Fattening of Mangrove Crab (*Scylla olivacea*) By Silvofishery System with Different Feeding Frequency

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DOI: 10.29322/IJSRP.9.03.2019.p8709
http://dx.doi.org/10.29322/IJSRP.9.03.2019.p8709

Abstract: Mangrove crab culture within mangrove areas may be simultaneously done with silvofishery system i.e. an integrated cultivation activity of multiple uses of mangrove without eliminating the natural function of the ecosystems. This study was aimed to determine the frequency of efficient and effective feeding in the fattening cultivation of mangrove crabs (*Scylla olivacea*) which maintained the pattern of silvofishery. The research was conducted in mangrove areas of Pangkep Regency, South Sulawesi. The tested animals used were male mangrove (*S. olivacea*) crabs measuring 200 ± 10 g weighing 10 imdividuals/cage. The container used was a cage made of bamboo that placed in the mangrove areas. The feed used was trash fish dose 10% from crab biomass. The study used a complete randomized design consisting of five treatments and three replicates. The data obtained were analyzed using the Analysis of Variance (ANOVA) and W-Tuckey's advanced test. The results of variance analysis showed that feeding frequency had a very significant effect ($p < 0.01$) on the stability and growth of mangrove crab. Frequency of feeding twice a day and once dailyresulted in the same synthesis ($p > 0.05$) and significantly higher than other treatments ($p < 0.05$), and the lowest at feeding frequency of once per four days.

Keywords: feeding frequency, growth rate, mud crab, silvofishery, survival rate

INTRODUCTION

Mangrove is a typical coastal ecosystem that has high productivity and serves many physical, ecological and economical functions (Ong and Gong, 2013; Lee et al., 2014). The existence of interactions among the components of the mangrove ecosystem makes the ecosystem as a good habitat for various types of biota. In addition to tidal conditions and fertility that supports, mangrove has the potency to be developed into aquaculture area. In addition, the fact that we often encounter many areas of mangrove land have been converted into ponds.

The activity of the transfer of natural mangrove function into aquaculture area (economic function) is often not pay attention to the aspects of sustainability and feasibility. As a result, there is a decrease in the environmental quality so that cause threat to various species of mangrove fauna. Taking into account the various functions, then the effort to convert mangrove into a farm must be done rationally with environmental insight. Therefore, it is necessary to apply a system that can guarantee both interests. One system that considered as a solution is silvofishery. Silvofishery is a cultivation activity in the mangrove area with no loss of natural ecosystem function and obtained fishery results and various types of economical biota that can be cultivated in the mangrove area with silvofishery pattern, one of which is mangrove crab (*Scylla* sp.).

Mangrove Crab (*Scylla olivacea*) is one of the important economic commodity fishery that is favored by consumers both domestically and abroad because of its delicious and high nutritious meat taste which contains various important nutrients such as ω-3 fatty acids, amino acid, proteinand mineral (Sakthivel et al, 2013; Paul et al., 2015; Karim et al., 2017). So far, the consumer needs for most of the mangrove crab still filled from the results of arrests in nature that are fluctuating. Along with the increasing consumer demand for mangrove crab, especially in the international market demands sustainable crab production that can only be met through intensive cultivation efforts.

In general, the activities of mangrove crab cultivation consist of: enlargement, fattening, production of eggs, and soft shell crab production. Fattening of mangrove crab is an attempt to increase the weight of crab. Efforts to produce mangrove crab through fattening activities have been conducted in ponds with cage system and mangrove area (Begum et al., 2009;

Santhanakumar et al., 2010). Mangrove area is a natural habitat of potential crabs to be used as a cultivation area of fattening crab mangrove with silvofishery system.

One of the factors that influence the success of mangrove crab cultivation is feed. Mangrove crab cultivation business, generally still looking for technology systems and feed management is effective and efficient, with the frequency of feeding is still uncertain. The right frequency of feeding is important to know when the proper time to feed so that feeding becomes more efficient. However, until now there has been no standard reference on the frequency of feed for fattening crab mangrove. Frequency of feeding effect on feed availability, feeding, and feed utilization have an effect on crab metabolism which ultimately have an effect on crabs' growth and growth.

The purpose of this study is to determine the frequency of feeding that is efficient and effective in generating maturity, growth and production of mangrove crab to the maximum maintained silvofishery pattern.

RESEARCH METHODS

This research was conducted in mangrove areas of Pangkep Regency, South Sulawesi, Indonesia. The tested animals used were male mangrove crab (*Scylla olivacea*) measuring 250 ± 10 g. The crabs were supplied by crab collectors from Pallime Village, Cenrana Subdistrict, Bone District, South Sulawesi, Indonesia.

The container used was a cage made of bamboo with length, width, and height of 1.0m x 1.0m x 1.0m each and placed in the mangrove area. The outside of the confinement was coated by *waring* (plastic net) which aimed to protect the confinement from garbage and dirt brought by the waves.

The feed used was trash fish, which obtained from the vicinity of the study site. The feed dose used was 10% of crab biomass with feeding frequency according to treatment. To keep the water circulation in confinence flowing smoothly, the space among the bamboo slices was given a space of about 1 cm. To facilitate feeding and controlling the crabs, on the upper part of the cage was given a door that can be opened at any time.

Before starting the experiment, crabs were firstly stocked, the weight was measured and adapted to the culture environment condition for two days. Adaptation was applied by soaking the crabs into the water around the cage. Weighing the initial weights were also done before being stocked with a weight of 10 g. At the end of the study, the calculation of the number of live crabs and weighing back the body weight.

The study was designed using a completely randomized design consisting of five treatments and each treatment had three replications. Thus, this research consisted of 15 experimental units. The treatments were the difference of frequency of feeding, namely: A. Twice a day; B. Once a day; C. Once per two days; D. Once per three days; and E. Once per four days.

The placement of research containers was randomly assigned based on a complete randomized design pattern (Steel et al., 1997). The parameters observed in this study were the stability, growth and production of mangrove crabs.
The mangrove crabs passed was calculated using formulas as follows:

$$S = (N_t / N_o) \times 100$$

Where: S = crab stability (%), N_o = number of crabs at the beginning of the study (tail), and N_t = number of crabs at the end of the study (individuals)
The daily specific weight rate of crabs is calculated using the formula (Changbo et al., 2004) as follows:

$$SGR = 100 \times (\ln W_t - \ln W_o) / t$$

Where SGR = daily crab-specific growth rate (%/day), W_o = average crab weight at the beginning of the study (g), and W_t = average crab weight at the end of the study (g), and t = length of maintenance (days)
Crab biomass production was calculated at the end of the study by weighing all remaining living crabs harvested.

During the experiment, measurements of several parameters of environmental chemistry of crab maintenance include salinity, temperature, pH, dissolved oxygen, ammonia, nitrite, and turbidity

Data obtained in the form of syntax, growth, and production was analyzed using analysis of variance (ANOVA) and further test of W-Tuckey. SPSS version 20 program packagewas used as a tool for the statistical test. The water quality data obtained were analyzed descriptively based on live feasibility of mangrove crab (*S. olivacea*).

RESULTS AND DISCUSSION

Survival Rate

Average of Survival rate of mangrove crab that cultured by silvofishery pattern with different feeding frequency is presented in Table 1.

The result of variance analysis showed that feeding frequency had a very significant effect ($p < 0.01$) on the mangrove crab survival maintained by silvofishery pattern. Furthermore, W-Tuckey's further test showed that amongn feeding frequencies twice a day, once a day, and once per two days yields the same synthesis ($p > 0.05$) and higher than feeding frequency of once per three days and once per four days ($p < 0.05$).

Table 1. Average of survival rate of mangrove crab that cultured with different feeding frequency

Frequency of Feeding Requirement (%)	Survival Rate (%)
twice a day	96.67 ± 5.77[a]
onces a day	96.67 ± 5.77[a]
once per 2 days	93.33 ± 11.55[a]
once per 3 days	76.67 ± 5.77[b]
once per 4 days	53.33 ± 5.77[c]

Description: significantly different among treatments at 5% level (p <0.05)

Growth and Production

Average daily growth rates and mangrove crab production cultured by silvofishery patterns with different feeding frequencies are presented in Table 2. Variance Analysis results showed that feeding frequency significantly affected (p <0.01) in daily growth rates and mangrove crab production which cultured the pattern of silvofishery. The result of variance analysis showed that feeding frequency had significant effect (p <0.01) on daily growth rate and mangrove crab production maintained by silvofishery pattern.

Table 2. Average growth rate and Production of mangrove crabs cultured with silvofishery system with different feeding frequencies

Frequency of Feeding Requirement (%)	Daily Growth Rate (% / day)	Production (g)
twice a day	1,05 ± 0,02 [a]	2417,33 ± 134,15[a]
onces a day	1,04 ± 0,02[a]	2407,67 ± 148,07[a]
once per 2 days	0,99 ± 0,03[a]	2267,33 ± 132,95[a]
once per 3 days	0,67 ± 0,00[b]	1761,33 ± 131,92[b]
once per 4 days	0,52 ± 0,05[c]	1268,33 ± 141,45[c]

Description: significantly different among treatments at 5% level (p <0.05)

Further test results W-Tuckey showed that among feeding frequencies of twice a day, once a daily, and once per two days resulted in the same synthesis (p> 0.05) and higher than feeding frequency of once per three days and once per four days (p <0.05).

Water Physico-Chemistry

During the research conducted measurement of several parameters of environmental chemistry of crab maintenance. The values of the chemical range of aquatic environment chemistry during the study are presented in Table 3.

Table 3. Range of environmental chemical parameters of crab maintenance during maintenance research

Parameters	Value Range
Temperature (ºC)	25 – 30
pH	7,11 - 7,93
Salinity (ppt)	18 - 27
DO (ppm)	3.62 - 4.39
Ammonia (ppm)	0.005 - 0.009
Nitrite (ppm)	0.27 - 0.38
Turbidity (NTU)	22,17 - 29,69

Discussion

Table 1 demonstrates that the synthesis, daily growth rate, and production of mangrove crabs maintained by the highest silvofishery pattern are produced at the highest feeding frequency of twice daily, once daily and once per two days while the lowest was produced at feeding frequency of once per four days.

In general, the syntax value obtained in this study ranged from 53.33-96.66%. Some research results about the fattening of mangrove crabs conducted in ponds, among others, by Trino and Rodrigues (2001) obtained 47-56% syntax, while Begum et al. (2009) obtained 86.25-93.75% syntax. In fact, research on the fattening of silvofishery mangrove crabs has been done using cages and pens obtained by 31.3-53.2% (David, 2009), Mireraand Mtile (2009) 35.0-61.5%, while Karim et al. (2015) obtained 61.67-93.33% synthesis maintained a pattern of silvofishery monosex systems with different densities.

The lowest survival rate of crabs fed with frequency of once within four days. This was due to the subsequent feeding within four days causing the existing feed to be damaged or destroyed so carried by the movement of the water. In addition, there was competition by microorganisms such as bacteria or other organisms that entered through the cracks of confinement.

Table 1 also shows that daily growth rates and mangrove crab production are highest in crabs fed with feeding frequencies of twice daily, once daily, and once per two days, while the lowest was observed in crabs fed once per four days. This shows that the growth and production of mangrove crabs were influenced by the frequency of feeding. Frequency of frequent feeding will cause the availability of feed at any time so that the crabs can use the feed according to their requirements. However, if the frequency of feeding of twice a day i.e. morning and evening resulted syntax, growth, and crab biomass the same with once in 1 to 2 days, then for the efficiency of feeding time it is sufficient to apply once in two days. Feeding should be done in the afternoon considering the feeding activity of crabs increases at night.

The daily growth rate of mangrove crab obtained in this study ranged from 0.52-1.05% / day and absolute growth ranged from 23.67 to 49.45 g. Trino and Rodriguez (2001) gained 0.9% per day growth of mangrove crabs, while David (2009) gained 1,3 and 0.7% / day cultured using cages and pens.

The suitability of water physic-chemistry in an environmental culture plays an important role in supporting the life and growth of mangrove crabs. Cortes-Jacinto et al. (2005) suggested that the physical and chemical aspects of water affect the physiological functions of aquatic organisms including their synthesis and growth. Based on Table 2, the environmental temperature of crab maintenance during the study ranged from 25-30 oC, pH 7.11 to 7.93, salinity 23-27 ppm, dissolved oxygen 3,62-4,39 ppm, ammonia 0,005-0, 00 ppm, nitrite 0.27-0.38 ppm, and turbidity 22.17-29.69 NTU. The range of values were feasible to support the life of mangrove crabs. Optimum temperatures for mangrove crab growth were 26 to 32 oC, pH ranging from 7.0 to 8.5; dissolved oxygen> from 3 ppm, ammonia <0.1 ppm and nitrites <0.5 ppm (Christensen et al. 2005). The turbidity level of waters allowed for marine cultivation was <30 NTU. (Boyd, 1990; Mwaluma, 2002; Karim, 2017).

CONCLUSION

The highest rate of daily growth and production of mangrove crab were produced on crabs fed twice daily, once daily and once per two days, while the lowest was observed in crabs fed once per four days.

For the cultivation of mangrove crab fattening silvofishery pattern for efficient feeding is sufficiently done once per two days i.e. in the afternoon.

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