Study Of Mud Crab (*Scylla Olivacea*) Growth Which Cultivated In Silvofishery System In Various Types Of Mangrove Vegetation

Asriani[1], Muhammad Yusri Karim[2], Hasni Y. Azis[2]

[1] Magister Program of Fisheries Science, Hasanuddin University
[2] Marine Science and Fisheries Faculty of Hasanuddin University
Makassar – South Sulawesi

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Abstract - Silvofishery is a cultivation activity in the mangrove area without removing the function of the mangrove natural ecosystem. This study aims to find the best mangrove vegetation in the maintenance of silvofishery system mangrove crabs. The study was conducted in the mangrove area of Mandalle Village, Mandalle District, Pangkep Regency, South Sulawesi. The research container used a bamboo cage measuring 1.0x1.0x1.0 m which were plugged into 3 types of mangrove vegetation, namely: Avicennia, Rhizophora, and Sonneratia. The test crabs used were weighing 150 ± 10 g which were maintained for 40 days.

The results of non-parametric statistical analysis showed that mangrove vegetation had a significant effect (P <0.05) on litter productivity and growth of mangrove crabs, but did not significantly influence (P> 0.05) in mangrove crab systems. Rhizophora produced litter productivity and the highest growth was 2.51g / m2 / day with an N content of 2.55%, P of 0.57%, C of 8.76%, and absolute growth of 72 g.

Keywords: mangrove crabs, growth, silvofishery, mangrove vegetation.

I. INTRODUCTION

Mangroves are typical coastal ecosystems which are habitat for various organisms both land and sea which have various functions such as economic functions and ecological functions (Polidoro et al., 2010). Some types of vegetation that make up the mangrove ecosystem include Rhizophora, Sonneratia, Avicennia, and others (Paruntu et al. 2016). Although mangroves act as physical, ecological and economic functions, in reality, the existence of mangrove forests in Indonesia is increasingly caused by human factors themselves. There is an assumption that causes mangrove forests in Indonesia to be damaged, the first is utilization that is not controlled by humans, the second is the conversion of mangrove forests to various interests such as plantations, ponds, settlements, industrial estates, tourism, etc. without considering sustainability and its function to the surrounding environment (Sitorus et al., 2017; Prawita, 2018). Therefore, in order to maintain the sustainability of mangroves, a sustainable management model needs to be applied without destroying its natural functions. one of the cultivation methods that can be applied is mina or silvofishery.

Silvofishery is a cultivation activity in the mangrove area. The basic principle of the cultivation system is the multiple or multiple uses of mangroves without eliminating the function of the ecosystem naturally so that the fisheries and mangroves can still play a role as biological, ecological and economic functions. The main purpose of applying the silvofishery pattern is to prevent the widespread destruction of mangrove forests and to preserve the mangrove ecosystem (Fajri, 2013). Various types of biota that can be cultivated in mangrove areas with silvofishery patterns, one of which is mangrove crabs (Scylla spp).

Mangrove crabs are one of the fisheries commodities that have important economic value. As an export commodity, mangrove crabs develop and become a source of state income, consumer demand from year to year is relatively increasing (Siahaininea, 2008). Mangrove crabs have been well known in the market domestically and abroad because of their delicious meat taste and high nutritional value. Based on the results of the proximate analysis it is known that mangrove crab meat contains 44.85-50.58% protein, 10.52-13.08% fat and 3,579-3,724 kcal / g energy. In addition, crab meat contains various important nutrients such as minerals and fatty acids (Karim, 2013). Crab meat also contains EPA and DHA (Brown, 2008). Mangrove crabs are native habitat in the mangrove area, mangrove crabs can be cultivated in the soil and can be cultivated in mangrove areas (Juliette, 2010).

The mangrove ecosystem consists of various types of vegetation, and from the results of research (Zamroni and Rohyani, 2008) states that each type of mangrove vegetation produces different litter so that the contribution of nutrients to aquatic ecosystems is also different. Thus, differences in the type of mangrove vegetation as the location of mangrove crab cultivation in the silvofishery system are thought to result in different crab growth and quality. Therefore, a study of the type of mangrove vegetation is needed to obtain crabs that are fast growing and of high quality.

Formulation of the problem :

1. What is the content of C, N, and P litter on various types of mangrove vegetation ?

2. How does the metabolism of mangrove crabs maintain a silvofishery system in various types of mangrove vegetation ?
3. How is the survival and growth of mangrove crabs that are maintained by the silvofishery system on various types of mangrove vegetation ?

II. THE RESEARCH METHOD

The research was conducted from September to November 2018 in the mangrove area of Mandalle Village, Mandalle District, Pangkep Regency, South Sulawesi as a maintenance location.

The test animals used were male mangrove crabs (Scylla olivacea) measuring 150 ± 10 g, which were stocked with a density of 10 birds/confinement. The crabs were imported from crab collectors in Pallime Village, Cenrana District, Bone Regency, South Sulawesi.

The container used is a cage made of bamboo measuring length, width, and height of each 1.0 x 1.0 x 1.0 m which is plugged into mangrove vegetation according to treatment and a glass jar with a volume of 2 L each of 15 pieces filled with water. The outer part of the cage is coated with waring which aims to protect the confinement from garbage and dirt carried by the waves. The feed used is trash fish, which is obtained around the study site. The feed dose used is 10% of crab biomass with the frequency of feeding 1 time a day given in the afternoon.

Before the test crab is stocked first, the weight is selected and adapted to the environmental conditions of maintenance for 2 days. Adaptation is done by soaking the crabs into the water around the cage. Weighing the initial weight is also carried out before being stocked using a metering sit scale of 10 g.

The Sampling of litter in the mangrove ecosystem by installing Litter-Trap with a size of 100 x 100 cm made of nylon net. This litter trap is placed in the transect line on each plot measuring 10 x 10 m mangrove with a height of 1.5 m above the ground to avoid tide. Taking litter of mangrove samples is carried out once a week for five weeks as sampling replications start at 7, 14, 21, 28 and 35. This is intended to obtain data or results that are accurate and have a diversity of data. The litter that has been collected is weighed to get the value of its wet weight. Litter wet weight is obtained after weighing before being an oven. Litter dry weight was obtained after drying in an oven at 80 ° C until it reached a constant weight (Rudiansyah, 2013).

The study consisted of 3 treatments with 5 replications each. The three types of treatment are differences in mangrove vegetation, namely: A. Avicennia; B. Rhizophora, and C. Sonneratia.

The parameters observed in this study are mangrove litter production, survival, and growth. Litter production is calculated using the formula equation (Rudiansya, 2013):

$$X_j = \frac{\sum X_i}{n}$$

Description: Xj = Production of litter every period (gram dry weight / m2 / day), Xi = Dry weight of mangrove leaves (grams of dry weight), and n = Litter-trap area (m2)

The synthesis is calculated using the formula used by Huynh and Fotedar (2004):

$$S = (Nt / No) \times 100$$

Description: S = crab survival (%), No = number of crabs at the beginning of the study (tail), and Nt = number of crabs at the end of the study (tail)

The absolute growth of the average crab is calculated using the formula used by Effendie (2002) as follows:

$$W = Wt - Wo$$

Description: W = Growth in absolute weight of crabs (g), Wo = average weight of crabs at the beginning of the study (g), and Wt = average weight of crabs at the end of the study (g).

As supporting data during the research, measurements were taken of several physical-chemical parameters of water: temperature, salinity, pH, dissolved oxygen, ammonia, and nitrite. Temperature, salinity, pH, and dissolved oxygen are measured 2 times a day, ie in the morning (06.00) and in the afternoon (17.00). Ammonia and nitrite were measured 3 times during the study, namely at the beginning, middle and end of the study.

The data obtained were analyzed using non-parametric statistics Kruskal Wallis test and Mann Witney u test.

III. RESULTS

A. Litter Mangrove Production

The average value of litter productivity in various types of mangrove vegetation is presented in Table 1.

Table 1. The average value of litter productivity in various types of mangrove vegetation

Vegetation	Productivity ± sd			
	Litter production (g / m2 / day)	N(%)	P(%)	C(%)
Avicennia	$1{,}72 \pm 0{,}08^b$	$1{,}39 \pm 0{,}08^b$	$0{,}52 \pm 0{,}02^b$	$7{,}70 \pm 0{,}12^b$
Rhizophora	$2{,}51 \pm 0{,}05^a$	$2{,}55 \pm 0{,}15^a$	$0{,}57 \pm 0{,}02^a$	$8{,}76 \pm 0{,}17^a$
Sonneratia	$1{,}38 \pm 0{,}05^c$	$1{,}19 \pm 0{,}03^c$	$0{,}43 \pm 0{,}01^c$	$7{,}88 \pm 0{,}08^b$

Description: different letters show significant differences between treatments at the level of 5% (P <0.05)

The results of non-parametric statistical analysis of Kruskal Wallis showed that the type of mangrove vegetation had a very significant effect (P <0.01) on litter production and C, N, P. content. Furthermore, the results of the Mann Withney advanced test showed that there were significant differences (P <0, 05) on litter productivity between mangrove vegetation.

Based on Table 1 it can be seen that the highest litter productivity value is produced by Rhizophora compared to other vegetation. This shows that Rhizophora has a high fertility rate so that it can support the life of the organisms associated therein. If seen from the tree density level, Rhizophora has a higher density compared to Avicennia and Sonneratia. This is thought to be one of the causes of the high productivity of litter in Rhizophora compared to other vegetation. According to Hossain and Hoque (2008) the higher the density of trees the higher the production of litter. Besides the density level, litter production is also influenced by the type of mangrove. Different types of mangroves will have different litter production.

Mangrove plants are strongly influenced by salinity, very high salinity can cause stress on mangroves and cause relatively low growth (Dangremond et al., 2015). Mangroves abort their leaves to be able to adapt to environmental conditions that have high salinity because salts absorbed by mangroves will be stored on leaves (Zamroni and Rohyani, 2008). Mangrove leaves are the largest part of litter primary production (Sharil, 2008; Saban et al. 2013; Zhila et al., 2013; Hardianto et al., 2015; Naranjo et al., 2017).

The results obtained in this study are in line with the research of Zamroni and Rohyan (2008), Saban et al (2013), and Wahyuni (2016) which showed that the highest litter production was in Rhizophora because of its high density. Different results were obtained by Mchenga and Ali (2017) who obtained the highest annual litter productivity at Bruguiera by 3.0 dry tons/ha/year, followed by Rhizophora at 2.8 dry tons/ha/year, and Avicennia's lowest at 2.0 tons dry /ha/year. Similarly, Suriani (2017) found that the average production of Sonneratia litter was 4.38 g / m2 / day and Rhizophora was 3.61 g / m2 / day, where Sonneratia had larger tree heights and advances denser when compared to the type of Rhizophora. The results of the Susan et al (2013) study also showed that the largest litter production was obtained from the Sonneratia species of 1.28 tons/ha/3 months, followed by the Rhizophora species of 1.09 tons/ha/3 months and the Bruguiera lowest of 0.64 tons/ha/3 months.

B. Survival rate

The average survival of mangrove crabs maintained by the silvofishery system on various types of mangrove vegetation is presented in Table 2.

Table 2. The average survival of mangrove crabs that are maintained by silvofishery systems in various types of mangrove vegetation

Vegetation	**Survival rate (%) ± sd**
Avicennia	84,00 ± 5,47[a]
Rhizophora	86,00 ± 5,47[a]
Sonneratia	86,00 ± 5,47[a]

Description: the same letter shows the value that is not significantly different between treatments at the level of 5% (P <0.05)

The results of non-parametric analysis of Kruskal Wallis showed that differences in mangrove vegetation had no significant effect (P> 0.05) on the survival of mangrove crabs. This shows that the difference in mangrove vegetation as a cultivation location results in the survival of the same mangrove crab. There is no difference in the survival of mangrove crabs in this study because mangroves are the native habitat of mangrove crabs. Mangrove vegetation is important for crabs as habitats and food providers (Maxemilie et al., 2014). The role of mangrove vegetation causes the condition of mangrove vegetation to be directly proportional to the abundance of mangrove crabs (Miranto et al., 2014).

Based on Table 2, it can be seen that the average survival value of mangrove crabs produced in this study is quite high, ranging from 84-86%. The results obtained in this study are higher than those of Sulaeman et al. (2008) who only got 41% survival. However, it is lower than Sagala et al. (2013) who get 100% survival using the basic confinement method in a single space (single room). The same value was also obtained by Natan (2014), namely life survival reached 100% with a stocking density of 1 bird/confinement because his life was isolated in each maintenance box so there was no cannibalism process.

Mangroves and mangrove crabs live in symbiosis because mangroves provide suitable habitat for mangrove crabs and conversely mangrove crabs help in introducing oxygen into the mangrove substrate (Nagelkerken, 2008; Kochey, 2013). Mangrove crabs have a high survival rate due to the fact that the location of the research on mangrove land is still quite good so that it can support the survival of mangrove crabs. According to (Triyanto et al., 2013; Lapolo et al., 2018), damage to mangrove ecosystems can result in a decline in mangrove crab populations. Mangrove loss will be followed by a lack of crab species found in the mangrove habitat (Akpaniteaku, 2014).

C. Growth

The average value of growth of mangrove crabs maintained by the silvofishery system on various types of mangrove vegetation is presented in Table 3.

Table 3. The Growth of mangrove crabs that are maintained by silvofishery systems in various types of mangrove vegetation

Vegetation	**Absolute Growth (g) ± sd**
Avicennia	70,20 ± 1,02[ab]
Rhizophora	72,00 ± 0,55[a]
Sonneratia	69,43 ± 0,81[b]

Description: the same letter shows the value that is not significantly different between treatments at the level of 5% (P <0.05)

The results of the non-parametric statistical analysis of Kruskal Wallis showed that the type of mangrove vegetation had a significant effect (P <0.05) on the absolute growth of mangrove crabs. Furthermore, the results of the follow-up analysis of the Mann Withney analysis showed significant differences (P <0.05) between the types of mangrove vegetation in the growth of mangrove crabs.

Based on Table 3 above, it can be seen that the absolute growth of mangrove crabs is best produced in Rhizophora. The absolute growth value of mangrove crabs maintained by the silvofishery system on various types of mangrove vegetation is around 69.43-70.20 g, the value of this range is higher than that of Samidjan and Rachmawati (2014) who got the highest absolute growth value of 56.5 g. While Sugiani (2014) obtained a high value of absolute growth, namely range 67.08-106.54 g. The results of the study by Irwani and Suryono (2012) show that crabs raised in mangrove areas have greater growth compared to those that are maintained in waters without mangroves, this proves that mangroves give something positive to the lives of crabs.

The highest absolute growth was obtained in Rhizophora because this vegetation had higher litter productivity compared to Avicennia vegetation and Sonneratia vegetation. Litter productivity greatly influences the quality of the mangrove ecosystem. Mangrove litter in the form of leaves, twigs and other biomass that fall also become a source of food for various animals and at the same time become nutrients that play a role in the productivity of marine fisheries (Zamroni and Rohyani, 2008). The quality of habitat environment greatly influences the speed of crab growth (La Sara, 2010).

In addition to high litter productivity, the abundance of macrozoobenthos in Rhizophora is also higher than that of other vegetation. The abundance and distribution of macrozoobenthos influence the presence of mangrove crabs in a waters region. Mangrove crabs are omnivorous scavengers. Adult mangrove crabs are benthos-eating organisms or slow-moving organisms (Arirola, 1940; Webley, 2008; Irwani and Suryono, 2012; Karim, 2013). Satheeshkumar and Khan (2011), that environmental quality such as salinity, oxygen, temperature, and nutrition affect the growth of biota either directly or indirectly. Availability of feed and sufficient levels of feed utilization in Rhizophora cause the growth of mangrove crabs in this vegetation to be higher than that of other vegetation.

D. Water Quality

During the research, measurements were taken of several physical-chemical parameters of the water for the maintenance of mangrove crabs presented in Table 4 as follows:

Table 4. Results of measurements of the physical chemistry of water environment maintenance of mud crab silvofishery systems in various types of mangrove vegetation

Parameter	**Value range**	**Optimal Range**
Temperature ^{o}C	25 – 30	25-35 ^{o}C (Shelley dan Lovatelli, 2011)
pH	7,08 – 7,95	6,50-7,50 (Siahainenia, 2008)
Salinity (ppt)	17 – 29	15-25 ppt (Setiawan dan Triyanto, 2012)
DO (ppm)	3,12 – 4,45	3-8 mg/L (Fujaya, 2008)
Ammonia (ppm)	0,005 – 0,012	(<0,1 ppm) (Karim, 2013)
Nitrite (ppm)	0,22 – 0,40	(0,5 ppm) (Karim, 2013)

The temperature obtained during the study ranged from 25-30 ^{o}C, the pH value obtained during the study ranged from 7.08 to 7.95. The range of salinity values obtained during the study was 17-29 ppt, the dissolved oxygen values obtained ranged from 3,12–4, 45 ppm, the average value of the ammonia range obtained during the study was 0.005 - 0.012 ppm, nitrite obtained during the study was 0.22 - 0.40 ppm. Niai this range is still considered suitable for the lives of mangrove crabs.

CONCLUSION

Litter productivity and the highest growth were generated in Rhizophora while the synthesis obtained was relatively the same for each mangrove vegetation.

SUGGESTION

In the cultivation of mangrove crabs which are maintained by the silvofishery system, it is recommended to maintain the vegetation of Rhizophora.

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