Green Catfish (\textit{Hemibagrus nemurus}) Seeds Cannibali at Different Stocking Densities

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Abstract. Green catfish is a high economic value commodity in Riau. However, cannibalism in green catfish seeds is still an obstacle in its hatchery, and so far there has been no specific study of cannibalism in green catfish. The purpose of this research was to study the cannibalism of the green catfish seeds at different stocking densities. The research used a completely randomized design with four treatments, namely stocking density 1 (A), 2 (B), 3 (C) and 4 (D) individual/liter with five replications. A feed with 40% protein was given four times a day at satiation. The results indicated that the cannibalism index increased with the increase in stocking density, namely 32, 34.5, 53.33 and 51.50%, respectively. The highest incidence of cannibalism was at stocking density of 3 individuals/l, but it was not different from that of 4 individuals/l. The dominant cannibalisms are type 1 cannibalism, namely 26, 27.5, 50.67 and 43.75% respectively; however, type 2 cannibalism did not differ among treatments. There was no difference in growth performance among treatments. It could be concluded that there is a link between cannibalism and an increase in stocking density in the green catfish seeds.

1. Introduction
Green catfish is a type of fish with high economic value in Riau. Part of the market demand for consumption-sized green catfish has been met through cultivation. The cultivation of green catfish in Riau province has been running for the last 15 years. So far, the source of seeds for cultivation has been obtained from hatcheries. However, the green catfish seed producers will not produce seeds if there is no order from the fish grower. This occurs because of the high risk of death in the green catfish seed production process. The lifespan of green catfish seeds is very diverse, ranging from 2-18.7% [1], 20-28% [2], 40-49% [3], 44-48% [4], to 50.17-64.75% [5]. The cause of the death of the green catfish seeds is often associated with the cannibal nature of the green catfish seeds [6, 7, 8, 2, 9, 3, 10, 11, 4, 1].

According to [12], there are three groups of factors that influence cannibalism, namely interspecific factors (parental care and fish eating), endogenous intraspecific factors (nutritional status, size differences, genetic linkages, schooling habits, flight response and recognition of similarities in species) as well as exogenous intraspecific factors (density, protection, light and chaos). The factors that influence cannibalism into two categories, namely factors related to size and habit factors [13].

Of all the factors mentioned above, it is not clear which of the factors predominantly affects cannibalism in green catfish. So far there has been no specific study to look at the cannibalism index in green catfish. One of the factors thought to influence cannibalism in green catfish seeds is stocking density. Therefore, this study aims to see how the effect of different stocking densities on cannibalism in green catfish seeds.
2. Methods
This research was conducted in December 2019 - January 2020, at the Laboratory of Fish Breeding and Hatchery, Faculty of Fisheries and Marine Sciences, Riau University. This study used 4 cm of green catfish fry obtained from the hatchery. This study used a completely randomized design consisting of different stocking densities, namely 1 (A), 2 (B), 3 (C) and 4 (D) fish/l with five replications. The determination of stocking density is based on the results of preliminary research which found that for a size of 4 cm the optimum stocking density was 1 fish/l.

Green catfish seeds were reared in media with a water volume of 20 l. The rearing was carried out for 30 days by giving 40% protein feed at a frequency of four times a day at satiation. The parameters observed included growth performance (length and weight), cannibalism index, survival rate and water quality. Data were tabulated and analysed statistically (ANOVA) using Microsoft Office Excel and SPSS 22.

Growth performance using the formula
Length growth : final Length - initial length
Weight growth : final weight - initial weight

Survival rate using the formula
Survival rate : Final number of fish/initial number of fish x 100%

Index of cannibalism determined by type of cannibalism, there are 2 type of cannibalism. Type A cannibalism is a cannibalistic death incident with the loss of body parts due to predation and type B is the incidence of difference in fish loss at the end of the study. To determine cannibalism index (Type A, Type B and normal dead) using formula :

Cannibalism index : number of dead fish / number of initial fish x 100%

3. Result
Research data consisting of cannibalism type, cannibalism index, normal mortality and survival rate are presented in Table 1.

| Treatment | Type A Cannibalism | Type B Cannibalism | Index of Cannibalism | Normal Mortality | Survival Rate |
|-----------|--------------------|--------------------|----------------------|------------------|---------------|
| A         | 26.00±4.18         | 6.00±5.48          | 32.00±7.58           | 5.00±3.54        | 63.00±9.75    |
| B         | 27.50±3.54         | 7.00±5.48          | 34.50±7.42           | 3.00±4.18        | 62.50±10.00   |
| C         | 50.67±3.71         | 2.67±5.48          | 53.33±7.58           | 4.33±4.18        | 42.33±9.62    |
| D         | 43.75±2.50         | 7.75±4.54          | 51.50±4.87           | 1.75±4.47        | 46.75±7.58    |

From Table 1, it can be seen that the increase in stocking density increases the cannibalism index in green catfish seeds, where treatments A and B were different from treatments C and D. The highest cannibalism index values were at stocking density of 3 fish/l and, 4 fish/l, namely 53.33% and 51.50%
respectively. Type A cannibalism is a cannibalistic death incident with the loss of body parts due to predation. The highest incidence of type A cannibalism occurred at the stocking density of 3 fish/l, namely 50.67%. There was no difference in type B cannibalism, which is the incidence of difference in fish loss at the end of the study. Likewise, for normal death, which is death without any bodily damage, there is no difference between treatments. The lowest survival occurred at stocking density of 3 fish/l and 4 fish/l, and the highest was found at stocking density of 1 fish/l. This highest survival value is in line with the results of the previous preliminary research.

The results of this study are in line with [12] suggestion that one of the factors that influence cannibalism is intraspecific exogenous where different stocking density can cause cannibalism in fish.

Table 2. Growth Performance of green catfish seeds at four stocking densities

| Treatment | Weight Growth (g) | Length Growth (mm) |
|-----------|-------------------|--------------------|
| A         | 1.58±0.82a        | 23.92±10.93a       |
| B         | 1.76±0.73a        | 27.73±10.09a       |
| C         | 2.29±0.72a        | 32.55±9.96a        |
| D         | 2.11±0.72a        | 29.75±9.86a        |

Data from Table 2 shows that there is no difference in growth performance between treatments. Likewise, in term of size, no seed is over twice the average size. This condition is different from the research of [14] on juvenile black rockfish (Sebastes schlegeli) which showed that cannibalism only occurred in groups of non-uniform size. From observations of behavior, it appears that the green catfish seeds perform predation by attacking the tail of the target fish. The injured fish will be attacked continuously by other fish with the same body size, causing their tails to be cut off and some showing the spine of the tail (Figure 1).

In terms of behavior, cannibalism in green catfish seeds is thought to be related to hormone action, as revealed by [15] who stated that aggressiveness in the group that causes death is regulated in a hormonal manner, which is the basis for cannibal behavior. One of the hormones responsible for aggressive behavior is testosterone. High Testosterone levels in the body increase aggressiveness in Junco hyemalis [16]. Furthermore, [17] explained that the content of the hormone testosterone in Clarias batrachus broodstock began to increase at the age of eight months in line with the increase in the vitellogenesis process and the maturity of the gonads. In this condition, it is suspected that the content of the hormone testosterone will also accumulate in the eggs and then carry it to the stage of larval development. The content of the hormone testosterone from the parent is thought to be a trigger for aggressive behavior that can lead to cannibalism.

Figure 1. A seed of a green catfish whose tail breaks off due to predation
Table 3. Water Quality

| Treatment | Temperature (°C) | pH  | Dissolve Oxigen (ppm) |
|-----------|-----------------|-----|-----------------------|
| A         | 28-29           | 6   | 6.5 – 7.5             |
| B         | 28-29           | 6   | 6.5 – 7.5             |
| C         | 28-29           | 6   | 6.5 – 7.5             |
| D         | 28-29           | 6   | 6.5 – 7.5             |

During the study, water quality did not differ between treatments, still within normal ranges for the cultivation of green catfish seeds.

4. Conclusion

Based on this research, it may be concluded that stocking density affects the cannibal behavior in green catfish seeds. The highest cannibalism occurred at the stocking density of 3 fish/l, while for growth performance there was no difference between treatments.

Suggestions for further studies are to look at the cannibal behavior in green catfish seeds at a higher stocking density, and find ways to reduce the cannibalism.

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