Fattening Mangrove Crab (*Scylla olivacea*) With Silvofishery Systems in Different Type Mangrove Vegetation and Trash Fish

Sukirman[1], Zainuddin[2], Muhammad Yusri Karim[2]

[1]Fisheries Science Study Program, Faculty of Marine Science and Fisheries, Hasanuddin University

[2]Faculty of Marine Science and Fisheries, Hasanuddin University

DOI: 10.29322/IJSRP.12.07.2022.p12734
http://dx.doi.org/10.29322/IJSRP.12.07.2022.p12734

Paper Received Date: 20th June 2022
Paper Acceptance Date: 5th July 2022
Paper Publication Date: 12th July 2022

Abstract- Mangrove crab is one of important economically valuable aquatic biological resource whose habitat is in estuarine areas (mangroves). Mangrove crab can be cultivated with a silvofishery system, namely cultivation of mangrove forest areas. This study aims to examine the interaction between mangrove vegetation types and trash fish species of mangrove crabs in the silvofishery system. This study used 27 bamboo cages and kept 10 crabs/m^2 with an average weight of 200±10 g with a carapace width of ±10 cm. The study was designed using a factorial design with a randomized block design. The first factor is the type of mangrove vegetation (A) and the second factor is the type of trash fish feed (B). Mangrove vegetation consists of 3 levels, namely A1 = *Rhizophora*, A2 = *Avicennia*, A3 = *Sonneratia*, while the trush fish type factor consists of 3 levels, namely B1 = cattle fish, B2 = goldstripe sardinella, B3 = tilapia fish. Each treatment interaction was repeated 3 times, so that the study consisted of 27 experimental units. The results of the analysis of variance showed that trash fish species had a significant effect ($p<0.05$) on mangrove crab survival. However, mangrove species and their interactions with trash fish did not have a significant effect ($p>0.05$). Interaction between mangrove species and fish feed also significantly affected ($p<0.05$) on the absolute growth of mangrove crab. However, the type of mangrove vegetation, trash fish species and their interactions had no significant effect ($p>0.005$) on crude protein, crude fat, NFE, and energy levels of mangrove crabs. The best survival rate was found in *Rhizopora* and *Tilapia*, which was 90,00% and the best absolute growth was produced in *Rhizopora* and *Sardinella*, which was 32,96 g.

Index Terms-, Mangrove, Mangrove Crab, *Silvofishery*, Trash fish

I. Introduction

Mangrove is a typical coastal ecosystem that has high productivity and acts as a physical, ecological and economic function in coastal areas. In addition to tidal conditions and supporting fertility, some assumptions cause mangrove forests in Indonesia to experience degradation, which is caused by the conversion of mangrove forests for various purposes such as plantations, ponds, settlements, industrial areas, tourism, and others without considering their sustainability and function. to the surrounding environment (Sitorus *et al*., 2017; Prawita 2018). Therefore, to maintain sustainability and remain utilized, it is necessary to implement a system that can guarantee these two interests, namely silvofishery (Karim *et al*., 2018).

Silvofishery is an aquaculture activity in mangrove areas. The basic principle of the cultivation system is the plural or dual use of the existence of mangroves without losing their natural ecosystem functions so that fishery and mangrove products can still act as biological, ecological, and economic functions. Various types of economic biota can be cultivated in mangrove areas with a silvofishery pattern, one of which is the mangrove crab (*Scylla* spp). Mangrove crab (*Scylla olivacea*) is one of the important economically valuable aquatic biological resources whose habitat is estuarine (mangrove) areas. Mangrove crabs can be cultivated in mangrove areas composed of various types of vegetation. The mangrove ecosystem consists of various types of vegetation that compose it. The results of research by Asriani *et al*., (2019) show that litter productivity greatly affects the quality of the mangrove ecosystem. So that, each type of mangrove vegetation produces different litter so it is thought to also affect the quality of aquatic ecosystems. Thus, the different types of mangrove vegetation as a location for mangrove crab cultivation in the silvofishery system are thought to produce different growth and quality of crabs due to several factors such as mangrove litter productivity, nutrient dynamics, and feed abundance.

Research on Mangrove crab cultivation silvofishery system has been carried out by Karim *et al*. (2016), Karim *et al*., (2017), and Wijaya *et al*., (2019). Meanwhile, Asriani *et al*. (2019) investigated the silvofishery system of mangrove crab cultivation in various mangrove vegetation, but in that study only used trash feed in the form of tilapia fish alone. Meanwhile, research on silvofishery system of mangrove crab cultivation on various types of mangrove vegetation of various types of trash fish feed has never been carried out. According to Adila *et al*., (2020) that feeding trash fish affects the weight gain of mangrove crabs.

A good feed must meet the elements of feed, which contain protein, fat, carbohydrates, minerals, and vitamins. So far, cultivators tend to use Mozambique tilapia feed because it is a fish that is easy to obtain and becomes a pest in ponds. However, there are likely other types of fresh bycatch feed that are higher in protein content and are affordable and more economical, such as common ponyfish (*Leiognathidae*) and goldstripe sardinella classified as fish that are easily obtained and the price is quite cheap, but in terms of nutrient content, it is quite high. According to Manuputty (2014), goldstripe sardinella contains 20.227% protein, 3.055% fat, and 2.025% carbohydrates. The cattle fish contains 37.07% protein, 16.85% fat, 1.92% crude fiber, 33.25% ash, and 4559 kcal/g energy (Hasnidar, *et al*., 2021)

Based on the description above, to study and obtain information about the interaction of mangrove vegetation types and trash fish species in aquaculture for the fattening of mangrove crab cultivation with silvofishery a study on this is needed. Thus, this research needs to be carried out to obtain information about the type of mangrove vegetation and the right types of trash fish in the silvofishery system of mangrove crab cultivation that produces the best growth and production of mangrove crabs.

II. METHOD

This research was conducted from January to April 2022 in the Coastal Mangrove Area, Minangae Village, Sajoanging District, Wajo Regency. Analysis of body chemical composition was carried out at the Animal Feed Chemistry Laboratory, Faculty of Animal Husbandry, Hasanuddin University. The location of crab cultivation can be seen in Figure 1 below.

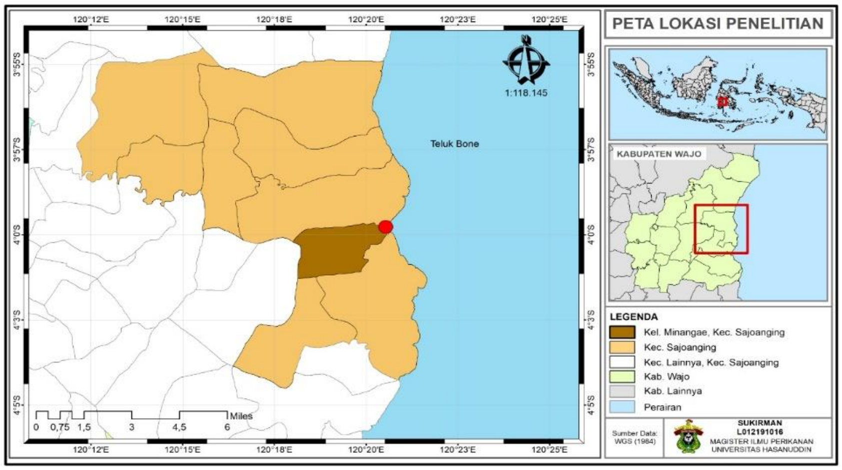

Figure 1. Location of mangrove crab cultivation

The test animals used in this study were mangrove crabs *S. olivacea* with an average weight of 200±10 g and carapace width of ±10 cm which was stocked with a density of 10 crabs/container and maintained for 30 days. The mangrove crabs were obtained from Malili District, East Luwu Regency, South Sulawesi. The containers used in this study were a circular bamboo cages with diameter of 2 m as many as pieces placed in the mangrove area. The outside of the cage is covered with a lining which aims to protect the cage from garbage and dirt carried by the waves. The type of feed used was bycatch feed, namely cattle fish, goldstripe sardinella, tilapia fish with feeding dose of 10% of the mangrove crab biomass. The frequency of feeding was given twice a day, in the morning (07.00 am) and the afternoon (16.00 pm).

Before the mangrove crabs were stocked in the rearing container, acclimatization was carried out to the rearing environment for 1 day. After the acclimatization period was completed, the mangrove crabs were fasted for 24 hours to remove the remaining feed in the digestive tract. Furthermore, the initial weight of the crabs was weighed using an electric scale, then stocked in the rearing container. At the end of the study, harvest was carried out by counting the number of live crabs, weighing them, and analysis of the chemical composition of the crab's body.

The study was designed using a factorial randomized block design consisting of 2 factors. The first factor is the type of mangrove vegetation (A) and the second factor is the type of trush fish feed (B). Mangrove vegetation consists of 3 levels, namely A1 = *Rhizophora*, A2 = *Avicennia*, A3 = *Sonneratia*, while the bycatch fish species factor consists of 3 levels, namely B1 = cattle fish, B2 = goldstripe sardinella, B3 = tilapia fish, thus there are 9 treatment combinations. The treatment combinations are as follows::

A1.B1 = *Rhizophora* with cattle fish
A1.B2 = *Rhizophora* with goldstripe sardinella
A1.B3 = *Rhizophora* with tilapia fish
A2.B1 = *Avicennia* with cattle fish

ISSN 2250-3153

A2. B2 = *Avicennia* with goldstripe sardinella
A2.B3 = *Avicennia* with tilapia fish
A3. B1 = *Sonneratia* with cattle fish
A3.B2 = *Sonneratia* with goldstripe sardinella
A3.B3 = *Sonneratia* with tilapia fish

The variables observed in this study include:

Surviva Rate or the survival of the mangrove crab is calculated using the following formula:

$$SR = \frac{Nt}{No} \times 100$$

Information: SR = Survival rate (%)
N_t = Number of live crabs at the end of the study
N_o = Number of crabs at the beginning of the study

Absolute Growth The absolute growth average crab was calculated using the formula used as follows:

$$W = W_t - W_o$$

Information: W = absolute weight growth of crabs (g),
W_o = average weight of crabs at the beginning of the study (g),
W_t = average weight of crabs at the end of the study (g).

Body Chemical Composition Test crabs were carried out at the beginning and the end of the experiment. Include protein, fat, NFE, and body energy. Protein was analyzed using kjedal method, NFE is calculated using the formula : NFE = 100 % - % Protein - % Fat-% Crude Fiber, fat with soxlet and energy using a bomb calorimeter according to AOAC instructions (2005).

The data obtained were analyzed using analysis of variance (ANOVA). If there is a significant effect, then it is continued with further W-Tukey test with the help of SPSS software version 23.00.

III. RESULTS

Survival Rate

The average survival rate of mangrove crabs maintained by the silvofishery system on various type of mangroves and type of fish feed were presented in Table 1 below.

Table 1. The average survival rate of mangrove crabs maintained by the silvofishery system on various type of mangroves and fish feed

Type of Vegetation and Type of Feed	Survival (%) ± StDev (n=27)
Rhizophora and cattle fish	70.00 ± 10.00^{b}
Rhizophora and goldstripe sardinella	80.00 ± 10.00^{ab}
Rhizophora and tilapia fish	90.00 ± 10.00^{a}
Avicennia and cattle fish	70.00 ± 10.00^{b}
Avicennia and goldstripe sardinella	83.33 ± 11.54^{ab}
Avicennia and tilapia fish	80.00 ± 0.00^{a}
Sonneratia and cattle fish	76.66 ± 5.77^{b}
Sonneratia and goldstripe sardinella	76.66 ± 5.77^{b}
Sonneratia and tilapia fish	83.33 ± 5.77^{a}

Description: Different letters in the same column indicate significantly different between treatments ($p < 0.05$)

The results of the analysis of variance showed that the trash fish species had a significant effect ($p<0.05$) on the survival of mangrove crabs. However, the types of mangroves and their interactions with trush fish do not have a significant effect. Furthermore, the results of the W-Tuckey test of trash fish on mangrove crab survival showed that all type of fish feed treatment for cattle fish were significantly different with tilapia fish ($p<0.05$) but not significantly different from goldstripe sardinella and goldstripe sardinella were not significantly different with tilapia fish ($p>0.05$). the best mangrove crab survival was produced on *Rhizopora* vegetation tilapia fish, which was 90,00%.

Absolute Growth

The average absolute growth of mangrove crabs maintained by silvofishery system on various type of mangrove and fish feed were presented in Table 2.

Table 2 The average absolute growth of mangrove crabs maintained by silvofishery system on various type of mangrove and fish feed.

Type of Vegetation and Type of Feed	Absolute Growth (g) ± StDev (n=27)
Rhizophora and cattle fish	12.33 ± 0.91[e]
Rhizophora and goldstripe sardinella	32.96 ± 0.88[a]
Rhizophora and tilapia fish	25.95 ± 1.87[b]
Avicennia and cattle fish	17.59 ± 0.71[d]
Avicennia and goldstripe sardinella	19.10 ± 0.66[cd]
Avicennia and tilapia fish	19.76 ± 0.12[cd]
Sonneratia and cattle fish	19.51 ± 1.68[cd]
Sonneratia and goldstripe sardinella	23.88 ± 2.99[b]
Sonneratia and tilapia fish	22.71±0.96b[c]

Description: Different letters in the same column indicate significantly different between treatments (p<0.05)

The results of the analysis of variance showed that the type of mangrove, the type of trush fish feed, and their interactions had a very significant effect on the absolute growth of mangrove crabs. Furthermore, W-Tuckey test showed that the growth of mangrove crabs reared on *Rhizophora* was significantly different (p<0.05) with all treatments, *Rhizophora* and tilapia fish were not significantly different from *Sonneratia* and goldstripe sardinella and so *Sonneratia* and tilapia fish (p>0.05). But significantly different from other treatments. Furthermore, the absolute growth of mangrove crabs reared in *Avicennia* and cattle fish was significantly different (p<0.05) with *Avicennia* and goldstripe sardinella and tilapia treatments, and then *Avicennia* and goldstripe sardinella were not significantly different with *Avicennia* and tilapia and then *Sonneratia* and cattle fish and tilapia (p>0.05) but significantly different from other treatments. Furthermore, the absolute growth of mangrove crabs reared in *Sonneratia* and cattle fish was significantly different from *Sonneratia* and goldstripe sardinella and tilapia fish treatments (p<0.05), *Sonneratia* and goldstripe sardinella were not significantly different from *Sonneratia* and tilapia and *Avicennia* and goldstripe sardinella (p>0.05), *Sonneratia* and cattle fish were not significantly different from *Avicennia* and goldstripe sardinella and tilapia fish and *rizhopora* and tilapia (p>0.05) but significantly different from other treatments. The best absolute growth of mangrove crab was produced on *Rhizopora* and *Sardinella* vegetation, which was 32.96 g.

Body Chemical Composition

The results of the analysis of the chemical composition of the body of mangrove crabs in the form of crude protein, crude fat, NFE, and body energy of mangrove crab maintained by the silvofishery system on mangrove species and fish feed types were presented in Table 3 below.

Table 3. Chemical composition of mangrove crabs on mangrove species and fish feeds

Vegetation and Type of Feed	(%) ± StDev (n=27)			
	Crude protein (%)	Crude Fat (%)	NFE (%)	Body Energy (k.cal/g)
Rhizophora and cattle fish	82.27±0.84	7.94±0.64	3.23±0.43	4.29±0.55
Rhizophora and goldstripe sardinella	82.61±0.42	7.56±0.47	1.85±0.46	4.18±0.07
Rhizophora and tilapia fish	82.32±1.38	7.55±0.63	2.99±1.31	4.25±10.00
Avicennia and cattle fish	81.99±0.33	8.02±0.76	3.59±1.49	4.14±0.30
Avicennia and goldstripe sardinella	81.85±0.77	7.55±0.35	3.88±0.24	4.28±0.02
Avicennia and tilapia fish	83.70±1.20	7.29±0.18	3.00±1.75	4.11±0.34
Sonneratia and cattle fish	82.42±0.99	7.68±0.58	2.70±0.92	4.26±0.04
Sonneratia and goldstripe sardinella	82.44±0.46	7.41±0.40	2.97±0.62	4.24±0.02
Sonneratia and tilapia fish	82.09±0.40	7.29±0.17	4.26±0.61	4.29±0.02

Description: Not significantly different between treatments (p>0.05)

The results of the analysis of variance showed that the types of mangrove and trush fish had no significant effect (p>0.05) on crude protein, crude fat, NFE, and energy levels of mangrove crab.

DISCUSSION

Based on Table 1, it can be seen that the average survival value of mangrove crabs reared on various type of mangroves and trush fish did not show a significant difference. This value was not statistically significantly different in the mangrove vegetation, so it can be said that the survival rate of mangrove crabs reared in these three mangrove species was relatively the same. The average survival rate value obtained in this study was quite high, ranging from 83-90%, indicating that these three types of mangrove vegetation were able to support the life of mangrove crabs. This is because mangrove vegetation is a characteristic of coastal ecosystems which is the original habitat of mangrove crabs, a place where mangrove crabs live, breed, and forage for food. The results obtained in this study are in line with Asriani's *et al.* research (2019) that there is no difference in the survival of mangrove crabs because mangroves are the natural habitat of mangrove crabs. has met the needs of mangrove crabs for various needs including locomotion activities and survival. To maintain the existence of life and growth, the Mangrove crab requires a certain amount of feed. Mangrove crabs will grow well if the feed consumed follows their needs. However, all types of trash fish were statistically different, with the highest survival value obtained was tilapia fish, which was 80-90%, it is suspected that tilapia has protein content which is still in the high protein category, easy to digest, and does not use too much energy for the feed used. According to Karim (2007), the resulting survival rate provides an overview of the results of the interaction between the carrying capacity of the feed.

Several research results on mangrove crab silvofishery according to Nagelkerken *et al.*, 2008; Kochey, (2013) found Mangrove survival and mangrove crabs live in symbiosis because the mangrove area provides a suitable habitat for mangrove crabs and vice versa, mangrove crabs help in inserting oxygen into the mangrove substrate. According to Harshith *et al* (2016) crabs are an important part of the mangrove ecosystem and eat leaf litter and other organic materials as food reserves. Mangrove crabs have a high survival rate, this is because the mangrove land in the research location is still quite good. The mangrove crab population is typically associated with mangrove vegetation which is still in good condition (Wijaya *et al*., 2010). The survival rate obtained in this study was higher than Asriani, *et al*. (2019) who got a survival rate of 84-86% and lower than Natan (2014) which the result of survival rate reached 100% with a stocking density of 1 fish/cage, because their lives were isolated in each maintenance box then there is no cannibalism process.

The average absolute growth value of crabs obtained in this study was different. Based on table 2, the highest absolute growth of mangrove crabs was produced by Rhizophora vegetation type of bycatch fish feed goldstripe sardinella, with a growth of 32.96 g, while the highest growth of mangrove crabs from Avicennia vegetation was produced, namely 19.76 ± 0.12 g of trush fish feed and growth of crabs. The highest Sonneratia mangrove vegetation produced was 23.88 g of trash fish goldstripe sardinella feed. The value of this range is higher than the study of Tulangow *et al*. (2019) which has an absolute growth value of 24.66 g.

The highest absolute growth was obtained in Rhizophora and goldstripe sardinella because this vegetation was thought to have higher productivity and abundance of feed compared to Avicennia and Sonneratia and also in line with chemical tests having the highest protein for goldstripe sardinellafeed, which was 81.48%.

Crab growth is due to maintenance in a limited space so that the ability to move is very limited, so that crabs can minimize energy, and the stored energy is used for growth. If the use of energy for osmoregulation (environmental adaptation) is low, it will allow a larger portion of the energy for growth (Wamnebo, 2022). Litter productivity greatly affects the quality of the mangrove ecosystem and also environmental quality affects the growth rate of crabs. The abundance of feed affects the metabolism and chemical composition of the Mangrove crab body in Rhizophora relatively higher than in other vegetation. High in protein, fat, and body energy of mangrove crabs on Rhizophora causes higher nutrient retention so that the growth of mangrove crabs on Rhizophora is higher than in other vegetation. This is because litter productivity is an indicator of the quality of the mangrove ecosystem.

Based on table 3, it is known that the chemical composition of the body of the mangrove crabs kept is not significantly different in the three types of mangroves. This result was due to the three types of mangroves having the same litter productivity and abundance of macrozoobenthos. This encourages the availability of feed so that it affects the metabolism of crabs. With abundant feed, crabs can consume feed according to their needs. Sufficient feed is available and its high utilization rate causes the body's chemical composition to be high. Crabs need feed to maintain their existence and growth and will grow well if the feed is available in sufficient quantities and contains all the required nutrient elements at optimal levels (Aslamyah & Fujaya 2012). Several studies have shown that different conditions can affect the chemical composition of the body (protein, fat, and fiber) of crustaceans (Jacoeb and Carter, 2008). Energy requirements are influenced by several factors, including species, age, size, activity, and type of feed. Crabs obtain energy through the food they consume and the expenditure is used for various activities, including protecting their bodies against environmental changes (Karim, 2007). The utilization of feed is closely related to the entry of energy sources and is utilized by Mangrove crabs for growth (Rahadiyani *et al.* 2014). Changes in the percentage of nutrients in the crab's body indicate the use of these nutrients, both as a source of energy and as an insulator and protector of important organs (Katiandagho, 2014). According to Aslamyah and Fujaya (2012), the energy derived from the feed is used by crabs for growth, reproduction, and physiological activities.

The range of protein, fat, and energy values of crabs in this study was relatively the same as the range of values obtained by Karim *et al.* (2017), namely protein (45.26-47.54%), fat (10.33-12.75%) with using different types of feed. Protein is a building block, regulator and burner). As a protein-building substance, it functions to repair damaged or shrinking tissue and to build new tissue (Kabangga *et al*., 2004).

IV. CONCLUSIONS

Based on the results of the research that has been carried out, it can be concluded that the survival of mangrove crabs reared in the silvofishery system is highest in Rhizophora mangrove and tilapia fish. Furthermore, the highest absolute growth was obtained in those reared on Rhizopora and Goldstripe sardinella.

REFERENCES

Adila, A., Septifitri, M. Ali., 2020. Fattening Mangrove Crab (*Scylla serrata*) with Different Feed. Journal of Fisheries and Aquaculture Sciences. Vol. 15. No. 2: 86-94.

AOAC. Official methods of analisys of the association of official analytical chemist. 15 th eds. Association of Official Analytical Chemist. Arlington VA. 2005.

Aslamyah, S & Fujaya, Y. 2012. Gastric Evacuation Rate, Chemical Body Composition, Liver and Muscle Glycogen, Molting and Growth of Mud Crabs Feeding on Different Percentages in the soft Shell Crab Cultivation. Aquaculture Study Program. Faculty of Marine Science and Fisheries. Hasanuddin University. Makassar.

Asriani, Karim, M. Y., H. Y. Azis. 2019. Study of Mud Crab (*Scylla olivacea*) Growth Which Cultivated In Silvofishery System In Various Types of Mangrove Vegetation. International Jurnal of scientific publications. Vol. 9. No. 2. 388-389

Harshith, U. P., Apoorva, M.D., Silva, P., Lima, A. 2016. Crab Diversity in mangrove and coastel ecosystem. Deptartemen of Zoology. St Aloysius Collage. Mangalur.

Hasnidar, Tamsil. A, Akram, A. M, Hidayat, T. 2021. "Chemical Analysis of Cattle Fish (*Pterygoplichthys Pardalis Castelnau* 1855) From Lake Tempe". JPHP Vol. 24 No.1: 78-88.

Jacob, J. P.; Carter, C. A., 2008. Inclusion of buckwheat in organic broiler diets. J. Appl. Poult. Res., 17 (4): 522–528

Kabangga, N. Palinggi N.N., Laining, A, & Pongsapan. D.S. 2004. Effect of different feed fat sources on retention growth and nutrient digestibility coefficients of humpback grouper, *Cromilep altivelis*. J. Indonesian Fisheries Research Journal, Vol. 10. No. 5: 71:79.

Karim, M, Y., Azis, H, Y., Muslimin., Tahya, A, M. 2016. Nutrient Content of Body and Growth as Physiological Responses of Mud Crab *Scylla olivacea* Reared Male Monosex in Mangrove. International Journal of Pharm Tech Research. Vol.9. No.6: 337-338.

Karim, M, Y., Azis, H, Y., Muslimin., Tahya, A, M. 2017. Physiological response: survival, growth, and nutrient content of the mud crabs (*Scylla olivacea*) which cultivated in mangrove area with different types of feed. AACL Bioflux. Vol. 10. No 6: 1534-1539.

Karim, M. Y., H. Y. Azis., dan M. Bunga. 2018. Fattening of Mangrove Crab (*Scylla olivacea*) Silvofishery System on Various Types of Mangrove Vegetation. National Seminar on Fisheries and Maritim at the University of Riau. Faculty of Marine Science and Fisheries. Hasanuddin University. Makassar.

Karim, M, Y. 2013. Mangrove Crab (*Scylla spp*.) (Bioecology, Cultivation and Hatchery). Yarsif Watampone. Jakarta

Karim. M. Y. 2007. Effect of Osmotic on Various Levels of Media Salinity on Vitality of Female Mangrove Crab (*Scylla olivacea*). Protein Journal. Vol 14. No. 1: 65-72.

Katiandagho, B. 2014. Analysis of fluctuations in water quality parameters on the molting activity of mud crab (*Scylla* sp). Scientific Journal of Agribusiness and Fisheries. Vol 7. No 2: 21-25

Kochey, J.K., 2013. Determination of thermal tolernace, Density and distribution of the mangrove crabs, perisesarm guttatum (sesarmidae) and *Uca urvillei* (Ocypodidae) at Gazi-bay. Kenya. Thesis. Department of Zoological Scinces. Kenyatta Univercity.

Manuputty G.D. 2014. Proximate feed and goldstripe sardinella *Sardeninella* sp. for fattening *Scylla serrata* mangrove crab. Chemica et Natura Acta Vol 2. No.3: 174-178.

Nagelkerken, I.S.J.m., Blaber, S., Bouilion, P., Green, M., Haywood, L.G. Kriton. J.O., Meynecke, J., Pawlik, H.M., Penroso, a., Sasekumar, P.J., Somerfield. 2008. The habitat of mangrove for terrestrial and marine fauna: A review. Jurnal Aquatic Botany 89: 155-185.

Prawita, N, A. 2018. Analysis of Mangrove Forest Damage in Indonesian Territory. Universitas Muhammadiyah Yoyakarta.Yogyakarta

Rahadiyani, M., Rachmawati, D., Samidjan, I. 2014. Substitution of fresh feed with artificial feed on the growth and survival of mangrove crabs (*Scylia paramamosain).* Journal of Aquaculture Management and Tecnology. Vol. 3. No.4. 34-39.

Sitorus, H., Lesmana, I., Taringan, R. 2017. Relationship of mangrove density with fish diversity in the waters of mangrove area at lubuk Kertang Village, Langkat District of North Sumatera. International Jurnal of Fisheries and Aquatic Studies. Vol. 5. No. 5: 266-271.

Tulangow C., Priyo Santoso dan Ade Y. H. Lukas. 2019. Effect of frequency of feeding bycatch fish on the growth of mangrove crab (*Scylla serrata*) using a battery system. Jurnal Aquatik, Vol 2. No.2. 1-10.

Wamnebo M.I., Abdul Rauf A.Yusuf K. 2022. Effect of Feeding Different Dosages of Cattle Fish (Pterygoplichthys spp) on Fattening Mangrove Crab (*Scylla sp*). Jurnal Airaha. Vol.11. No.01: 167-174

Wijaya N.I., Ninis T. Aniek S. 2019. Potential Development of Silvofishery Cultivation in Wonorejo Mangrove Area, Surabaya. Journal of Forest Research and Nature Conversion.Vol 16. No 2: 173-189

Wijaya, N.I.F., Yuianda, M., Boer, & Juwana S. 2010. Biology of mangrove crab populations (*Scylla serrata F*.) In The Mangrove Habitat of Kutai National Park, East Kutai District. Oceanology and Limnology in Indonesia. Vol. 36. No. 3: 443-461.

AUTHORS

First Author– Sukirman, Fisheries Science Study Program, Faculty of Marine Science and Fisheries, Hasanuddin University and sukirmanbahri@gmail.com.

Second Author– Zainuddin, Faculty of Marine Sciences and Fisheries, Hasanuddin University and zainudinlatief@gmail.com.

Third Author– Muhammad Yusri Karim, 2 Faculty of Marine Sciences and Fishery, Hasanuddin University and muhyusri.abdulkarim@gmail.com.

Correspondence Author– Sukirman, sukirmanbahri@gmail.com , +6285399962053