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The Effectiveness of Stocking Density on the Growth Rate and Survival *Channa striata* in Aquaponic Systems

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Abstract

Channa striata is the one of the local comodity in West Kalimantan Province which has important economic value. The demand for *Channa striata* comes mostly from urban communities, while urban areas only have narrow land / yard. One of the techniques of fish cultivation in narrow land is the aquaponics system. Thus, *Channa striata* cultivation with the aquaponics system can increase the productivity of cork fish in urban areas. The purpose of this study was to obtain the optimal amount of stocking density in *Channa striata* culture with an aquaponics system with indicators of success namely survival and growth rate. This study lasted for 75 days, taking place at the Pontianak City Fish Agribusiness Farm. The study design used a Completely Randomized Design (CRD) with 4 treatments and 3 repetitions, The stocking solid treatment used in this study is A: 40, B: 60, C: 70, and D: 50 tails / m^2. The results showed that treatment A had a significant effect on the absolute growth rate of 12.85 gr followed by perlkuan D: 12.46 gr, B: 8.87 gr, C: 7.9 gr, while the best specific growth rate was needed at time A: 3.50%, D: 3.44%, B: 3.05%, C: 2.91%. The observation of life survival also has the same trend, namely the best treatment in treatment A: 95%, D: 90%, B: 70%, C: 49%. From the results of these studies it can be concluded that the higher the stocking density in aquaponics fish farming systems will have an impact on the growth rate and the survival rate of *Channa striata* with the best treatment, namely with stocking density of 40 fish / m^2.

Keyword: ***Stocking density, Channa striata, Aquaponics, Growth Rate, Survival, Aquaponics***

Introduction

The demand for *Channa striata* comes mostly from urban communities, while most of the housing in urban areas only has a narrow land / yard. One of the techniques of fish farming in narrow land that is currently popular is the aquaponics system. The advantages of the aquaponics system for the community besides being able to produce plants, especially vegetables, can also produce fish so that they can be used as additional income.

The determining factor for cultivation received by *Channa striata* is "stocking density". Stocking density is the large amount of fish stocked with units of area or volume of cultivation media. *Stocking density* is important because it is very difficult to use space, feed, dissolved oxygen or other resources. Stocking density will affect fish growth rates and increase which is an increase indicator of fish enlargement business. So if it is stocking density too low, then resource efficiency is not optimal.

Based on the above, a research is needed to determine the optimal amount of stocking density to produce the best survival rate and growth rate. The purpose of this study was to obtain optimal stocking density from *Channa striata* culture with an aquaponics system. The results are expected to be used as a reference for people who have implemented aquaponics and those who are just trying to create effective and efficient use of resources.

Materials and Methods

The study lasted for 75 days conducted from September to November 2018. The research container used was in the form of a divided fiber tub in accordance with the treatment of the research and the manufacture of pipelines as interconnected aquaponic plants. The test fish used was *Channa striata* size 3 - 5 cm with an average weight of 0.25 gram / head. Test fish were fed 3 times a day as much as 5% of the weight of pet fish.

The study design used a Completely Randomized Design (CRD) with 4 treatments and 3 repetitions. The stocking solid treatments used in this study were 40, 60, 70, and 50 tails / m2 and were arranged randomly. Furthermore, monitoring was carried out with a sampling method to obtain growth data, while to obtain data on the survival of *Channa striata* seeds, *Channa striata* seed calculations were observed. Monitoring of growth and test fish populations is carried out every 10 days.

Growth Rate

The formula for calculating the absolute growth rate is as follows:

$$W = Wt - Wo$$

While the relative growth rate uses the following formula:

$$SGR = \frac{wt - w0}{t} \times 100\%$$

Information :

- W = Weight growth (g)
- Wt = Biomass weight at the end of the study (g)
- Wo = Biomass weight at the beginning of the study (g).
- t = Maintenance time (day)
-

Survival Rate

The survival rate in calculating by calculating the number of fish living at the beginning of stocking and end of maintenance, is expressed in percent. Survival rate can be calculated by formula (Jatilaksono, 2007) :

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

Information :

- SR = Survival Rate
- Nt = Final amount (ekor)
- No = Initial amount (ekor)

The collected data will be processed by normality test and BNT test using SPSS Version 23 software.

Results and Discussions

Indicators observed include growth rates, survival rates and water quality during maintenance. During the study, observations of survival were carried out every day to determine the number of fish deaths during the study. While observing the cork fish growth rate is done once every 10 days and obtained sampling data 8 times, the method of fish sampling is intended to measure the weight of the fish measuring the success of the study.

Growth Rate

The growth rate data is calculated using the speci fi c growth rate formula by means of absolute growth divided by the number of days the study then multiplied by 100%. So that the form of the data is in the form of a percentage of specific growth that is passed by *Channa striata* on a daily basis.

Table 1. Specific Growth Rate

Perlakuan	SGR (%)
A	3,50
B	3,05
C	2,91
D	3,44

The best growth rate was observed in treatment A, namely by obtaining a daily growth value of 3.50%, then the best treatment was found in 50 tail / m2 stocked fields, namely treatment D by obtaining a specific growth value of 3.44%. Then the higher the density of stocking in treatment B and C then the percentage value of the specific growth rate is decreased, namely the

value at treatment B is 3.05% followed by treatment C with a value of 2.91%

Data on absolute growth rates can also be one measure of success in research, where the value of absolute growth of *Channa striata* was observed to experience significant growth every day during the study. This is presented in table 5.3. which shows a different value on average in each treatment, the following table is meant:

Table 2. Average Absolute Growth

Perlakuan	PM
A	12,85
B	8,87
C	7,9
D	12,46

Assessing from absolute growth data it can be concluded that specific growth data and absolute growth data have the same trend where it is observed that treatment with the lowest density is treatment A has the specific growth rate and absolute best growth continued in treatment D followed by treatment B and C. Studying from these data, the *Channa striata* during the study experienced growth, but along with the increase in stocking density conducted by the study, the cork fish's growth rate decreased further.

As long as this research takes place the measurement of growth is based on indicators of fish weight gain. Fish weight gain is one indicator of increasing yields on the body's metabolism. According to Rahmat (2010), that in high stocking densities, fish will have a high competitiveness in utilizing food, and movement space, so that it will affect the daily growth rate of the fish. Illustration of the growth rate in cork fish cultivation can be put on the chart following growth:

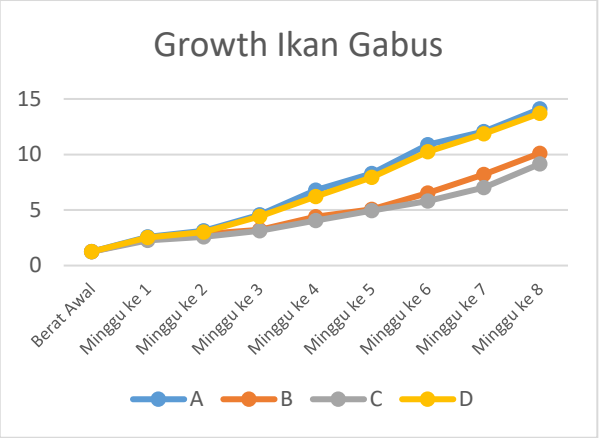

Figure 1. Growth Rate Graph *Channa striata*

The cultivation environment with the aquaponic system applied has a significant effect on the growth of *Channa striata* where according to Nugroho, R.A (2012), states that there is an influence of seed density on the growth of culture using aquaponic systems. This is also observed in the maintenance of Channa striata in this study, which looks good with the best need for stocking densities of 40 fish / m2 which has a daily specific growth percentage of 3.50% and an absolute growth of 12.85. These results are indicated to be slightly better when compared to the results of conventional cultivation system research conducted by Heriansah and Dian F.A (2016) through her research to maintain Channa striata in various maintenance containers having a percentage value of SGR 2.72% to 3.12%.

Studying from these data, the absolute growth value has the same trend as the daily specific growth data where the higher the stocking density, the Channa striata absolute growth value gets lower for 75 days the research takes place.

Survival Rate

Channa striata seeds which are maintained in controlled conditions are adapted to the cultivation environment considering that cork fish seeds are obtained from nature so that it takes time in a more controlled adaptation of the cultivation environment so that the data obtained is more ideal. Detailed survival data for each treatment

observed every day is presented in the following table 3:

Table 3. Survival Rate *Channa striata*

Perlakuan	SR (%)
A	95
B	70
C	49
D	90

Reviewing from observational data, the best treatment for Channa striata survival indicators is treatment A and D with stocking densities of 40 fish / m2 and 50 fish / m2 with an average survival rate of 95% in treatment A and 90% in treatment D. Furthermore the percentage of survival of 70% in treatment B is with stocking density of 60 tails / m2 and the highest mortality rate during the study on treatment C which is with stocking density of 70 tails / m2 with an average percentage of survival of 49%.

In order to know the effect of stocking solid treatment on the survival of Channa striata, anova test was conducted. ANOVA test shows the output results that it is known that P-Value is 0.05 which means P-Value <α (0.05). These results can be said that there is a difference in the average stocking density treatment for the survival of Channa striata. So to find out which stocking density influences survival, then the Tukey test is continued, where from the results of the Tukey P-Value test of 0.05 with the P-Value assumption <0.05 it can be seen that stock solid treatment has an influence on each average survival of each treatment. So it can be concluded that there are significant differences in the density treatment of fish survival.

According to Fauji *et al.*, (2015) in his study stated that with a low stocking density of 10 tails - 30 tails / m2 can be collected that the difference in the level of density of Channa striata tends to decrease as Channa striata's stocking density increases, but still shows that survival relatively the same due to the fact that the stocking density is relatively low. This is in accordance with the results of this study, where the increasing stocking density will significantly affect the survival of cork fish in accordance with the opinion of Effendi (2004) which states that the higher the density of survival tends to decrease and denser stocking will increase the risk of death. The weekly mortality rate is presented in the following graph:

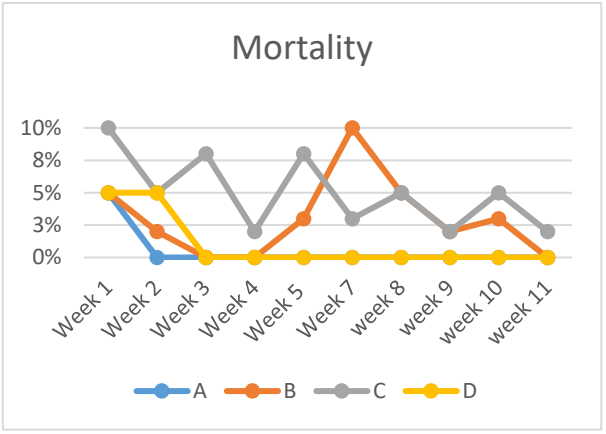

Figure 2. Mortality *Channa striata* Every week

The nature of Channa striata is carnivorous. According to Muflikhah et al., (2008) in nature Channa striata is predatory and savage, because its main food is natural, where fish that are carnivorous tend to cannibalism in other individual fish. This is also seen in studies where a high stocking density has the potential for cannibalism. This is corroborated by the results of research (Qin & Fast 1996; War et al. 2011), which suggests that cannibalism in Channa striata is the main cause of mortality in Channa striata where during research even though the supply of feed provided is adequate. This is the main factor that the stocking density is very influential on the level of survival of Channa striata during the study.

Water Quality

The acupuncture system can also improve the quality of water used in the maintenance of Channa striata, where according to Nugroha RA et al. (2012) states that the aquaponic system can

affect the improvement of water quality of fish nursery media, especially the ammonia content so that it can maintain the viability of cork fish maintained by the system aquaponics cultivation. The most important parameters in aquaculture measured in fish farming in general are physical factors including temperature, chemical factors including dissolved oxygen (DO), acidity (pH) and the content of ammonia (NH3) dissolved in aquaponic waters. Water quality data during the study are presented in the following table:

Table 4. Kualitas Air

Paramater	Satuan	Nilai
Suhu	^{0}C	25 - 28
pH		6,5 – 9
Oksigen Terlarut	mg/l	6 - 9
NH_3	mg/l	0

Channa striata has the ability to adapt to poor water quality, but the temperature factor becomes very important for the influence of Channa striata's body metabolieme. In the research carried out the temperature distribution in the maintenance pond with acupuncture system was relatively stable which ranged from 25^0 C– 28^0 C, it was observed well when referring to the assumption of Kordi (2011), that Channa striata can grow well at temperatures of 25–32^{0}C. while Muslim (2007), that the temperature tolerance range for Channa striata is 25,5−32,7^0 C.

According to Kordi (2011), a good pH for the maintenance of Channa striata seeds is 6.5-9. This confirms that the results of pH measurements during the study were observed in normal conditions where the pH range during the study was in the range 6-9.

During the research, oxygen dissolution was observed in a very good position, namely the range between 6-9 mg / l. this is in accordance with the opinion of Nugroho R.A, et al. (2012) in his study stating that the results of the observation showed that the DO content of water in aquaponic media was higher than that of non-aquaponic media.

On observing water quality with ammonia (NH3) parameters carried out during the study by taking water samples once a week it was observed that the ammonia content was very low even close to 0 mg / l. the water content in the maintenance of cork fish during the study was in a very good threshold, according to the results of the study of Gaffar et al. (2012) that the ammonia content of 0.08 mg / l is still in a safe range for *Channa striata* seeds.

Conclusions

Based on the results and discussion of the effectiveness of stocking density on the growth rate and survival rate of Channa striata, conclusions can be taken as follows:

1. The most effective stocking density in the observation of life span and growth rate was observed in the treatment with stocking density of 40 fish / m2 followed by the higher stocking density, indicating that the higher the stocking density the lower the percentage of survival and growth rate of Channa striata
2. Cultivation of *Channa striata* with an acupuncture system can improve water quality optimally with sufficient organic matter in the waters
3. *Channa striata* responds positively to the application of aquaponics cultivation systems, it is observed that Channa striata experiences optimal growth and good survival with narrow land use

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