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THE EFFECT OF VARIOUS TYPES OF NATURAL FEED ON THE GROWTH OF MANGROVE CRABS (*Scylla serrata*) IN TRADITIONAL POND FARMING

PENGARUH BERBAGAI JENIS PAKAN ALAMI TERHADAP PERTUMBUHAN KEPITING BAKAU *(Scylla serrata*) PADA TAMBAK TRADISIONAL

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Abstract

The Mangrove Crab (Scylla Serrata) is one of the economically important fishery commodities that has delicious meat and high nutritional content. This study aims to obtain the best type of natural feed and analyze the effect of feeding various types of natural feed on the growth of mangrove crabs (Scylla Serrata) in traditional ponds. This study employed an experimental design using a Completely Randomized Design (CRD) with 4 treatments and 3 replications, comprising 12 units. The natural feed treatments were P1 (Rucah Fish), P2 (Chicken Intestines), P3 (Keongmas), and P4 (Rajungan), each at 5% of the diet. The study was analyzed using ANOVA with Excel and Duncan's multiple range test with SPSS. The study was conducted over 40 days in traditional ponds in Desa Lingkungan 3 Kampung Baru, Kelurahan Pangkalan Batu, Kecamatan Berandan Barat, Kabupaten Langkat. The results showed that the use of various types of natural feed did not have a significant effect (Fhit > Ftab) at a significance level of P > 0.01 on moulting percentage, absolute weight gain, daily specific growth rate, and survival rate (SR), but had a very significant effect (Fhit < Ftab) at the P < 0.01 significance level on the feed conversion ratio (FCR) of mangrove crabs (Scylla Serrata) in traditional ponds

Keywords: *Crab (Scylla Serrata), RAL Experiment, Natural Feed, Growth.*

Abstrak

Kepiting Bakau (Scylla Serrata) termasuk salah satu komoditas perikanan ekonomis penting yang memiliki rasa daging lezat dan kandungan gizi yang tinggi. Penelitian ini bertujuan untuk memperoleh jenis pakan alami terbaik dan menganalisis pengaruh pemberian berbagai jenis pakan alami terhadap pertumbuhan Kepiting Bakau (Scylla Serrata) pada tambak tradisional. Penelitian ini menggunakan metode percobaan eksperimen dengan menggunakan Rancangan Acak Lengkap (RAL) dengan 4 perlakuan dan 3 ulangan dan terdapat 12 unit dengan pemberian pakan alami berupa P1 (Ikan Rucah), P2 (Usus Ayam), P3 (Keongmas), dan P4 (Rajungan) sebanyak 5%. Penelitian ini dianalisis dengan uji ANOVA menggunakan Excel dan uji lanjut DUNCAN mengunakan SPSS. Penelitian ini dilakukan selama 40 hari di tambak tradisional Desa Lingkungan 3 Kampung Baru, Kelurahan Pangkalan Batu, Kecamatan Berandan Barat, Kabupaten Langkat. Hasil penelitian menunjukkan bahwa penggunaan berbagai jenis pakan alami tidak memberikan pengaruh yang nyata (Fhit> Ftab) dengan taraf uji P > 0,01 terhadap persentase moulting, pertumbuhan bobot mutlak, laju pertumbuhan spesifik harian, dan Sintasan/Survival Rate (SR) namun memberikan pengaruh yang sangat nyata (Fhit < Ftab) pada taraf uji P < 0,01 terhadap rasio konversi pakan/Feed Conversion Ratio (FCR) Kepiting Bakau (Scylla Serrata) pada tambak tradisional.

Kata Kunci : *Kepiting Bakau (Scylla Serrata), Eksperimen RAL, Pakan Alami, Pertumbuhan*.

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1. Introduction

Mangrove crab is one of the economically important fishery commodities. Mangrove crabs not only have delicious meat, but also high nutritional content, containing 65.72% protein, 0.83% fat, 7.5% ash, and 9.9% moisture (Sulaiman et al. 1992), making them a commodity with great potential for development.

One of the problems faced by mangrove crab farmers is the lack of appropriate feed for mangrove crab growth. The feed must meet certain requirements, including availability, processing, nutritional content, and suitability for the eating habits of mangrove crabs. Feed that is suitable for the eating habits of mangrove crabs will provide optimal growth because feed is one of the important factors for maximizing production in crab farming. Crab growth can be improved by adjusting feed provision to their needs, so that the energy produced will also be appropriate (Tridjoko et al. 2010). Feed availability is one of the absolute requirements for successful crab farming.

This research aims to determine the best type of natural feed for the growth of mangrove crabs (*Scylla Serrata*) in traditional ponds and to analyze the effect of feeding various types of natural feed on the growth of mangrove crabs (*Scylla Serrata*) in traditional ponds.

2. Research Method

2.1. Time and Place

This research will be conducted in January–February 2024 in traditional ponds in Lingkungan 3 Kampung Baru Village, Pangkalan Batu Subdistrict, Brandan Barat District, Langkat Regency.

2.2 Research Design

The research method used is an experimental method using a Completely Randomized Design (CRD) with 4 treatments and 3 replications, where there are 12 units with feeding in the form of four different types of natural feed in each treatment, namely:

P1 = 5% rucah fish feed
P2 = 5% chicken intestine feed
P3 = Feeding 5% snail feed
P4 = 5% crab feed administration

2.3 Research procedure

2.3.1 Tools and Materials

The container used for maintenance is a plastic basket with a top diameter of 23 cm, a bottom diameter of 17 cm, and a height of 10 cm, assembled using PVC pipes measuring 550 cm x 70 cm, which are used to assemble the plastic basket so that it can float on the water surface. The plastic basket assembly is placed in the pond near the inlet/outlet circulation. The plastic basket assembly is located at a depth of 10 cm from the water surface and is anchored with wood so that it always remains in the center of the pond/tambak. There is a vertical bridge in the middle of the pond/tambak measuring 6m x 1.5m, which is used to feed the mangrove crab larvae. There is a 2m drainage channel. Before the pond/tambak is used, it is cleaned and treated with simponen poison to sterilize it from pests. The pond/tambak is then dried for 1 week. Next, water is let in at high tide and waited for the water to reach a depth of 1.2m, then the water circulation is closed. Each unit has 6 plastic baskets containing 6 crabs. Before use, the plastic baskets are cleaned by washing them with fresh water and drying them for 2 days to kill *pathogenic* bacteria that are harmful to crabs. Next, the plastic basket assembly is placed in the pond with a small bridge. The research design can be seen in Appendix 2.

2.3.2 Test Animal Preparation

The crabs used weighed between 50g and 80g, with the criteria that the crab seeds must be healthy, have a high appetite, and have complete/undamaged body organs. The mangrove crabs were obtained from a mangrove crab collector in Medan.

2.3.3 Stocking Density

The stocking density of crabs per unit consisted of 6 plastic baskets, each containing 1 mangrove crab. A total of 72 test organisms were used. The seeds were released in the morning so that the mangrove crab seeds would not be stressed by high temperatures. Before release, the crab seeds were acclimatized for 30– utes. The test crab seedlings were kept in plastic baskets and placed in the pond for 40 days.

2.3.4 Test Feed Preparation

Fresh fish were obtained from fish markets. Before being fed, the fish were washed thoroughly and then chopped (1-2 cm). Golden apple snails (*Pomacea canaliculata*) were obtained from rice fields and prepared by breaking the shells, removing the meat and entrails, and then washing them thoroughly with fresh water. Next, they were washed again with salt water to remove acidic substances. Chicken intestines were obtained from poultry markets and prepared by splitting them open, cleaning out the contents, chopping them into 1-2 cm

pieces, and washing them thoroughly. Crabs were obtained from fish markets, chopped, and cleaned with water.

2.3.5 Feed Administration

The feed used in this study consisted of small fish, chicken intestines, golden snails, and crabs. The amount of feed given was 5% of the crab's body weight, twice a day, in the morning and evening. To adjust the amount of feed, weight sampling was conducted every 10 days to measure the increase in crab weight.

2.3.6 Water Quality Observation

Water quality monitoring was conducted at the beginning, middle, and end of the study to maintain stable water quality. Samples were collected from three locations. The environmental parameters measured included several water quality parameters, such as temperature, pH, DO (*dissolved oxygen*), and salinity.

2.3.7 Data Collection

The data measured included: percentage *of moulting* performed daily, absolute weight growth measured every 10 days using digital scales, daily growth rate and survival measured daily, and feed conversion ratio measured at the end of the study. Water quality data was measured using *a Multifunction Water Quality Tester* to measure temperature, pH, *salinity*, and a DO meter to measure DO (dissolved oxygen).

2.4 Research Parameters

2.4.1 *Moulting* Percentage

The moulting percentage of the test crabs was calculated using the following formula:

$$\text{Moulting Percentage} = \frac{\text{Test animals moulting}}{\text{Number of test animals}} \times 100$$

2.4.2 Absolute Weight Growth

Absolute weight growth was calculated using Effendie's (2002) formula as follows:

$$W = Wt - Wo$$

Explanation
W : Absolute weight gain (g)
Wt : Average weight of mangrove crabs at the end of the study (g)
Wo : Average weight of mangrove crabs at the start of the study (g)

2.4.3 Daily Specific Growth Rate

According to Changbo et al. (2004), the daily growth rate is calculated using the following formula:

$$SGR = \frac{(\text{Ln Wt-Ln Wo})}{T} \times 100$$

Explanation:
SGR : Daily growth rate (%/day)
Wt : Average crab weight at the end of the study (g)
Wo : Average crab weight at the start of the study (g)
T : Study duration (days)

2.4.4 Survival Rate (SR)

Survival rate (*SR*) observations of mangrove crabs were conducted daily throughout the study. The survival rate of mangrove crabs was determined using the following formula (Effendi, 1978):

$$SR = Nt/No \times 100$$

Explanation
SR : Degree of survival
No : Number of mangrove crabs at the start of the study (tails)
Nt : Number of mangrove crabs at the end of the study (tails)

2.4.5 Feed Conversion Ratio

The feed conversion ratio can be calculated using Effendie's (2002) formula as follows:

$$FCR = F/((Wt+d)-Wo)$$

Explanation
FCR : Feed conversion ratio
F : Weight of feed consumed (g)
Wt : Biomass of mangrove crabs at the end of cultivation (g)
Wo : Biomass of mangrove crab seeds at the beginning of cultivation (g)
D : Weight of dead larvae (g)

2.4.6 Data Analysis

The observation data were analyzed using F-test Analysis of Variance (ANOVA), which included absolute weight growth, specific growth rate, and feed conversion ratio. This was done to determine the effect of treatment on the observed parameters. The mathematical model was as follows:

$$Yij = \mu + Ti + + €ij$$

Explanation:
Yij : The growth variable of the i-th mangrove crab ( ) using different natural feed treatments j
μ : General mean value.
Ti : Effect of treatment i.
€ij : The effect of error receiving treatment i and repetition j

If there is a significant effect (Fhit < Ftab) with a test level of P < 0.01 to see the difference, then a Duncan follow-up test is performed. The observation data were analyzed using descriptive analysis, including water quality and growth rate.

3. Results and Discussion

3. Percentage of Moulting, Absolute Weight Growth, and Daily Specific Growth Rate

The percentage *of moulting*, absolute weight growth, and daily growth rate of Mangrove Crabs (*Scylla serrata*) in traditional ponds during 40 days of research obtained ANOVA test results that the treatment of providing various types of natural feed did not have a significant effect (*Fhit > F0*.01). These results can be seen in (Table 1).

Table 1.
Average percentage *of moulting*, absolute weight, and daily growth rate of Mangrove Crabs *(Scylla serrata)* during the study

Treatment	*Moulting* Percentage (%)	Absolute Weight (g)	LPH (%/Day)
P1	100 ± 0.00[b]	30.37 ± 1.97[b]	0.99 ± 0.04[b]
P2	100 ± 0.00[b]	28.49 ± 1.30[b]	0.87 ± 0.02[b]
P3	66.70 ± 0.00[a]	20.62 ± 2.83[a]	0.69 ± 0.04[a]
P4	94.43 ± 9.64[b]	26.68 ± 3.21[b]	0.84 ± 0.14[b]

Note : Different letters in the same column indicate significantly different treatments .

Based on the results of *Duncan's* multiple range test (Table 1), the percentage *of moulting,* absolute weight, and daily growth rate of Mangrove Crabs (*Scylla serrata*) in treatment P3 (Keongmas) were significantly different from the other treatments. Meanwhile, treatments P1 (Rucah fish), P2 (chicken intestine), and P4 (Rajungan) did not differ significantly. Based on *Duncan*'s test, treatments P1 (Rucah fish), treatment P2 (chicken intestines), and treatment P4 (rajungan) produced the best values for the parameters of *molting* percentage*,* absolute weight, and daily growth rate of the mangrove crab (*Scylla serrata)*. This is thought to be because the protein content in treatments P1, P2, and P4 is higher and can be utilized well by mangrove crabs for *moulting,* absolute weight growth, and daily growth rate compared to treatment P3, where the protein content is 58.97% in (P1) Rucah Fish (Utomo et al. 2013), 53.10% in (P2) Chicken Intestines, and 35.77% in (P4) Rajungan (Jacoeb et al. 2012). Meanwhile, in treatment (P3) Keongmas, the protein content was only 14.72% (Sadinar et al. 2013).

All *arthropods*, including mangrove crabs, undergo a *moulting* process (shedding of skin) that increases their body size. The *moulting* process involves water absorption and changes in carapace volume, causing the crab to shed its old carapace while absorbing water to enlarge its new carapace (Habibi, 2013). Therefore, the *moulting* process causes an increase in the size of the crab. The faster the *moulting* process in mangrove crabs, the faster their growth will be. This is in line with Hartono's (2007) opinion that *moulting* serves to stimulate and accelerate growth and plays a role in the gonadal maturation process, so that females can produce eggs and males can produce sperm.

Feed is a source of energy needed by mangrove crabs to live and grow. According to Prianto (2007), feed that enters the crab's body will be used as a source of energy (*metabolism*) to drive all bodily functions and as material for building body biomass (*anabolism)*. The high percentage *of moulting,* absolute weight growth, and daily growth rate in mangrove crabs is due to feed having optimal nutritional value, so that the nutritional needs of mangrove crabs are met, one of which is protein. Growth requires a higher percentage of protein compared to fat and carbohydrates. Protein is the most important feed component that functions to form body tissue, repair damaged body tissue, form enzymes in the body, and provide energy for *metabolism* (Fujaya et al. 2012). According to Aslamyah and Fujaya (2010), the protein content required by crabs in feed ranges from 34-58%.

This is because the type of fish feed provides varied nutrients, so that the nutrient content deposited in the mangrove crab's body is in accordance with its needs and life cycle. This is supported by Septian et al. 2013, who stated that fish feed sinks easily, so there is a greater chance of it being eaten by crabs because crabs prefer to forage at the bottom. In addition, fish scraps are easily digestible and have tender meat, making it easy for mangrove crabs to cut and tear them apart. This is also suspected to be due to the mangrove crabs' preference for food during the study. Mangrove crabs preferred fish scraps, chicken intestines, and rajungan (a type of crab), which were always completely eaten, compared to keongmas (a type of snail), which was always left over. The more feed consumed, the greater the utilization of nutrients and energy absorbed in the body to support growth.

Additionally, chicken intestines are easily obtained, not as a staple food for humans but have low economic value, and contain good nutritional content for crab growth. Chicken intestines have a distinctive aroma and taste that stimulate crabs to eat them. Chicken intestines also have a shape that does not easily break apart when submerged in water, making it easier for crabs to grasp them.

The low percentage *of moulting*, absolute weight gain, and daily growth rate in mangrove crabs in the golden apple snail treatment (P3) is thought to be due to the nutrients contained in the feed being unable to provide energy for growth. According to Zonneveld et al. (1991), low growth is caused by the amount of feed consumed being only available for maintenance and little available for growth. According to Agus (2007), the energy required by crabs is first used for adaptation, repairing cells damaged by physical activity, *metabolic* processes*,* and then the remaining available energy is used for reproduction and growth.

3.2. Survival Rate (SR)

The ANOVA test results show that the treatment of various types of natural feed has a significant effect (*Fhit < Ftab)* at a test level of P >

0.01 on the survival rate of mangrove crabs (*Scylla serrata*). The results of the study on the survival rate of mangrove crabs (*Scylla serrata*) during the study obtained average data as shown in (Table 2).

Table 2.
Average Survival Rate (SR) of Mangrove Crabs *(Scylla serrata)* During the Study

Treatment	SR (%)
P1	100 ± 0.00^{b}
P2	83.33 ± 16.66^{ab}
P3	72.22 ± 9.61^{a}
P4	100 ± 0.00^{b}

Note: Different letters in the same column indicate significantly different treatments

The ANOVA test results obtained indicate that the treatment of various types of natural feed has a significant effect (*Fhit* < *Ftab*) at a test level of P > 0.01 on the survival rate of mangrove crabs (*Scylla serrata*). The results of the study on the survival rate of mangrove crabs (*Scylla serrata*) during the study obtained average data that can be seen in (Table 2).

Based on the results of *Duncan's* post-hoc test (Table 2) to examine the differences between each treatment, it was found that the survival rate (SR) of mangrove crabs (*Scylla serrata*) in treatment P3 (Keongmas) was significantly different from treatment P1 (Rucah fish) and treatment P4 (Rajungan), but not significantly different from treatment P2 (chicken intestines). During the maintenance period, one crab fed with chicken intestines and Keongmas died. Judging from the physical appearance of the dead crab, it is suspected that the cause of death was the crab's inability to molt (*moulting* failure*)*. Kanna (2002) stated that as organisms associated with water, crabs obtain energy from the food they consume. When energy content decreases, the protein in the body will be broken down and used as an energy source. The energy required for the *moulting* process is quite large. If the protein used as an energy source is insufficient, it can cause the death of the crab during *moulting.* Meanwhile, protein is the main source of energy and *a macronutrient* that plays a major role in growth. If the protein is damaged, the crab cannot grow. This is suspected to be due to the type of feed given, which cannot be properly digested by mangrove crabs. In addition, the *moulting* factor also affects the survival rate. A *molting* process that is shorter than *the molting interval* will increase hormonal imbalance or stress, leading to death. Furthermore, crabs undergoing *molting* require energy for the process. This can also cause death because the energy required is quite substantial (Phelan et al. 2007).

3.3 Feed Conversion Ratio

Based on the results of the ANOVA test, it was found that the treatment of various types of natural feed had a significant effect (*Fhit* < *Ftab*) at a test level of P < 0.01 on *the feed conversion ratio* (FCR) of mangrove crabs (*Scylla Serrata*). *The* average *feed conversion ratio* (FCR) of mangrove crabs (*Scylla Serrata)* during the study can be seen in (Table 3).

Table 3.
Average *Feed Conversion Ratio* (FCR) of Mangrove Crabs *(Scylla Serrata)* During the Study

Treatment	FCR
P1	4.24 ± 1.14^{a}
P2	4.29 ± 0.12^{a}
P3	5.50 ± 0.43^{a}
P4	4.92 ± 0.19^{a}

Note: The same letters in the same column indicate that the treatment means are not significantly different

Based on the results of *Duncan's* multiple range test *(*Table 3), the calculation of feed conversion ratio data during the study showed that the various types of natural feed treatments did not differ significantly in terms of feed conversion ratio in each treatment. This is in line with the opinion of Watanabe et al. (2001), who stated that the lower or smaller the feed conversion value, the greater or higher the feed utilization efficiency. In general, the feed conversion ratio in this study was too high, with an average value of 4.74±0.59 for each treatment. This indicates that the four types of feed provided were of poor quality and resulted in low feed efficiency. According to Shelly and Lovatelli (2011) and Simanchala and Nayak (2012), a good feed conversion ratio (FCR) for mangrove crabs is less than 2.0. According to Huet (1979), the higher the feed conversion ratio, the less efficient the utilization of feed for growth. In addition, *digestibility* and *bioavailability* also affect feed efficiency. Good digestion will increase feed consumption and utilization, resulting in more optimal crab growth (Praing *et al.* 2013).

3.4 Water Quality Parameters

Water quality is a variable that greatly determines the survival rate of mud crabs (*Scylla Serrata)* because all *crustaceans* are very sensitive to poor water quality parameters, which can cause stress and death. The water quality parameters observed include temperature, pH, DO (dissolved oxygen), and salinity, which can be seen in Table 4.

Table 4.
Average Water Quality Parameters of the Mangrove Crab *(Scylla serrata)* During the Study

Parameter	Range	Standard Value	Literature
Temperature (°C)	28-30	22-36	Iromo *et al.* (2018)
pH	6-7	6-8	Iromo *et al.* (2018)
DO (mg/l)	4-5	4-7	Kordi (2012)
Salinity (ppt)	16-23	15-25	Susanto (2008)

The results of water quality observations at temperatures ranging from 28-30 °C. These temperatures indicate that the water is in optimal condition. Temperature is one of the important abiotic factors that affect activity, survival, growth, and moulting. According to Fuad (2005), temperature plays an important role in the life of crabs in regulating crab activities, including respiration, metabolism, behavior, growth, reproduction, and feed consumption. Iromo et al. (2018) stated that mangrove crabs can live and grow well in a range of 22-36 °C with no sudden changes in temperature.

The acidity level (pH) during the study was 6-7, which is a good pH for crab cultivation. Iromo et al. (2018) explained that a good acidity level is 6-8. The DO value in the study ranged from 4-5 mg/l, which is optimal for crab growth. Kordi (2012) explains that mangrove crab cultivation with dissolved oxygen content of 4-7 mg/l or >3 mg/l provides good growth.

The salinity measurements during the study ranged from 16-20 ppt. Susanto (2008) states that the average salinity range that is good for supporting the growth of mangrove crabs (*Scylla Serrata*) is 15-25 ppt, and growth is slower at salinity levels > 25-30 ppt.

4. Conclusion

Based on the results of the study, it can be concluded that the use of various types of natural feed does not have a significant effect *(Fhit > Ftab*) at a test level of P > 0.01 on the percentage *of moulting,* absolute weight growth, daily specific growth rate, and *survival rate* (SR), but has a very significant effect (*Fhit< Ftab)* at a significance level of P < 0.01 on *the Feed Conversion Ratio* (FCR) of Mangrove Crabs (*Scylla Serrata)* in traditional ponds.

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