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The Effect of Different Feeding Frequency on Specific Grow Rate, Survival Rate, and Canibalism of Culture Blue Swimming Crab (*Portunus pelagicus*)

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A B S T R A C T

Blue swimming crab (Portunus pelagicus) is a product commercial fishery that crab has high economic value. Therefore, the population of P.pelagicus is decreasing because of over exploitation. Blue Swimming crab culture is option to overcome this problem but cannibalism inhibits the survival rate of P.pelagicus. Cannibalism will be occurred when crabs are hungry and an increase in appetite to prey on molting crab. The hypothesis of this research is higher feeding frequency will minimize periods with feed shortage and the appetite to prey on the molting crab. This research uses blue swimming crab size 2-3cm with weight 2-5gr. The research used completed random design with 3x repeated and 4 treatments. This research was doing for 42 days. Treatment for this research is different frequency A:1x, B:2x, C:3x, D: 4x of days. The result of this research is different feeding frequency has significant effect on specific growth rate (SGR) but not for survival rate (SR) of blue swimming crab. The best treatment of this research is the twice fed (B) is the best feeding frequency for blue swimming crab (Portunus pelagicus) with value of SR 70,0±10,00%, SGR 4,35±0,44%, Cannibalism 13,33±5,77%. Water quality value during of research was ranged temperature 25,8-27,5 °C, salinity 23-25 ppt, pH 8,3-8,11, DO 4,7-5,6mg/L, ammonia 0,07-0,49mg/L, and nitrite 0,01-0,2mg/L

Keywords: *Blue Swimming Crab, Feeding, Growth, Survival Rate, Cannibalism*

Introduction

Blue swimming crab is a fishery product that is much favoured by the public. Blue swimming crab has long been the belle of Indonesian society and foreign society. Crab meat has been exported in various countries, such as Japan, Singapore, and the United States. Blue Swimming crab has high economic value and is still difficult to find in the market. This is not in line with market demand that continues to increase, according to Kurnia *et al*., (2014) crab production in Indonesia still relies on catches from nature, while market demand continues to increase. The small blue swimming crab exported is in the form of canned meat. Indonesia's blue swimming crab exports in 2011 reached 42,410 tons with a value of ± Rp. 978 billion rupiah. This is also reinforced by the CTF data (2012) that in 2012 it reached 28,211 tons with a value of 329.7 million US dollars, in 2013 it increased to 34,172 tons with a value of 359.3 million US dollars, in 2014 it only reached 28,090 tons with the value of 414.3 million US dollars, while in 2015 it reached 29,038 tons with a value of 321,842 US dollars.

Because it has a high economic value, often the blue swimming crab seekers in nature look for too much so that exploitation occurs. The existence of blue swimming crab in nature is increasingly difficult to find. This is reinforced by Ningrum *et al*., (2015) that crab is a type of sea crab that is found in many Indonesian waters. All exported crab products still rely on the catch from the sea. The occurrence of natural damage causes the original habitat of crabs increasingly threatened, so that crab production in nature is getting lower. Therefore, it is necessary to do aquaculture activities to increase crab production to become a market commodity, both local and export so that it can improve the community's economy.

Blue swimming crabs is an carnivorous animals. Carnivorous animals tend to have cannibal properties towards their friends. Cannibal traits can occur due to genetic or environmental factors. The nature of cannibal crab often becomes a problem for farmers, because with the occurrence of cannibalism, it will reduce the value of *survival rate* (SR) during the cultivation process. Resulting in decreased yields obtained. This is reinforced by the statements of Suharyanto and Yudhistira, (2012), which stated that cannibalism is usually caused by genetic factors and living habits, the differences in size contained in one container of cultivation are the main causes. These habits are also influenced by environmental conditions such as food availability, food type, population, light intensity, density, shade, and water clarity. Ways to minimize the nature of cannibalism by giving the right feed,

both the amount, time, and method. Timely feeding can minimize cannibalism in crabs. According to Suharyanto and Yudhistira, (2012), proper feeding is two to three times a day to minimize cannibalism.

Efforts to increase blue swimming crab production are necessary for culture activities. But in cultivation activities have problems that are often faced. The problem that is often faced is the nature of cannibalism in the crab. Cannibalism that occurs will affect the *survival rate* (SR) in aquaculture activities. This will be detrimental to farmers because the results obtained are small. To reduce cannibalism, it is necessary to do good feeding. Feed is an important component so that the crab does not become a cannibal. This is confirmed by Zaidin *et al*., (2013) stating that feed is the main component needed by crabs to maintain its survival and growth. Completeness of nutrients in the feed must be needed to maintain the growth of the crab can take place normally.

Research Method

Test animals used for research are small crab seeds in young crab stadia with a size of 2-3 cm. The density of crab seeds in this study is 10 tails/pond. The number of small crab seeds used in this study is 120 small crab seeds. Test animals used are weighing 10 grams per head. Feed used in the study and also the treatment of test animals are shrimp pellets with a protein content of 30% with a dose of 5% of the weight of the test animal biomass per day. Feeding is done as much as A: once a day; B: twice a day; C: three times a day; D: four times a day.

The pond used is a round tarpaulin pond with a height of 1m and a diameter of 1.8m with a water level of around 50cm. The volume of the pond is 1,27 L. Media used in pond are brackish water and sand that function as shelters. The tools used in this research are as follows, digital scales to weigh the blue swimming crab weight, callipers used to measure the length of the blue swimming crab carapace. Blower and hose which is a tool for oxygen supply. Another tool used is the *water quality checker* used to measure water quality.

The experimental design used was a completely randomized design (CRD). This study uses 4 treatments and 3 repetitions. The treatments carried out in this study are as follows:

Treatment A: 1x a day (06.00am)

Treatment B: 2x a day (06.00am and 06.00pm)

Treatment C: 3x a day (06.00am, 12.00am, and 06.00pm)

Treatment D: 4x a day (06.00am, 12.00am, 06.00pm and 12.00pm)

Each treatment carried out each gets 3 replications. The placement of the pond used to conduct research randomized*(random).* The research procedure has several stages, including the preparation of an enlargement pond, stocking of test animals, the maintenance process, measurement of water quality, and field analysis. Swimming crab was obtained from the Central Brackish Aquaculture Fisheries (BPPBAP) Jepara. The crab used has a carapace length of 2 - 3cm. The pellets used in this study were shrimp pellets with a protein content of 30%. During the maintenance process, crabs are fed as much as 5% of the weight of biomass with the frequency of feed in accordance with the treatment given. The observation of water quality itself includes observations of temperature, salinity, DO and pH for which data are taken daily, while for ammonia observations are carried out once a week. The maintance of culture blue swimming crab was doing on 42 days.

The data used in this study are life pass, growth, cannibalism, and water quality during the culture of blue swimming crab:

a. Specific Grow Rate

Specific growth rate *(*Specific Growth Rate) of shrimp calculated using the formula: SGR weight Hidayat *et al*., (2014)

$$SGR = \frac{\text{Ln Wt - LnWo}}{t} \times 100\ \%$$

Where:

SGR = specific growth rate (% / day)
Ln Wt = average final body weight maintenance (g)
Ln Wo = average initial body weight maintenance (g)
t = length of maintenance (days)

b. Survival (SR)

According to Suharyanto and Yudhistira, (2012), survival is a percentage of cultivation life that can be calculated with the following formula:

$$SR = \frac{N_t}{N_o} \times 100\ \%$$

Where:

SR = survival rate (%)
Nt = number of fish at the end of treatment (ind)
N0 = number of fish at the beginning of treatment (ind)

c. Canibalism

Cannibalism can be calculated based on formulas from Suharyanto and Yudhistira, (2012) as follows:

$$K = \frac{KA - KS - KBK}{KA} \times 100\ \%$$

Where:

K = cannibalism level

KA = initial amount

KS = number of remaining (alive)

KBK = number of deaths not due to cannibalism

d. Water Quality

Quality is measured every week using a *water quality checker*. The measured variable is the acidity (pH) of water, dissolved oxygen (DO) (mg / l), temperature (°C), salinity was measured every day. Where as amonia and nitirate are measured once a week.

Result

Specific Growth Rate

Based on data value growth of blue swimming crab (P.*pelagicus*) on each maintance week, the specific growth rate (SGR) blue swimming crab. The results of the calculation of the specific growth rate (SGR) in the crab can be seen in Table 1.

Tabel 1. Specific growth rate (SGR) of culture blue swimming crab

Treatment	SGR (%)			
	Repitition			Average±SD
	I	II	III	
A	3,14	3,59	3,74	3,49±0,31[a]
B	3,99	4,21	4,83	4,35±0,44[b]
C	3,75	3,85	3,70	3,77±0,08[a]
D	3,89	3,50	3,19	3,53±0,35[a]

Note: same superscript [a]) dont have impact, [b]) have real impac

Based on Table 1 data, the highest specific value added value (SGR) for blue swimming crab (P. pelagicus) in treatment B is 4.35 ± 0.44 and the lowest value required for treatment A is 3.49 ± 0.31.

This can be seen in the specific growth rate chart (SGR) of the crab (P. *pelagicus*) as in Figure 1.

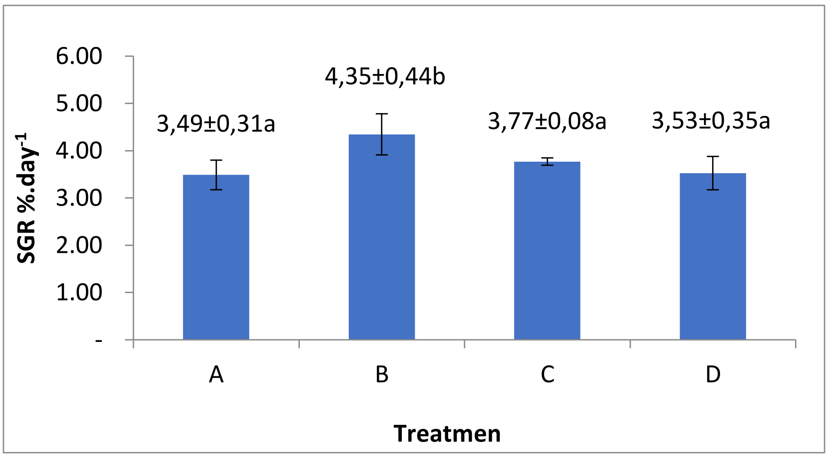

Figure 1. chart of specific growth rate of culture blue swimming crab

Survival Rate

Based on data on the number of blue swimming crab rearing (*P. pelagicus*) at the beginning and end of maintenance, the survival value of crabs is obtained. The results of calculating the survival rate (SR) in the crab are listed in Table 2.

Table 2. Survival rate (SR) of culture blue swimming crab

Treatment	SR (%)			
	Repitition			Rerata±SD
	I	II	III	
A	70,00	60,00	60,00	63,33±5,77[a]
B	70,00	60,00	80,00	70,00±10,00[a]
C	70,00	60,00	70,00	66,67±5,77[a]
D	50,00	80,00	80,00	70,00±17,32[a]

Note : same superscript show dont have impact

Based on Table 2 data, the highest specific value added value (SR) for blue swimming crab (P. *pelagicus*) in treatment B is 70,00 ± 10,00 and the lowest value required for treatment A is 63,33 ± 5,77.
This can be seen in the survival rate chart (SR) of the crab (P. *pelagicus*) as in Figure 2.

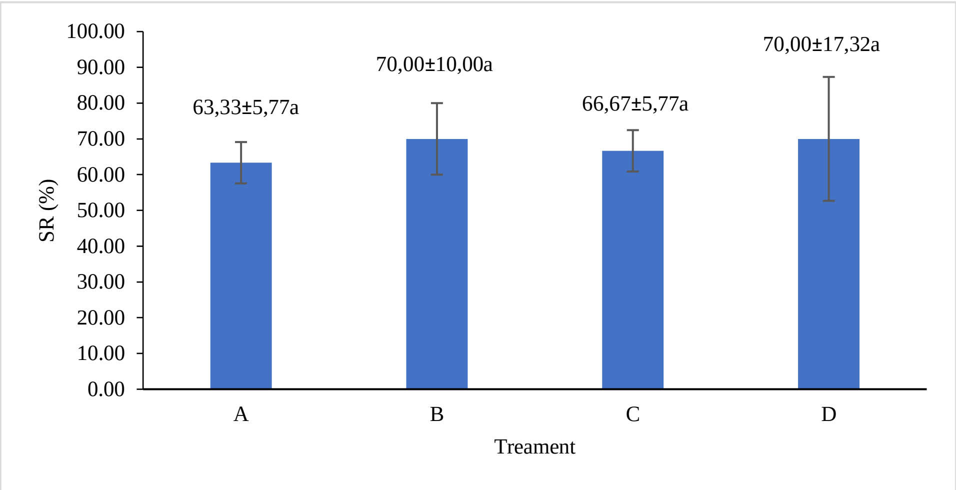

Figure 2. chart of survival rate culture blue swimming crab

Canibalism

The level of cannibalism in rearing blue swimming crabs (*P. pelagicus*) on a weekly. Obtained the value of crab cannibalism. The results of calculating the level of cannibalism in the crab can be seen in Table 3.

Table 3. Cannibalism of culture blue swimming crab

Perlakuan	Kanibalisme			
	Ulangan			Rerata±SD
	I	II	III	
A	20,00	30,00	20,00	23,33±5,77[a]
B	10,00	20,00	10,00	13,33±5,77[a]
C	20,00	10,00	10,00	13,33±5,77[a]
D	20,00	10,00	10,00	13,33±5,77[a]

Note : same superscript show dont have impact

Based on Table 3 data, the highest specific value added value cannibalism for blue swimming crab (P. *pelagicus*) in treatment A is 23,33 ± 5,77 and the lowest value required for treatment B,C,D is 13,33 ± 5,77.

This can be seen in the canibalism chart of the crab (P. *pelagicus*) as in Figure 3.

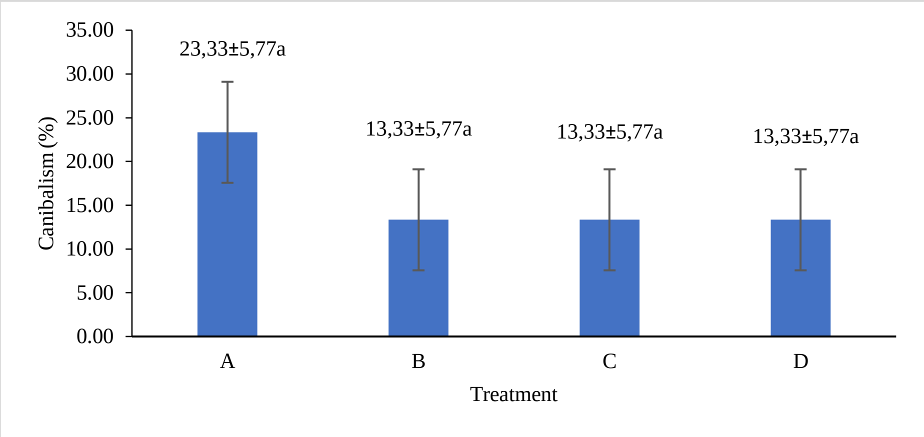

Figure 3. chart of canibalism culture blue swimming crab

Water quality

Value of water quality during maintenance of the crab (*P. pelagicus*). Obtained the value of water quality during the enlargement activity of the small crab can be seen in Table 4.

Table 4. Results of Water Quality Measurement of Small Crab Maintenance

Variabel	Treatment				Standard
	A	B	C	D	
Temperature (^{0}C)	25,7 - 26,8	25,8 - 27,5	25,9 - 27,6	26 - 26,8	21-30,0 [a]
pH	8,13 - 8,7	8,3 - 8,11	8,2 - 8,8	8,5 - 8,9	7 – 9 [b]
Salinity (ppt)	23 - 25	23 - 25	23 - 25	23 - 25	10-30 [a]
DO (mg/L)	4,8 - 5,3	4,7 - 5,6	4,7 - 5,4	4,8 - 5,1	4-6 [c]
Ammonia (mg/L)	0,13 - 0,60	0,07 - 0,49	0,13 - 0,40	0,06 - 0,47	<0,1 [c]
Nitrite (mg/L)	0,01 - 0,07	0,01 - 0,2	0,01 - 0,2	0,01 - 0,3	<0,5 [d]

Note : a. Astuti (2008)
b. Hastuti *et al.,* (2015)
c. Rejeki *et al.,* (2019)
d. Karim (2007)

4. Discussion

A The results obtained from the rearing of crab enlargement for 42 days, obtained results that have a significant effect on the specific growth rate (SGR). Treatment B (feeding 2x a day) significantly affected compared to other treatments. According to statements from Suharyanto and Yudhistira (2012), that the frequency of proper feeding for crabs is two to three times a day will provide optimum growth for blue swimming crabs. The frequency of proper feeding will provide increased growth for the crab. Frequency of feed can increase the rate of food flow in the digestive tract so as to produce optimum growth. In addition, digestibility also affects growth in the crab. This is reinforced by the statement from Suharyanto (2012), that the frequency of feeding fish will increase the rate of food flow in the digestive tract. In addition to digestibility of feed, which causes differences in growth is also caused by the quality of the food itself. The frequency of feeding the fish will increase the rate of food flow in the digestive tract. If food is not enough, it will disrupt the process so that there is no uniform size. The difference in size is one of the causes of cannibalism where large individuals in a hungry condition will eat smaller individuals.

The results obtained during the small crab (P. pelagicus) maintenance activities, from the four treatments, had no significant effect on the crab's survival rate. The blue swimming crab at the beginning of maintenance is in the period of adaptation to the new environment. Blue swimming crabs that are in the process of adaptation need more energy to adapt to the environment. If this adaptation period lasts longer than other crabs, it is easily devoured by other crabs. According to a statement from Djunaedi (2009), that the crab at the beginning of maintenance is in the process of adapting to the new environment, so it requires more energy and becomes weaker which results in being more easily devoured by other crabs. During the initial weeks of maintenance, some deaths occur due to adaptation to the environment. Having the characteristics of a complete body, pale orange and foul-smelling conditions. This does not happen in the middle to the end because the crabs are able to adapt to their environment. The value of the crab's survival rate can be influenced by various factors, including the stage used and water quality in the crab rearing media. Stadia used are crabs that are still in the crablet stage, so they are more vulnerable than adult crabs. This was confirmed by Marshall et al. (2005), that the crab on the crablet stage is more vulnerable than the larger crab. Small crab (P. pelagicus) at this size especially when premolt shows very high agitation properties so that the mortality is also high.

During the maintenance process, the highest value of cannibalism is in treatment A. Treatment A (feeding once a day) gets the highest value compared to other treatments. Cannibalism most often occurs when after one of the small crabs undergoing skin replacement or molting. Conditions like these make the crabs become weak, so that other individuals freely attack and eat them. This is confirmed by the statement from Kamaruddin et al. (2016), which states that deaths generally occur due to cannibalism between individuals especially when moulting occurs, because krablets that are or have just finished moulting are very weak and appear white, and the possibility of a stimulating odor that attracts attention to other larger krablets / more active. The nature of blue swimming crab cannibalism causes the solitary nature of smaller individuals that are higher when kept together with larger individuals. From several researchs, it is recommended to use shelters intended to reduce the level of cannibalism in the blue swimming crab. Male sex has a higher aggressiveness than female sex, causing more cannibalism in the male sex. This results in stunted male sex growth compared to female sex. According to a statement from Suprapto et al (2014), the factor of aggressiveness and cannibalism which is more dominant in male crabs results in a lower survival rate for males than females. Based on this description, according to its nature it is suspected that male crabs have a lower chance of continuing to grow well in bulk containers. The opposite is thought to be found in female sex where it is less aggressive, so that mass maintenance has no effect on growth opportunities.

The value obtained for water quality during maintenance activities is still included in the proper condition for blue swimming crab. the obtained temperature values range from 25.7 - 27.6 ° C. According to Astuti (2008), which states that the range of temperatures suitable for blue crab life is in the range of 21 to 30 ° C. Salinity values obtained ranged from 23-25 ppt. Blue swimming crabs belong to osmoregulateur organisms. According to Lantu, (2010) gills for the eurihalin crustace group act as the main organs of ion regulation for the osmoregulation process. The pH value obtained during maintenance is in the range of 8.1 - 8.9. This value is still considered reasonable. According to Astuti (2008), states that the pH value for maintenance of small crab (P. pelagicus), the pH value ranges from 7.2 to 8.6, but if the pH value in the range of 7.0 to 8.6 is still within the limit tolerance for crab life (P. pelagicus). For dissolved oxygen (DO) values range from 4.7 to 5.6 mg / L. This value is in the safe category. According to Karim et al. (2015), which states that in general the minimum requirement for dissolved oxygen from aquatic organisms is 3ppm. Ammonia value obtained during maintenance is 0.06 - 0.60 mg / L. Ammonia is a product of aquatic metabolic waste products in the aquatic environment and the breakdown of organic matter by bacteria. According to Karim et al. (2015), which states that ammonia has toxic properties so that in high concentrations it can poison the organism. Nitrite values obtained ranged from 0.01 to 0.3 mg / L. This value is still included in the condition can be tolerated. According Suharyanto (2008), states that nitrite concentrations of 0.1mg / L can cause stress in aquatic organisms. When the concentration reaches 1.00 mg / L can cause death in aquatic organisms.

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