > 3 : High diversity

2.10. Evenness Index

Evenness was calculated using the following formula (Syahrera *et al.*, 2016):

$$E = \frac{H'}{ln(S)}$$

Where:
E= Evenness index
H= Shannon-Wiener diversity index
S = Number of species

2.11. Dominance Index

Dominance of particular species was determined using the dominance index formula (Fachrul, 2012):

$$D = \sum_{i=1}^{s} \left(\frac{ni}{N}\right)^2$$

Where:
D = Dominance index
ni = number of individuals of species *i*
N = total number of individuals

Dominance index values range from 0–1. The higher the index value, the greater the tendency for dominance by a particular species.

3. Results

The results of this study describe the species composition, abundance, and ecological structure of *Scylla* spp. in the mangrove area of Jambu Beach. Three species were successfully identified: *Scylla* serrata, *Scylla* paramamosain, and *Scylla* tranquebarica. Among these, S. serrata dominated the total catch across all sampling stations, while S. tranquebarica was found in the smallest number. Variations in individual counts, abundance, and ecological indices such as diversity (H'), evenness (E), and dominance (D) were observed among stations, reflecting differences in habitat characteristics, substrate types, and environmental parameters. Detailed results are presented in the following tables.

Table 2. Number of Individuals and Species of *Scylla* spp. per Station

Station	Species	Number of Individuals
Station 1	*Scylla serrata*	12
	Scylla paramamosain	4
	Scylla tranquebarica	2
Station 2	*Scylla serrata*	15
	Scylla paramamosain	6
	Scylla tranquebarica	3
Station 3	*Scylla serrata*	10
	Scylla paramamosain	7
	Scylla tranquebarica	5

The distribution of *Scylla spp.* abundance at each station showed a noticeable difference, with Station 2 having the highest number of individuals. Abundance values were calculated based on the total number of individuals found divided by the sampling area at each station (Table 3). The substrate conditions were dominated by fine mud to sandy mud, which is an ideal habitat for mangrove crabs (Table 4).

Table 3. Abundance Distribution of *Scylla* spp.

Station	Total Number of Individuals	Abundance (Ind/m²)
Station 1	18	0,36
Station 2	24	0,48
Station 3	22	0,44

Table 4. Substrate Conditions and General Environment

Station	Substrate Type	Temperature (°C)	Soil pH	Salinity (ppt)
1	Fine mud	28	7,1	30
2	Sandy mud	29	7,3	32
3	Predominantly mud	28,5	7,2	31

3.1. Ecological Index and Statistical Analysis of *Scylla* spp. Abundance

The calculation results of the ecological indices of *Scylla* spp. (*Scylla* serrata, *Scylla* paramamosain, and *Scylla* tranquebarica) in the mangrove forest area of Jambu Beach shows variations among the three observation stations. The values of the diversity index (H'),

evenness (E), and dominance (D) presented in Table 5 illustrate the differences in the community structure of *Scylla* spp. at each location.

The highest diversity index (H') was found at Station 3 (0.995), followed by Station 1 (0.802), and the lowest at Station 2 (0.349). According to the Shannon-Wiener criteria (Baliton *et al*., 2020), all stations still fall into the low diversity category (H' < 1), although there are value variations between stations. The evenness index (E) also indicates that Station 3 has the most even distribution of individuals among species (E = 0.906), while Station 2 shows the most uneven distribution (E = 0.318). This indicates that at Station 2, there is a more dominant species compared to the others. The highest dominance index (D) was found at Station 2 (0.089), indicating a relatively strong dominance of one species, while Station 3 had the lowest dominance (0.037). Thus, Station 3 is considered to have a more balanced community structure compared to the other two stations.

3.2. Variation in *Scylla* spp. Abundance Across Stations

To determine whether the differences in *Scylla* spp. The abundance among the stations is statistically significant, an ANOVA test was conducted, and the results are presented in Table 6. The ANOVA test showed a significance value of 0.001 ($p < 0.05$), which means that there are significant differences in *Scylla* spp. abundance among the observation stations. The F-value of 24.818 also indicates a real variation that did not occur by chance. Overall, these results suggest that environmental factors and habitat conditions at each station most likely influence the community structure and abundance of *Scylla* spp. Station 3, which has the highest diversity and evenness values and the lowest dominance, can be said to have more favorable habitat conditions for a more even distribution of the three observed mangrove crab species.

Table 5. Diversity Index (H'), Evenness (E), and Dominance (D) of *Scylla* spp.

Station	(H')	(E)	(D)
1	0,802	0,73	0,054
2	0,349	0,318	0,089
3	0,995	0,906	0,037

Table 6. ANOVA Test Analysis of *Scylla* spp. Abundance

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	60,667	2	30,333	24,818	.001
Within Groups	7,333	6	1,222		
Total	68,000	8			

4. Discussion

This study revealed the presence of three species of mangrove crabs (*Scylla* spp.) found in the mangrove area of Jambu Beach, namely *Scylla* serrata, *Scylla* paramamosain, and *Scylla* tranquebarica (Figure 3). The identification results showed that *Scylla* serrata was the most dominant species at all observation stations. This aligns with the ecological characteristics of S. serrata, which is more tolerant of various environmental conditions, particularly the muddy substrate that dominates the research area. This type of substrate provides protection and facilitates feeding and hiding activities, as reported in studies by Avianto et al. (2013) and the Ministry of Marine Affairs and Fisheries (KKP, 2016).

The highest abundance was recorded at Station 2 with a value of 0.48 ind/m², followed by Station 3 (0.44 ind/m²) and Station 1 (0.36 ind/m²). This difference is most likely influenced by environmental factors such as substrate type and physical water parameters (temperature, soil pH, and salinity). Station 2, which has a sandy-mud substrate and the highest salinity (32 ppt), may provide more optimal conditions for crab growth and activity, particularly in terms of substrate oxygenation and the availability of detritus-based food (Awuku-Sowah *et al*., 2022). A similar relationship between substrate type, salinity, and the abundance of *Scylla* spp. has also been reported along the eastern coast of North Sumatra (Onrizal & Kusmana, 2008) and in the

mangrove ecosystems of Sarawak, Malaysia (Ikhwanuddin *et al*., 2011), showing that semi-sandy mud provides ideal conditions for higher survival rates and feeding efficiency in S. serrata populations.

Figure 3. Identified *Scylla* species. (A). *Scylla* tranquebarica. (B). *Scylla* serrata. (C). *Scylla* paramamosain.

Although the highest abundance was recorded at Station 2, the highest diversity index (H') was found at Station 3 (0.995), indicating a more balanced species composition. The evenness index (E) also supports this finding, with Station 3 showing the most even distribution of individuals among species (E = 0.906). In contrast, Station 2 exhibited the lowest H' value (0.349) and the lowest E value (0.318), indicating a strong dominance by a single species (in this case, S. serrata) and a lower presence of other species. This is further supported by the highest dominance index (D) at Station 2 (0.089), indicating an imbalanced community structure. These diversity patterns are consistent with findings from India (Raj *et al*., 2025) and the Bay of Bengal, Bangladesh (Habib *et al*., 2023), which demonstrated that habitat heterogeneity and substrate variation directly influence the diversity and dominance levels of *Scylla* spp.

The ANOVA test results provide strong evidence that the differences in abundance among stations are statistically significant ($p < 0.05$). This indicates that environmental factors play an important role in shaping the community structure of mangrove crabs. With an F-value of 24.818 and a significance level of 0.001, it can be concluded that the variation in abundance did not occur randomly but was influenced by specific ecological conditions at each station. Comparable results were also obtained by Gita (2016) and Habib *et al*., (2023), who found that environmental heterogeneity significantly affects the spatial distribution of *Scylla* spp. across various mangrove zones.

Ecologically, the high diversity and evenness observed at Station 3 indicate a relatively stable environment capable of supporting multiple species. This is important for maintaining the balance of the mangrove ecosystem, as mangrove crabs play a crucial role in the decomposition of organic matter, nutrient cycling, and strengthening of substrate structure through their burrowing activities. These findings emphasize the importance of conserving mangrove habitats and sustainably managing coastal environments to maintain the existence and balance of *Scylla* spp. populations, particularly in the context of climate change and increasing human pressures in coastal areas. This aligns with the global perspective that mangrove biodiversity contributes significantly to coastal ecosystem resilience and carbon sequestration (Lee *et al*., 2014; Raynaldo *et al*., 2024; Collins *et al*., 2021), highlighting the need for integrated management and conservation of mangrove-associated fauna.

5. Conclusion

This study revealed the presence of three species of mangrove crabs (*Scylla* spp.) in the mangrove area of Jambu Beach, Pajo District, Dompu Regency, namely *Scylla* serrata, *Scylla* paramamosain, and *Scylla* tranquebarica, with S. serrata being the most dominant species across all stations. The highest abundance was found at Station 2, while the highest diversity and evenness indices were recorded at Station

3. These findings indicate that variations in environmental conditions, such as substrate type, temperature, soil pH, and salinity, influence the distribution and community structure of *Scylla* spp. in the study area. The results suggest that the mangrove ecosystem at Jambu Beach provides a suitable habitat for the growth and survival of mangrove crabs. Further studies covering broader temporal and spatial scales are recommended to better understand population dynamics and habitat preferences of *Scylla* species in mangrove ecosystems.

Data Availability Statement

The data included and used in this study is not confidential and is available upon request.

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Conflict of Interest

The authors declare no conflict of interest in the conduct of this study.

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Author Contribution

Nikman Azmin played a role in designing the research, determining the sampling locations and methods, and conducting field data collection at the three research stations. Nikman was also responsible for the identification of *Scylla* spp. species, processing data on diversity and abundance, and preparing the results and discussion sections. **M. Ekahidayatullah** contributed to developing the research concept, performing statistical analyses (including ANOVA tests), interpreting ecological aspects of environmental parameters, and integrating the research findings into the context of coastal resource management. In addition, he wrote the introduction, abstract, and conclusion sections, carried out overall manuscript revision, and served as the corresponding author during the publication process.

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