

Relationship Between Mangrove Density And Mud Crab Density (Scylla Serrata) In Tungkal Satu Tungkal Ilir Village Tanjung Jabung Barat

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Abstract— The mangrove area of Tungkal Satu Village is characterized by diverse habitats supporting various species, particularly mud crabs. This study aimed to determine mangrove species density, mud crab density, and the relationship between mangrove density and mud crab density, while also considering environmental parameters in the waters of Tungkal Satu Village. The research method employed purposive sampling at three points, with an initial survey to determine vegetation observation sites based on previously known characteristics or properties of the vegetation. The results revealed mangrove tree density ranging from 466 to 1,400 ind/ha, indicating sparse to dense coverage. Mud crab density ranged from 533 to 900 ind/ha. The relationship between mangrove density and mud crab density showed a positive correlation, represented by the linear equation $Y = 0.3728x + 342.4$, with a coefficient of determination of 0.9361 or 93.61%. This suggests that mangrove density significantly influences mud crab density.

Keywords— Environmental Parameters; Mangrove; Mud Crab; Tungkal Satu Village.

I. INTRODUCTION

Mangroves are plant communities or individual plant species that form communities in tidal areas. Mangrove forests, often called bakau forests, constitute a part of the coastal ecosystem with unique and distinctive characteristics, possessing rich biodiversity potential [1]. Mangrove forests also serve a dual function as protectors and supporters of coastal ecosystems. Mud crabs are one of the animal species inhabiting the mangrove ecosystem. The species of mud crabs found in Indonesian waters include the red mud crab (*Scylla olivacea*), purple mud crab (*Scylla tranquebarica*), green mud crab (*Scylla serrata*), and white mud crab (*Scylla paramamosian*) [2].

Tanjung Jabung Barat is one of the regions requiring mangroves due to its direct border with coastal areas. Tungkal Satu Village, in Tungkal Ilir District, Tanjung Jabung Barat Regency, is an area where mud crabs serve as an economic resource. Tungkal Satu Village has a large mangrove ecosystem area, resulting in a high population of mud crabs (*Scylla serrata*). However, the growth of the mangrove ecosystem is influenced by decomposer factors. The decomposition process is carried out by benthic biota, including mud crabs. Mud crabs are one of the primary decomposers in mangrove ecosystems. They play a role in breaking down litter from fallen mangrove leaves, thereby increasing organic matter on the soil surface. This interaction forms a dynamic unity in maintaining the balance and productivity of the mangrove ecosystem [3].

Changes in the coastline occurring in Tungkal Satu Village potentially cause a decrease in mangrove density in the area. Coastal abrasion erodes the land and accelerates seawater intrusion inland, disrupting mangrove growth. This phenomenon warrants investigation as these coastline changes consume existing mangrove areas. The remaining mangrove forest area in Pangkal Babu,

Tungkal Satu Village, is approximately 40 hectares. The Pangkal Babu mangrove forest is increasingly experiencing damage or land degradation due to human activities around the coast and other natural factors. The damage is caused by increased growth rates, which increase human dependence on mangrove lands in the region [4].

The reduction in mangrove forest area will affect the sustainability of mud crab resources because mangrove trees produce abundant natural food and serve as a medium for mud crab life development. Therefore, it is necessary to identify the relationship between mangrove density and mud crab density in the waters of Tungkal Satu Village, Tungkal Ilir, Tanjung Jabung Barat. Research by [5] states that the relationship (correlation) between mangrove density values and mud crab density yields positive results. This aligns with research by [6], which found that the abundance of mud crabs and fluctuations in their catch are influenced by habitat quality, specifically mangrove ecology.

The above issues indicate that mangrove trees have a significant influence on mud crab resources, where mangroves serve as habitat and provide natural food for crab life. Therefore, it is necessary to conduct research on the relationship between mangrove density and green tobacco crabs (*Scylla serrata*) located in Tungkal Satu Village, Ilir Tanjung Jabung Barat. This study aims to examine several aspects such as determining mangrove density, mud crab density, and analyzing the relationship between mangrove density and green mud crab density in Tungkal Satu Village.

II. RESEARCH METHOD

A. Description of the study sites

This research was conducted in the mangrove area of Tungkal Satu Village, Tungkal Ilir District, Tanjung Jabung Barat Regency in February 2024. Tungkal Satu Village is characterized by dense mangrove forests and active community engagement in harvesting fishery resources. Notably, mud crabs are frequently captured for personal consumption or commercial purposes. This factor was a key consideration in selecting the research location to investigate the relationship between mangrove density and mud crab (*Scylla serrata*) density in Tungkal Satu Village. The research location is illustrated in Figure 1.

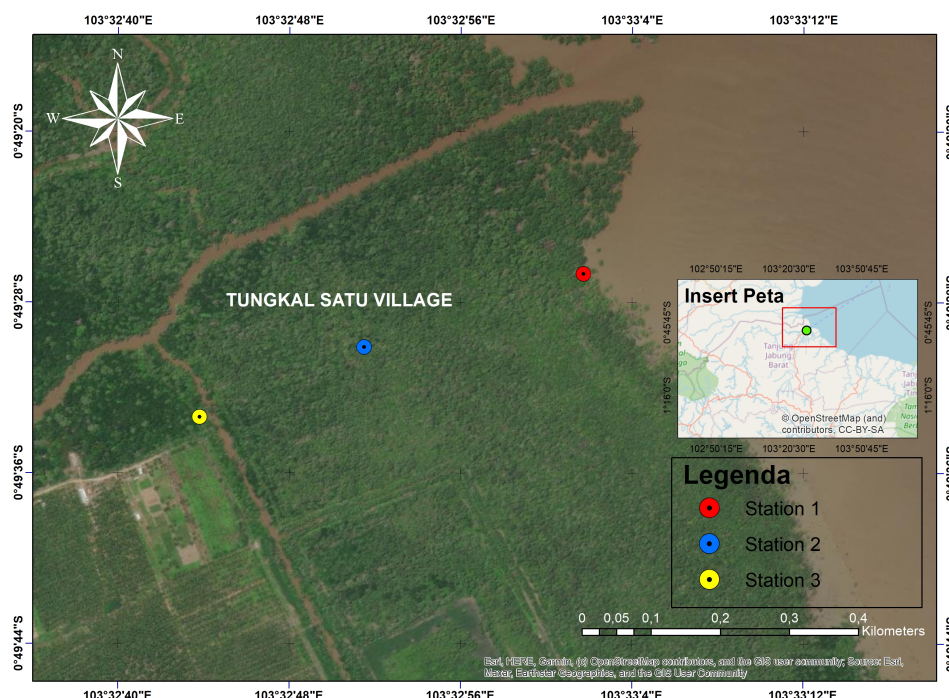


Figure 1. The location of Research, Tanjung Jabung Barat, Desa Tungkal Satu

B. Method Research

This research method employs purposive sampling at 3 research stations, preceded by an initial survey to determine vegetation observation sites based on previously known vegetation characteristics. Data collected in this study include both primary and secondary data. Primary data collection involves measuring water quality parameters, identifying mangrove species, and counting the number of mangrove crabs. Secondary data consists of tidal information, general conditions of the research location, and journal references.

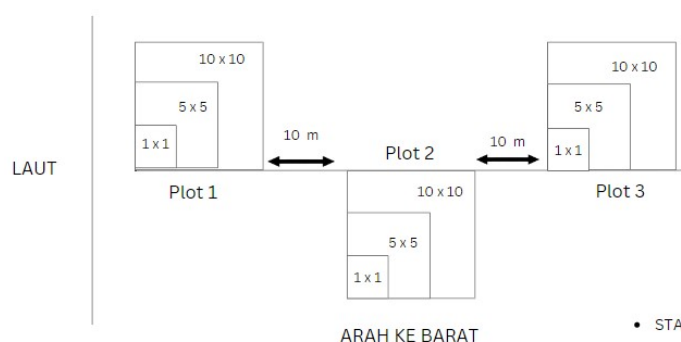


Figure 2. Mangrove Sampling Transect Plot at Each Station

Mangrove sampling at each station was conducted using zig-zag transects (line transect method) in figure 2. The line transect used consists of three plots with different areas and lengths: 100 m² (10 m x 10 m), 25 m² (5 m x 5 m), and 1 m² (1 m x 1 m). This line transect system was also used by [7] in their research, where the 10 m x 10 m plot was used to measure trees (diameter > 10 cm), 5 m x 5 m for the sapling/belta category (diameter 2-10 cm), and 1 m x 1 m for the seedling category (diameter < 2 cm).

The line intercept method is commonly used by ecologists to study mangrove communities. In this method, two points are first determined as the ends of the transect line. The length of the transect line can be 10 m, 25 m, 50 m, or 100 m. Transect lines are typically 1 cm wide. Along the transect line, segments are then marked that can be 1 m, 5 m, or 10 m in length. The zig-zag transect method was chosen because it is more practical and efficient for measuring mangrove stand density parameters in the field compared to the straight-line transect method with a length of 10 m. It also better captures the density of mangroves in a mangrove forest area.

To obtain samples of *Scylla serrata*, traps baited with mudskipper fish can be used. Five traps are placed in each plot. The traps are set during high tide and retrieved during low tide. The number of mud crabs caught in the traps is then counted. After counting and documenting, the mud crabs are returned to their natural habitat. Finally, the density of *Scylla serrata* is recorded in a logbook [7]

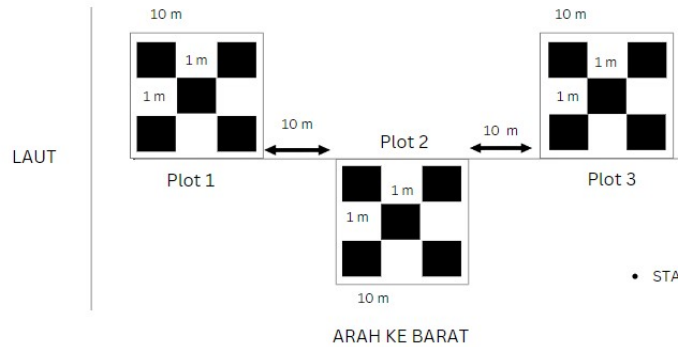


Figure 3. Transek of traps Location Plot

C. Analysis method of Mangrove Density and Mud Crab Density

The data analysis for this research is divided into two parts: mangrove data analysis and crab data analysis. For the mangrove data, the density and species of mangrove trees in each transect plot will be analyzed. The mud crab data analysis involves determining the density of the mud crab community. Subsequently, the relationship between mangrove density and mud crab density can be established.

The status of mangrove density is classified into five categories according to the criteria as shown in Table 3 below :

Table 1. Criteria for mangrove density in tree category [8]

Density (tree/ha)	Criteria
<500	Very low
>500 – 1000	Low
>1000 – 1500	Keep
>1500 – 2000	Dense
>2000	Very dense

According to the research conducted by [7], to determine the density value of mangrove species, the following formula can be used:

$$Di = \frac{\sum ni}{A}$$

Di : Density of mangrove species-i (ind/ha)

$\sum ni$: Number of individuals of species-I (ind)

A : Sampling area size (ha)

Analysis of mud crab density can be calculated using the formula by Krebs (1998) as follows :

$$d = \frac{x}{z \text{ (m}^2\text{)}}$$

d = Density

x = Number of individuals of the 1st species (ind)

z = Area of sampling site (m²)

D. Relationship between Mangrove Density and Mud Crab Density

To examine the relationship between two different variables (x and y), a simple regression model test is conducted. From the data on mangrove density and mud crab density, to determine the relationship between the two, the following formula is used:

$$Y = a + bx$$

y = Independent variable

x = Dependent variable

a = Constant

b = Regression coefficient (value of increase or decrease)

The relationship between mangrove density and mud crab density can be observed from the magnitude of the correlation coefficient (r) and the coefficient of determination (r^2). The coefficient value ranges from -1 to +1, with a negative sign (-) indicating a negative correlation and a positive sign (+) indicating a positive correlation. The coefficient of determination value ranges from 0 to 1. The coefficient of determination describes the extent to which the variation in the dependent index (y) can be explained by the independent index (x), while the correlation coefficient describes the strength of the relationship between the independent index and the dependent index in terms of the degree of relationship between variables. To interpret the value of the correlation coefficient, the following criteria [9] are used:

Table 2. Criteria for Coefficient Values

No.	R value	Interpretation
1.	0	There is no correlation between the two variables
2.	>0-0,25	Correlation is very weak
3.	>0,25-0,5	Sufficient correlation
4.	>0,5-0,75	Strong correlation
5.	>0,75-0,99	Correlation is very strong
6.	1	Perfect correlation

III. RESULT AND DISCUSSION

A. Environmental parameters

Water quality parameters are important factors to be measured and observed at the research location. The data of water quality parameters measured during field data collection can be seen in (Table 3).

Table 3. Physical-Chemical Parameters of Water

Parameter	St. 1	St.2	St.3
pH	6,80	7,6	7,75
Salinity (‰)	23	21,2	19
Temperature (°C)	28	29,8	31,5

The average pH obtained at the research location ranged from 6.80 to 7.75, as shown in Table 3. A pH range of 6.50 - 7.50 is considered suitable for mud crab growth [9]. Station 3 had the highest pH level at 7.75, while Station 1 had the lowest at 6.80. The growth rate of mud crabs (*Scylla serrata*) is influenced by pH through its ability to participate in physiological and biochemical processes, as well as its effect on gill structure and enzymes, thereby affecting oxygen consumption levels [10].

Observations showed that the average salinity at the research location ranged from 19 to 23 ‰. The highest salinity value was at Station 1 and the lowest at Station 3. The high salinity values at Stations 1 and 2 were due to their location further from the river mouth. Station 3, being closer to the river mouth, had more freshwater mixing, resulting in lower salinity. This is consistent with [11], which states that the mixing of river and sea water can cause a decrease in salinity.

The temperature obtained at the research location ranged from 29.8 to 31.6°C, as shown in Table 3. The temperature at Station 2 was lower than at other stations due to measurements being taken in the morning, while temperatures at Stations 1 and 3 were higher as measurements were taken during the day. Mud crabs thrive in moderate water temperatures, which aligns with [10], stating that the optimal temperature range for mud crab life cycles is 25 - 35°C.

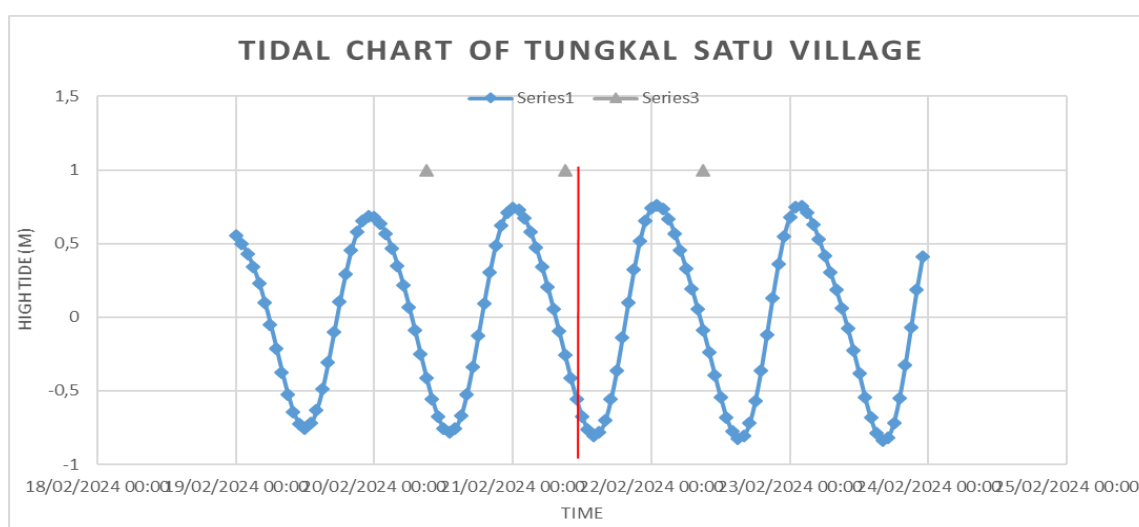


Figure 3. Tidal of Tungkal Satu Village

Observations by [12] show that the tidal type in Kuala Tungkal waters is predominantly semi-diurnal, experiencing two high tides and two low tides within 24 hours. The mangrove area of Tungkal Satu Village has a tidal period of 6 hours of high tide and 6 hours of low tide. The red vertical lines on the graph above indicate the operational times at each station. Tidal fluctuations influence mud crab density. [13] states that mud crabs enter and exit mangrove habitats usually in conjunction with tidal current mechanisms. This can affect the number of individuals found at each capture station.

B. Density of Mangrove Species

Based on research conducted in Tungkal Satu Village, five different mangrove species were found: *Avicennia marina*; *Rhizophora mucronata*; *Rhizophora apiculata*; *Sonneratia alba*; and *Kandelia candel*.

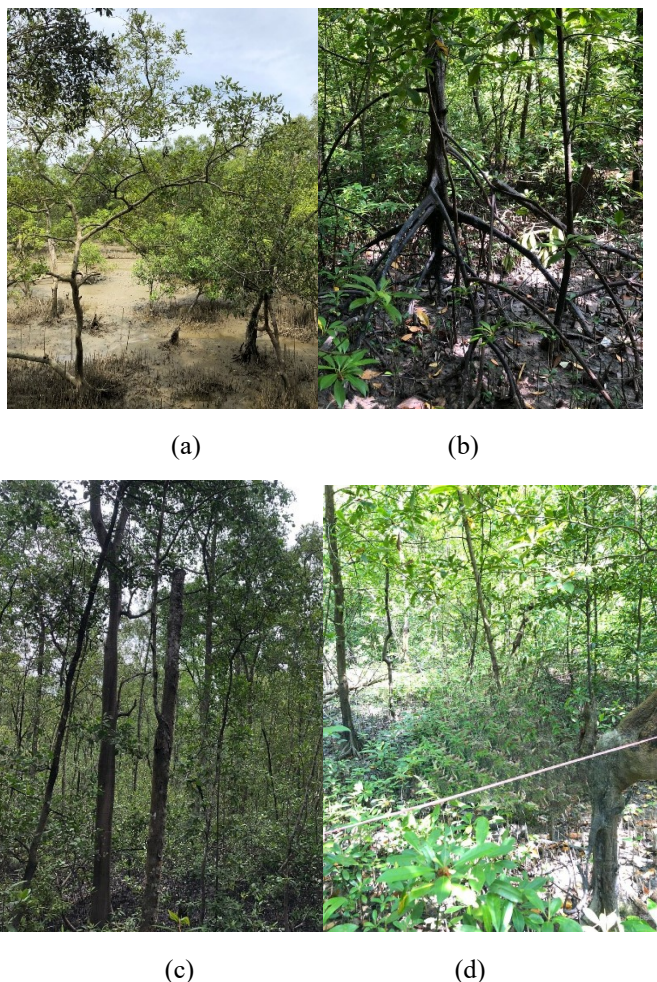


Figure 5. Types of Mangrove Found

(a) *Avicennia Marina* (b) *Rhizophora mucronata* (c) *Sonneratia alba* (d) *Kandelia candel*.

Observations also showed that *Avicennia marina* was found at each station due to its ability to adapt to environments with high and varied salinity and temperature levels [14]. *Rhizophora mucronata* and *Rhizophora apiculata*, belonging to the genus *Rhizophora*, are characterized by distinctive prop roots that help support them in their sedimentary environment. *Sonneratia alba* is often found in the outermost zone of mangrove forests facing the sea directly. This species can grow in more open environments exposed to sea waves. *Kandelia candel* is more commonly found in slightly more inland areas of mangrove forests, growing in environments more protected from sea waves. This explains why this mangrove species was only found at Station 2, located in the middle of the mangrove forest.

To determine the density of mangrove trees at each research station, it was necessary to identify the number of individuals of each mangrove species observed. This identification process involved direct field observations, where recordings were made in predetermined observation plots. Subsequently, these mangrove species were classified based on their vegetation level: seedlings,

saplings, and trees. This classification is important for understanding the structure and population dynamics of mangroves in the research area. Seedlings are mangrove offspring less than 1 m tall, saplings are young mangroves between 1-3 m tall or with stem diameters less than 10 cm, while trees are taller than 3 m or have stem diameters greater than 10 cm. The observation results showing the number of individuals from each vegetation level of mangroves at the three observation stations can be seen in Figure 6 below.

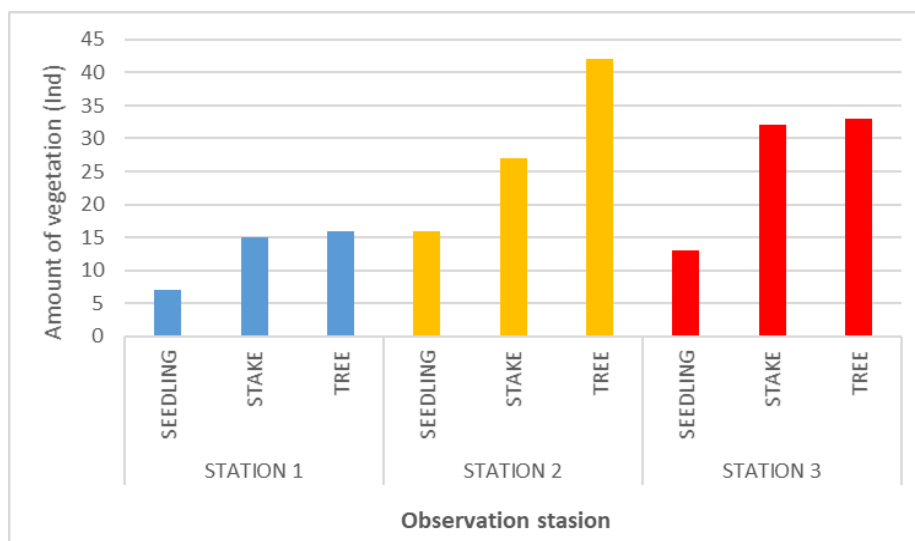


Figure 6. Graph of Mangrove Vegetation Composition in Tungkal Satu Village

Station 1, located on the beach edge, had the fewest mangrove seedlings compared to Stations 2 and 3. This is due to its location directly facing the high-wave sea, making it difficult for seedlings to grow. Conversely, Station 2 showed the highest levels of seedlings and trees, dominated by *Kandelia candel* for the seedling category and *Rhizophora mucronata* for the tree category. Meanwhile, Station 3 was dominated by *Sonneratia alba*. [15] The presence of more seedlings than saplings and trees indicates good mangrove forest regeneration. For the mangrove sapling category, Station 3 had the highest value, dominated by *Sonneratia alba*. At Stations 1 and 2, the sapling category was dominated by *Avicennia marina*. In the tree category, Station 2 also dominated due to its location near the mainland and protection from illegal logging, with *Rhizophora mucronata* being dominant. At Stations 1 and 3, the tree category was dominated by *Avicennia marina* and *Sonneratia alba*, respectively.

The density of mangrove trees at the research location ranged from 466 ind/ha to 1400 ind/ha. The highest density was at Station 2 with a value of 1400 ind/ha. *Rhizophora mucronata* was the dominant mangrove species with 29 individuals. The lowest density was at Station 1 with a value of 566 ind/ha. Table 4 will explain the overall density values.

Table 4. Species Density Value in Mangrove Forest, Tungkal Satu Village, Tungkal Ilir District, Regency Tanjung Jabung Barat

St.	Seedling (ind/ha)	Stake (ind/ha)	Tree (ind/ha)	Criteria for Mangrove tree density [8] (ind/ha)
1	23.333	2000	466	rendah
2	53.333	3600	1400	sedang
3	43.333	4266	1100	sedang

C. Mud Crab Density (*Scylla serrata*)

The analysis of mud crab density showed that the total density of mud crabs during observations conducted in February 2024 ranged from 0.053 to 0.09 ind/m² or 533-900 ind/ha. The highest density was found at Station 2 with a value of 900 ind/ha, while Station 3 had a density of 700 ind/ha. Station 1 had the lowest density with 533 ind/ha. This is due to the station's location on the beach edge with low mangrove density. Station 2, which had the highest crab density, is attributed to environmental conditions favorable for mud crab growth and habitat. The density of mud crabs (*Scylla serrata*) found during the study can be seen in Figure 7.

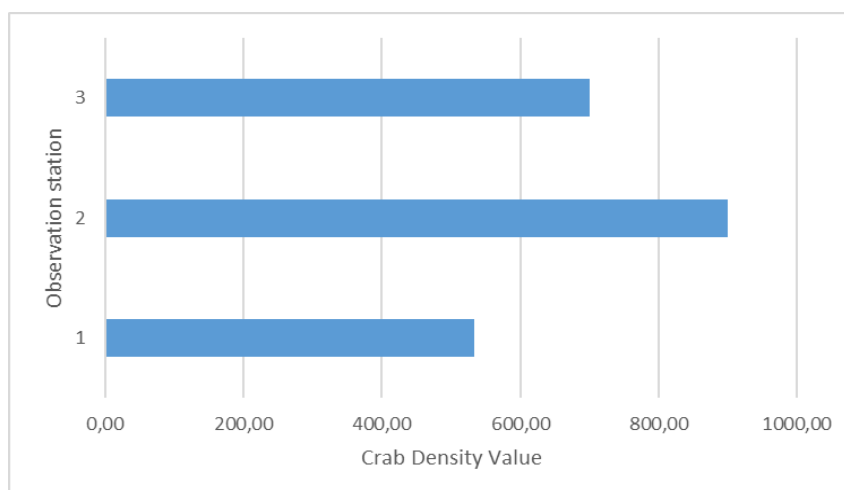


Figure 7. Mud Crab Density Graph

From the observations of mud crab (*Scylla serrata*) density, it can be seen that high density results were found in research locations with high mangrove density as well. [16] Mud crab density can be influenced by mangrove density and distance from human settlements. The relationship between mud crab density and mangrove density exists because mud crabs usually stay in the same place but do not always return to the same spot, sometimes moving between nearby locations. The mangrove ecosystem also functions as a source of organic matter and other natural food needed by mud crabs [17]. Therefore, these statements can explain that the density values obtained in this observation illustrate the relationship between mangrove density and the density of mud crabs (*Scylla serrata*) living as one of the aquatic biota in the mangrove area of Tungkal Satu Village, Tungkal Ilir, Tanjung Jabung Barat.

D. Relationship between mangrove density and mud crab density

Station 1 has a sparse mangrove forest density and is located on the beach edge, resulting in fewer mud crabs compared to Station 2. This causes mud crabs to seek locations with natural food supplies for their growth and survival. [18] states that sparse mangrove forests can cause mud crabs to seek other locations with better natural food supplies.

Station 2 has a moderate mangrove forest density with a value of 1400 ind/ha, located in a former pond area with abundant litter, resulting in many mud crabs and mangroves found at this station. Station 2 also has environmental characteristics suitable for mud crab and mangrove life, making it preferred by mud crabs due to its moderate mangrove density and optimal environmental conditions. [19] Higher mangrove vegetation provides more protection and food sources for mud crabs.

Station 3 also has a moderate mangrove density with a value of 1100 ind/ha. The increased mangrove density at Station 3 can influence the high mud crab density results. However, Station 3 has lower density results than Station 2. This is not only influenced by the lower density value compared to Station 2 but also due to the presence of river estuary waters and proximity to residential

areas. Research by [19] also states that river estuaries can affect mud crab individual density by disrupting their habitat. More complex environmental conditions can influence lower mud crab individual density.

Analysis of the relationship between mangrove density and mud crab density is presented in simple linear regression. The aim is to determine the correlation level between two variables. Variable X represents mangrove tree density, and variable Y represents mud crab density.

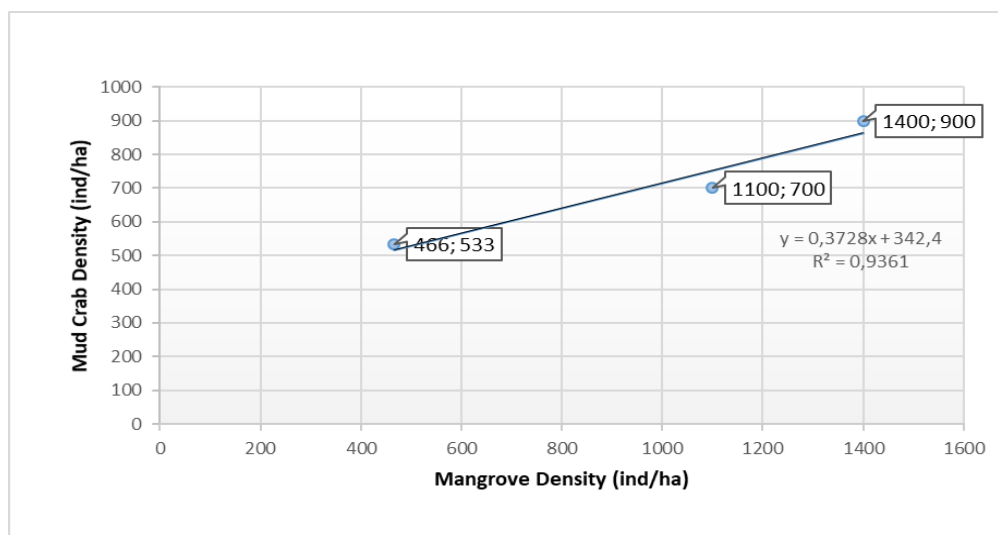


Figure 7. Regression Graph of the Relationship between tree-level mangrove density and Mud Crabs Density

Based on the graph above, the relationship between mangrove tree density and mud crab density shows a positive correlation, indicated by the linear equation $Y = 0.3728x + 342.4$ with an R-squared value of 0.9361 or 93.61%, with the remainder attributed to other variables such as observed environmental parameters. Based on the correlation relationship criteria, an r-value of 0.9361 indicates a very strong correlation. This is supported by research from [5], which states that the correlation between crab density and mangrove density shows that the higher the mangrove density value, the higher the mud crab density value obtained.

Table 5. Data values of Mud Crabs Density (ind/ha) and Mangrove Tree Density (ind/ha)

Station	Mud crabs density (ind/ha)	Tree Density (ind/ha)
1	533	466
2	900	1400
3	700	1100

Fallen mangrove leaves can become food for animals and will mostly undergo partial or complete decomposition by microorganisms and bacteria. The higher the litter production, the higher the productivity in mangrove forests [20]. Mud crabs (*Scylla serrata*) are one of the genera of animals that decompose organic matter in mangrove ecosystems. [7] explains that the habitat characteristics of mud crabs greatly influence how mud crabs are distributed in that habitat.

V. CONCLUSION

Research results show that five different mangrove species were found at the research stations in Tungkal Satu Village: *Rhizophora mucronata*, *Rhizophora apiculata*, *Sonneratia alba*, *Avicennia marina*, and *Kandelia candel*. The most abundant mangrove species found was *Rhizophora mucronata* with 29 individuals. Station 2 had the highest mangrove density of 1400

ind/ha, which is considered moderate. Station 2 also showed the highest mud crab density. There is a positive correlation between mangrove density and mud crab density, with a linear equation of $Y = 0.3728x + 342.4$ and a determination coefficient of 0.9361 (93.61%). These regression results indicate that mangrove density and mud crab (*Scylla serrata*) density in Tungkal Satu Village, Tungkal Ilir, Tanjung Jabung Barat, are strongly related.

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