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Mangrove ecosystem in North Sumatran (Indonesia) forests serves as a suitable habitat for mud crabs (*Scylla serrata* and *S. olivacea*)

RIKA KARNIATI[1], NURDIN SULISTIYONO[1,2], RIZKA AMELIA[1], BEJO SLAMET[1,2], YUNTHA BIMANTARA[1], MOHAMMAD BASYUNI[1,2]♥

[1]Department of Forestry, Faculty of Forestry, University of Sumatera Utara. Jl. Tri Dharma Ujung No. 1 Kampus USU Medan, Medan 20155, North Sumatra, Indonesia. Tel./fax.: +62-61-8201920, ♥email: m.basyuni@usu.ac.id
[2]Center of Excellence for Mangrove, University of Sumatera Utara. Medan 20155, North Sumatra, Indonesia

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Abstract. *Karniati R, Sulistiyono N, Amelia R, Slamet B, Bimantara Y, Basyuni M. 2021. Mangrove ecosystem in North Sumatran (Indonesia) forests serves as a suitable habitat for mud crabs (*Scylla serrata *and* S. olivacea*). Biodiversitas 22: 1489-1496.* Mud crabs (*Scylla serrata* and *Scylla olivacea*) are often found in muddy substrates associated with mangrove vegetation. The habitat of these crabs ranges from tropical estuaries to sheltered subtropical areas, riverbanks, lower river traits, and intertidal areas. These crabs have an important economic value, and it increases the income of the communities living around the mangrove area. This study aims to obtain more information on the environmental factors of habitat for mud crabs (*S. serrata* and *S. olivacea*): insights on the effects of abiotic and biotic factors and potential economic value, in the village of Lubuk Kertang, Langkat, North Sumatra, Indonesia. Data were collected by measuring abiotic factors (temperature, pH, salinity, dissolved oxygen, mud depth, distance from the river) and biotic factors (mangrove stand density through canopy cover). The dataset was analyzed using a binary logistic regression analysis with a stepwise method. Results showed that the abiotic factors that contributed to the presence of the mud crab were dissolved oxygen and a mud depth of 68.7%. Meanwhile, the remaining 31.3% that contributed to the presence of mud crabs were abiotic factors (temperature, pH, salinity, distance from rivers) and biotic factors (stand density through canopy cover). The present study suggests that dissolved oxygen and mud depth have an important function in predicting the presence of mud crabs.

Keywords: Abiotic and biotic factors, crab density, dissolved oxygen, mangrove forest, mud depth

INTRODUCTION

Mangroves are well-known in tropical and subtropical zones. They support a wide range of ecosystem services that provide spawning habitat and a food supply for many marine animals, including fish, shrimp, uca-uca crabs, rock crabs, and mud crabs (Wilson 1989; Lee 1998; Murdiyarso et al. 2015; Basyuni et al. 2018; Fitri et al. 2018; Salim et al. 2018; Fawwaz et al. 2019). Mud crabs generally inhabit muddy estuaries and embankments in mangrove ecosystems affected by tidal waves of seawater (Bir et al. 2020; Quinitio 2017). Therefore, environmental changes may affect the carrying capacity of the habitat and deplete the mud crab population (Indarjo et al. 2020).

Mud crabs are a very important fishery resource for local communities with commercial value in the form of demand and prices in the international market, as well as a fairly high growth rate of health. Mud crabs of *Scylla serrata*, *S. paramamosain*, *S. olivacea*, and *S. tranquebarica* are especially popular throughout the tropical and subtropical zones of the Pacific and Indian Ocean (Glaser and Diele 2004; Dan and Hamasaki 2014; Mirera and Mos 2014). This *Scylla* species of mud crab is in great demand as a quality food ingredient because of its size, nutritional content, and softness (Azra and Ikhwanuddin 2016). In addition, the sarasin contained in mud crabs is used as a therapeutic or prophylactic agent for disease control and health management (Anju et al. 2019).

The need for mud crabs arises from catches in nature, the frequency/amount of which mostly fluctuates. According to Tetelepta et al. (2020), the high demand for mud crab, both in the village of Lubuk Kertang and elsewhere, has a significant impact on the natural population of mud crabs. It has been reported that molting mud crab has been developed in Lubuk Kertang as a mangrove ecosystem service (Basyuni et al. 2020). Mud crabs were also cultivated for many years in Asia, mainly based on the capture and fattening of juveniles from the wild, particularly in Southeast Asia where production is rapidly increasing (Petersen et al. 2013; Hungria et al. 2017). Given the importance of mud crabs, this study was aimed to obtain further insight into the factors influencing the presence of mud crabs (*S. serrata* and *S. olivacea*), as well as their potential economic value in the village of Lubuk Kertang, Langkat, North Sumatra, Indonesia. Thus, it is expected that the results of this study can provide considerable information about the factors affecting growth as well as the potential economic value that can be used as a reference in the cultivation of mud crabs.

MATERIALS AND METHODS

Study area

The study was carried out in the mangrove forest of Lubuk Kertang Village, Brandan Barat Sub-district, Langkat District, North Sumatra Province, Indonesia, which has an area of around 1200 ha. The village of Lubuk Kertang is situated at 04º02'34.25"- 04º05'27.11" N, and between 98º14'57.92"- 98º18'37.87" E. In the restored mangroves, the sampling locations were conducted to collect mud crabs as shown in Figure 1.

The investigated mangrove forest was found by seven families and 16 species: from the Rhizophoraceae family: *Rhizophora apiculata*, *R. mucronata*, *Bruguiera gymnorrhiza*, *B. sexangula*, and *Ceriops tagal*; from the Acanthaceae family: *Avicennia marina*, *A. lanata*, *A. officinalis*, and *Acanthus ilicifolius*; Combretaceae consisted of *Lumnitzera racemosa* and *L. littorea*. Moreover, *Excoecaria agallocha* (Euphorbiaceae), *Scyphiphora hydrophyllacea* (Rubiaceae), *Sonneratia caseolaris*, and S. *alba* (Sonneratiaceae) and *Xylocarpus granatum* (Meliaceae) were detected. It was crossed by the Lubuk Kertang and Tanjung Balai rivers.

Data collection and analysis

Data were collected in May-June 2018 with a purposive sampling method by making a plot measuring 5 × 5 m (25 m^2) in the mangrove area and as many as 71 plots (Figure 1). In each plot, abiotic factors (water temperature, pH, salinity, dissolved oxygen, depth of mud, distance of river plot points, and number of potential burrows presented on the tally sheet) and biotic factors (canopy cover) were measured to determine the density of crabs recorded with the number of crabs found through the crab traps installed in each plot. Observations for abiotic factors were carried out in the morning at low tide and when the sea waves were receding according to Ulfa (2017). Data collection on mangrove vegetation density was carried out on each measurement plot using the canopy cover application in JPG format.

Multicollinearity test and regression analysis

The multicollinearity test aims to determine whether there is a relationship among the independent variables, namely temperature, pH, salinity, dissolved oxygen, mud depth, rivers, and canopy cover (Yoo et al. 2014). In a good regression model, there should be no correlation among the independent variables.

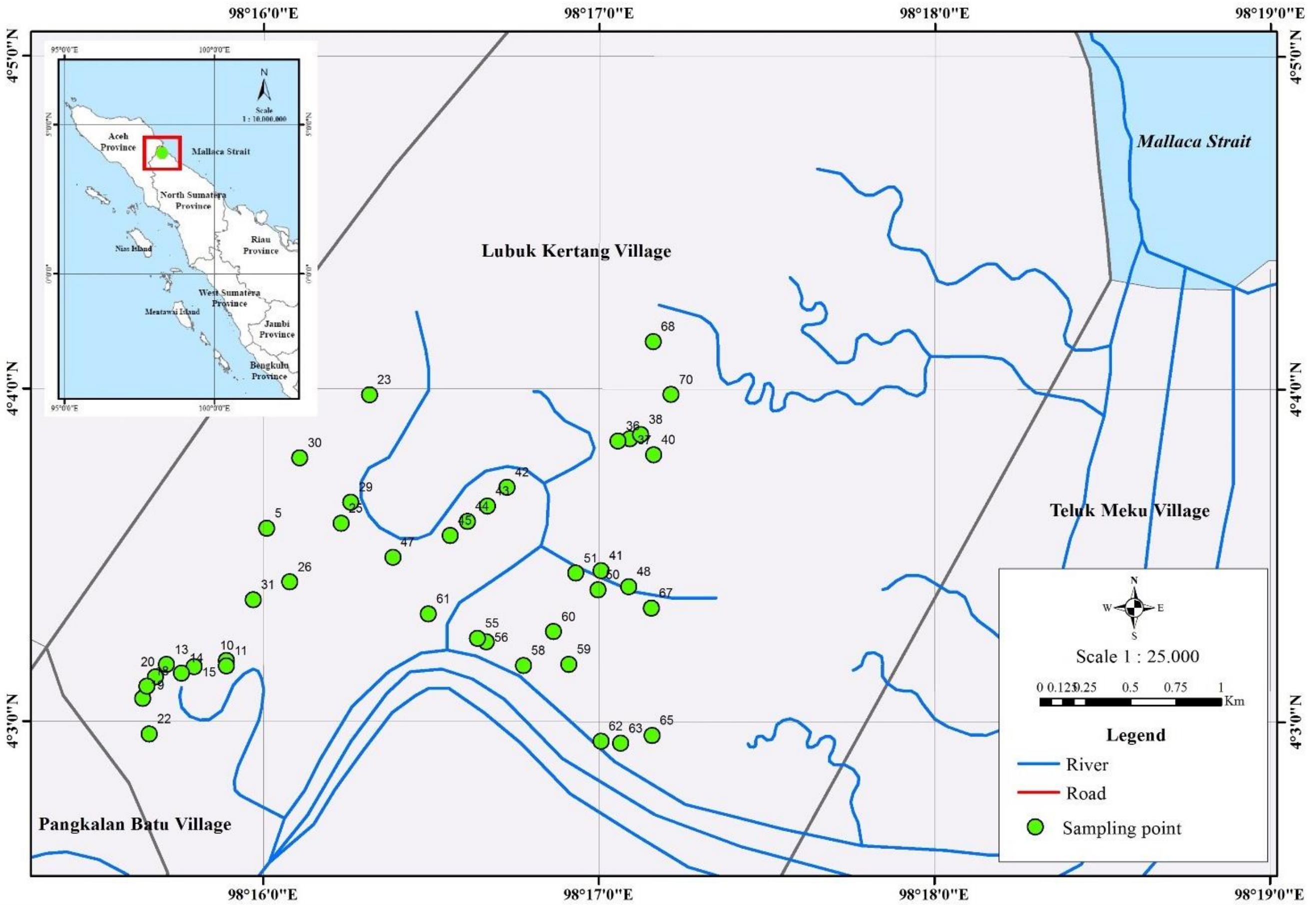

Figure 1. Sampling area showing the mangrove forest located near Lubuk Kertang village, Brandan Barat Sub-district, Langkat District, North Sumatra, Indonesia

A binary stepwise logistic regression analysis (Archer et al. 2007) was performed to determine the factors influencing the presence of mangrove crabs. The factors acting as independent variables are dissolved oxygen, sludge depth, salinity, pH, temperature, and canopy cover, while the dependent variable is the presence or absence of mud crabs. The analysis used in this research is binary logistic regression analysis using the stepwise method. In general, the binary logistic regression equation can be formulated by Archer et al. (2007) as follows:

$$Y=\frac{\text{Exp}\,(a+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+B_7X_7)}{1+\text{Exp}\,(a+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+B_6X_6+B_7X_7)} \quad (1)$$

Where: Y: dependent variable (0: mangrove crab not existing; 1: mangrove crab existing); Exp: 2,72; a: constant; B: coeficient; X: independent variable (X_1: temperature (°C); X_2: pH; X_3: salinity (‰); X_4: dissolved oxygen (mg/L); X_5: mud depth (cm); X_6: river (m); X_7: canopy cover (%).

Model validation

The results of the probability of mud crab existence were compiled based on a binary logistic regression model using the method of Hosmer et al. (2013), where $p > 0.05$ was accepted at H_0. The logistic regression model was able to explain the data and there was no difference between the model and its observation value. This shows that the logistic regression equation can be used to explain the relationship between the independent and the dependent variable. Meanwhile, for $p < 0.05$ to be rejected at H_0, the logistic regression model must be unable to explain the data and there would be a difference between the model and its observation value.

On the other hand, model validation testing was conducted using the Wilcoxon statistical test by looking at the Z-value and the p-value (Asymp. Sig. 2-tailed). Model validation was performed to determine the accuracy of the presence of mud crab. The Z-value and p-value (Asymp. Sig. 2-tailed) can provide a hypothesis decision on data testing. Validation is done by comparing actual data with data on the alleged presence of mud crabs. The validation value of the existence of mud crab was determined with the formula below (Ghazali 2009):

$$V=\frac{n}{N}\times 100\ \% \quad (2)$$

Where: V: actual percentage (validation); n: the number of match points between the actual data and the estimated data; N: the total number of validation points for the presence of mud crab.

Potential economic value of mangrove crabs

To find out the calculation of the economic potential value of mud crabs, each mud crab found in the measurement plot was weighed to determine the weight and category (Figure 2), because the weight and category of mud crabs determine the price at which the fishermen will sell them to the nearest agent (Basyuni et al. 2020). In Lubuk Kertang village, there are six categories of mangrove crabs that are commonly traded: pete (weight 30-50 gr, price IDR 18000/kg for nursery purposes), ceka/ashoka crab category (weight 80-100 gr, price IDR 35000/kg for sales purposes until the shell becomes hard), category A1 (weight 100-350 gr, price IDR 65000/kg), category AA (weight 350-500 gr, price IDR 80000/kg), category A Super (weight 500-1000 gr, price IDR 115000/kg), and female crabs laying eggs (weight 250 gr, price IDR 90000-150000). The economic potential value of mud crabs was calculated using the following formula (Cahyadinata et al. 2019):

$$\text{PNEKB}=\frac{\text{KKB}\times\text{LHM}\times\text{HJKB}}{\text{BK}} \quad (3)$$

Where: PNEKB: potential economic value of mud crab (IDR); KKB: density of mud crab (individual/Ha); LHM: extensive mangrove forest (Ha); BK: weight of mud crab (individual/kg); HJKB: market price of mud crab (IDR/kg).

RESULTS AND DISCUSSION

In the study area, with 71 measuring plots made, two species of mud crabs were found, namely green mangrove crabs (*S. serrata*) and red mud crabs (*S. olivacea*). As many as 57 plots showed the presence of mud crabs caught in crab installation. The remaining 14 plots did not show the presence of mud crabs.

Mud crabs and measured abiotic and biotic factors

Mud crabs and measured abiotic and biotic factors crabs belonging to the species *S. serrata* and *S. olivacea* were collected. Mud crabs were 120 in number, found in 57 plots; no crabs were detected in 14 plots. The number of crabs found per plot ranged from 0 to 5 (maximum number of crabs found per plot), with a mean number of 2.1. Mud crabs of the species *S. serrata* was found to be 84 in number, with crab density 0.0473 individual/m^2 or 478.6 individual/ha. Meanwhile, *S. olivacea* mud crabs were 36 in number, with crab density 0.0205 individual/m^2 or 205.13 individual/ha. This finding showed lower density compared to the study of Ulfa (2017), on the rehabilitated mangrove areas in Langsa, Aceh, where it was 3.35-3.65 individual/m^2 and 1.48 individual/m^2 on degraded mangrove areas.

Table 1 summarises the measured abiotic and biotic factors. The environment of mangrove forests indicates a natural-resource environment that is suitable for mud crabs. The development of mud crab aquasilviculture was done by analyzing each observation plot. Data were collected from 71 plots (pertaining to temperature, pH, salinity, dissolved oxygen, mud depth, a distance of the river plot point, the number of potential burrows).

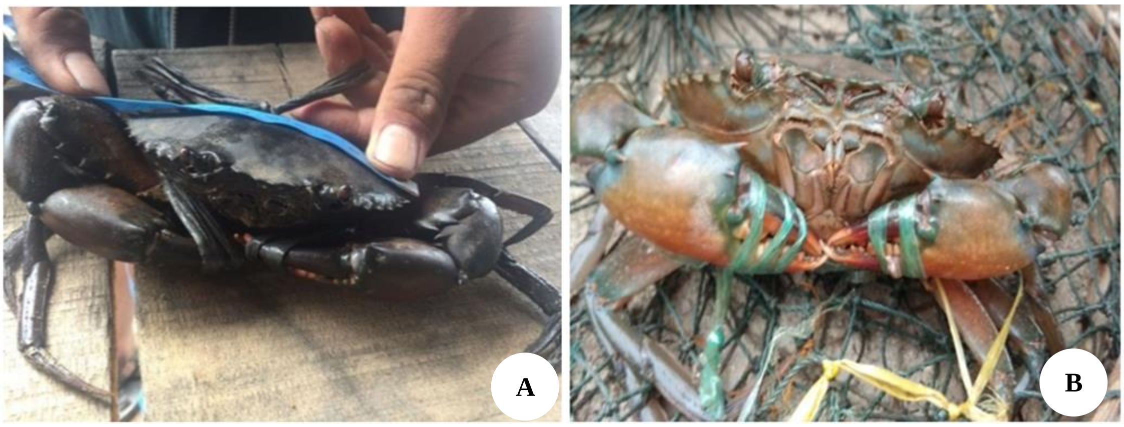

Figure 2. A. Green mud crab (*Scylla serrata*); B. red mud crab (*Scylla olivacea*)

Table 1. Minimum value (Min), maximum value (Max), mean and standard deviation of the measured abiotic and biotic factors

Parameter	Min	Max	Mean	Std. Deviation
Temperature (˚C)	26.50	34.57	30.18	1.84
pH	6.57	7.43	6.95	0.27
Salinity (%)	21.67	32.33	25.69	2.95
Dissolved oxygen (mg/l)	4.7	8.03	6.52	1.22
Depth of mud (cm)	28.33	233.67	121.85	52.29
Distance from the river (m)	0.00	215.60	215.6	27.92
Canopy Cover (%)	6.4	93.70	64.10	51.51
Potential burrows	0.00	5.00	1.65	1.29

pH

The lowest pH was 6.57 and the highest was 7.43, with an average value of 6.99. The optimal pH for crab growth ranges from 7 to 9 (FAO 2011; Hastuti et al. 2019b). Thus, the pH range recorded at the research location can be considered suitable for mud crabs. Very alkaline or very acidic pH conditions would be dangerous for these crabs' survival because they would cause metabolic disorders and respiration problems.

Temperature

The lowest recorded temperature was 26.50 °C and the highest temperature was 34.57 °C, with an average of 30.05 °C. The measured temperature range can be considered a good range for the growth of mud crabs, since, according to Hastuti et al. (2019b), the suitable temperature for the growth of mud crabs is 25-35°C. If the temperature increases too much, higher evaporation rates will dry the mud substrate. This circumstance makes it difficult for the mud crabs to mate and molt, eventually leading to their death. For instance, this can occur in areas with a large number of human activities that use ships as a means of transportation, or in areas where the natural ecosystems are converted to ship harbors (the substrate becomes artificial and heats up more easily).

Salinity

The lowest recorded salinity was 21.67 ‰ and the highest was 32.33 ‰, with an average of 25.30 ‰. According to Hastuti et al. (2019b) and FAO (2011), a good salinity range for mud crabs' growth is 21-25 ppt and 25-35 ppt, respectively. Thus, the salinity range measured at the research location is suitable for mud crabs. In a previous study on three species of mud crabs, *Scylla serrata* was found to be able to tolerate a wide salinity range (Parado-Estepa and Quinitio 2011).

Dissolved oxygen (DO)

The lowest measured DO was 4.7 mg/L and the highest was 8.03 mg/L, with an average value of 6.52 mg/L. According to Hastuti et al. (2019b), mud crabs can grow well with a DO range of 6-6,8 mg/L. According to FAO (2011), DO values higher than 5 mg/L are needed for the growth of mud crabs. DO in the water supports the breathing processes of the biota that lives in it. If the DO is too high (supersaturation), it can have negative consequences for the organisms, such as gas bubble disease in certain fish.

Therefore, the DO should be neither too low nor too high. Oxygen consumption is one of the factors affecting the mud crab juveniles. The amount of oxygen consumed by mud crab juveniles represents a measure of its metabolic rate and it can be used to study the effect of environmental conditions on mud crab juveniles' metabolism (Ikhwanuddin et al. 2015). Growth and survival rate of mud crabs are greatly affected by water temperature which is closely related to concentration of DO in water (Hastuti et al. 2019a), optimum salinity (Ruscoe et al. 2004), season, maturity, and food availability (Siahainenia et al. 2016; Li et al. 2007).

Mud depth

The lowest measured mud depth was 28.33 cm and the highest was 233.67 cm, with an average of 121.85 cm. Since mud crab density is significantly correlated with burrow density (Ulfa 2017), an area with a mud substrate with a good level of inundation, and a sufficient number of natural foods, is a preferred habitat for mangrove crabs. Burrows can be up to 2 m long and are used as a general shelter by both adult and juvenile mud crabs, especially when they are in the delicate soft-skin stage of the molt cycle and during mating (Morrisey et al. 1999).

Distance from the river

Mud crabs live better if they are close to rivers and well-preserved mangrove forests (Numbere 2018). The crabs eat mangrove leaves, thereby contributing to litter fall, which help to enrich the mangrove soil which can increase oxygen availability (Bir et al. 2020). Adult mud crabs can survive in salinity as low as 10 ppt (Hastuti 2019b), whereas small crabs have been found in estuaries, tidal plains, and mangroves where they live in mud or sand, and other shaded areas during the day (Quinitio et al. 2017); burrowing mud crabs display different movement patterns from those of crabs living in subtidal creeks. Smaller crabs (100-149 mm CW) are hardly found in burrows and inhabit subtidal waters only at low tide and move into the intertidal zone at high tide with peak abundances from spring to autumn (Hubatsch et al. 2015)

Stand density (canopy cover)

The lowest measured stand density (measured as canopy cover) was 6.4% and the highest was 93.7%, with an average of 64.10%. Stand density affects the presence of crabs because it is directly proportional to the number of leaves that are produced and fall on the forest floor. Mud crabs act as litter shredder and breaker, decreasing the size of the litter that becomes available to microbial organisms. Microbial communities carry out advanced decomposition functions to produce organic matter and nutrients in the ecosystem. This relationship maintains the ecosystem balance. In addition, it also ensures the sustainability of the food chain and energy flow in the mangrove ecosystem. Mud crabs prefer mangrove trees that have thick, dense roots and grow on soft substrates (Unthari et al. 2018). The availability of shaded areas is considered a very important factor for the survival and growth of mud crabs both in the wild and in aquaculture ponds (Mirera and Moksnes 2014).

Potential burrows

The lowest number of potential burrows was 0 and the highest was 5, with an average number of 2. Potential burrows are used by mud crabs to immerse and defend themselves, to stay cool during low tide, protecting themselves from predators and extreme environmental conditions (Agusto et al. 2020). The mothers of the mud crabs go to the sea or coastal areas with high salinity and release the eggs; therefore, they do not gather and raise the young. The life cycle of mud crabs has been described by Hubatsch et al. (2015). In contrast to sesarmid and fiddler crabs, the potential burrow is also used by the mother to gather and raise her young; they can also use them for food storage, usually in the form of leaf litter and propagules (Andreetta et al. 2014). Ulfa (2017) reported that crab density was significantly correlated with burrow density and significantly higher in the two rehabilitation locations. Some mud crabs were also detected in intertidal areas where low tide burrows are occasionally occupied. Female crabs would rather be buried in the mud than seek shelter in burrows; therefore, the majority of crabs occurred in burrows were males (Hubatsch et al. 2015).

Multicollinearity test

The results of the multicollinearity test (Table 2) showed that the tolerance value of each independent variable was > 0.10, which means that there is no correlation between the independent variables. The VIF value of each independent variable was < 10.00, which means that there is no correlation between the independent variables. The multicollinearity test showed that the considered variables are not correlated; therefore, they can be used in the stepwise logistic regression analysis to investigate which of these variables explain the existence of mud crabs in the study area.

Factors that influence the existence of mud crabs, using binary stepwise logistic regression

The results of testing the feasibility of the model using the Hosmer and Lemeshow test depicted a chi-square value of 0.00 with a probability value of 1.00 (> 0.05). The model was feasible (accept H_0) which is the resulting model to explain the data. Therefore, the existing model of mud crab was feasible.

Table 2. Multicollinearity test for the considered independent variables

Model	Tolerance	VIF
Temperature	0,57	1,72
pH	0,78	1,26
Salinity	0,73	1,35
Dissolved oxysigen	0,53	1,86
Depth of mud	0,71	1,40
Distance from river	0,95	1,04
Canopy cover	0,75	1,31

VIF: variance inflation factors

Table 3. Partial test and model formation

Predictor	B	S.E.	Wald	Df	Sig.	Exp(B)
Constant	-6607,51	110053,56	0.004	1	0,95	0,00
Dissolved oxysigen	983,89	16399,21	0.004	1	0,95	.
Depth of mud	6,78	112,47	0.004	1	0,95	882.21

B: beta coefficient, SE: standard error, Exp (B): odds ratio, Df: degree of freedom

Based on Table 3, the stepwise logistic regression analysis selected the dissolved oxygen and mud thickness as the best predictors (independent variables) for the presence of mud crabs in the study area. The probability of the presence of mud crab in areas that have high dissolved oxygen and high mud thickness will be predicted by the model as an area with a high probability of mangrove crab presence. Areas with low dissolved oxygen and low mud depths will be predicted by the model as areas with a low probability of mud crab presence.

The dissolved oxygen and the depth of the mud are directly proportional to the chance of the presence of mangrove crabs, which indicates the presence of more mangrove crabs. The chances of the presence of mud crab in areas that have high dissolved oxygen and high mud thickness will be predicted by the model as an area with a high chance of the presence of mangrove crabs.

The presence of mud crabs is directly related to the thickness of the mud, indicating that the presence of mangrove crabs is more in areas that have a high mud depth. This happens because the higher the depth of the mud, the more is the opportunity for the mud crabs to mate and molt.

Dumas et al. (2012) found that the stand density contributed significantly to the mud crab density. This study used generalized linear models (GLM) and obtained a significance of 84.80%. Regression analysis showed the magnitude of the correlation between crab density and burrow density ($p < 0.01$). Besides, the density of the burrow was seen to be significantly greater ($p < 0.05$) than the density of the crab.

In general, the writing models for estimating the existence of mud crab based on Table 2 are formed as follows:

$$Y = \frac{\text{Exp}\,(-6607{,}51 + 983{,}89\,X_1 + 6{,}78\,X_2)}{1 + \text{Exp}\,(-6607{,}51 + 983{,}89\,X_1 + 6{,}78\,X_2)} \quad (4)$$

Where: Y: opportunities for crab existence; X_1: dissolved oxygen (mg/L); X_2: mud depth (cm).

Variables that influence the presence of mud crab are dissolved oxygen and mud thickness. The dissolved oxygen variable of beta coefficient (983.89) indicates that dissolved oxygen has a positive effect on the chances of the presence of mangrove crabs. The mud thickness variable of 6.78 indicates that depth of mud has a positive effect on the chance of the presence of mangrove crabs. The presence of mud crab is influenced by the dissolved oxygen factor and the depth of the mud as much as 68.70%. In other words, the contribution of the dissolved oxygen and the depth of the mud to the presence of the mud crab is 68.70%, while the remaining 31.30% is contributed by other variables which were not measured in this study. The growth of mud crabs is supported by water temperature because mud crabs are poikilotherms. Temperature will affect activity, appetite, oxygen consumption, and metabolic rate of mud crabs (Hastuti et al. 2019b).

The existence of mangrove crabs is influenced by the good management of mangrove areas as a breeding ground for mangrove crabs (Dayal et al. 2019). Mangrove areas that are well managed can provide good growth for the mangrove trees in the area. Mangrove trees that grow well will have a dense crown and a large diameter. The size of the crown is directly proportional to the number of leaves (Unthari et al. 2018). The dense canopy has many leaves, so that more and more litter falls on the forest floor. The litter that falls on the forest floor is one of the natural foods for mangrove crabs. Dumas et al. (2012) stated that mangrove crabs are typically associated with good mangrove ecosystems, so that better the management of the mangrove area, the more the number of mangrove crabs living in the area will increase. Based on observations of body shape, mangrove crabs have enough food, but a lot of energy is used for growth. The condition index reflects the interaction between biotic and abiotic factors that influence physiological processes in fish (Rahman et al. 2012). According to Fatihah et al. (2017), the carapace-length growth rate of mangrove crabs is determined by natural activities such as the molting process.

Validation of opportunities for the existence of mud crabs

The results of data validation testing using the Wilcoxon Test Statistics test is displayed in Table 4. Based on Table 4, information is obtained that the Z-value was -1.73 with a p-value (Asymp. Sig 2 tailed) of 0.08, where more than the critical limit of research (> 0.50) is categorized as mud crab in the area; therefore, the hypothesis decision is to accept H0. This result shows that there is no real difference between the actual data and the alleged data. The validation value of the model was 90%, which means that 90% of the data between the actual data and the alleged data were the same.

Potential economic value of mud crabs

Mud crabs are an economically important crustacean species for fisheries and aquaculture (Shi et al. 2019). Based on research data from various locations (Williams and Primavera 2001; Fazhan et al. 2020), two types of mangrove crabs were found, namely green (*S. olivacea*) and red mud crab (*S. serrata*), with six categories based on specific weights, namely banana crab, ceka crab, category A1, AA, A super, and female crab laying eggs. Mangrove crabs that are commonly found in the mangrove forest areas of the research location were the banana, ceka, and A1 categories. Based on observations of body shape, mud crabs have enough food, but a lot of energy is used for growth. The condition index reflects the interaction between biotic and abiotic factors that influence physiological processes in fish (Rahman et al. 2012). According to Fatihah et al. (2017), the growth rate of carapace length of mangrove crabs is determined by natural activities such as the molting process (Basyuni et al. 2020).

Table 4. Wilcoxon test statistics

	Actual-estimate
Z	-1,73
Asymp. Sig (2-tailed)	0,08

Fishermen that work as mud crab catchers (*Scylla* sp.) sell their catches to the nearest agent. Each commercial category is sold at a different price: banana category (weight: 30-50 g, price: IDR 18000/kg, for nursery purposes), ceka/Ashoka crab category (weight: 80-100 g, price: IDR 35000/kg, for sale purposes until the shell becomes hard), A1 category (weight: 100-350 gr, price: IDR 65000/kg), AA category (weight: 350-500 gr, price: IDR 80000/kg), category A Super (weight: 500-1000 gr, price: IDR 115000/kg), and female crabs laying eggs (weight: 250 gr, IDR 90000-150000).

The estimated economic potential of mud crabs (*S. serrata* and *S. olivaxea*) in the Lubuk Kertang Mangrove Forest (Lubuk Kertang Village) was IDR 2,392,000.00/ha. Fishermen and crab aquaculture owners recommend that the government pay attention to this sector to prevent overexploitation of these species and environmental damage affecting their habitats. Fishermen are becoming increasingly interested in farming mud crabs (Basyuni et al. 2020; Bir et al. 2020).

In conclusion, mangrove forests in the village of Lubuk Kertang are a suitable place for the development of mud crabs. The most influential parameters, as observed in this study, were dissolved oxygen and mud depth. Because the mud crabs are a significant fishery resource in this area, it is important to preserve the local mangrove forests and ensure that the ecosystems hosting these crabs are not destroyed by human activities.

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