Cultivation Technology of Bronze Featherback (*Notopterus notopterus*, Pallas 1769) at Different Stocking Densities and Types of Feed

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Abstract. Bronze featherback (*Notopterus notopterus*, Pallas 1769) is one of Indonesia's endemic fish that needs to be cultivated. Stocking density and the right type of feed are important aspects of fish farming activities. This study aims to determine the stocking density and type of feed that is appropriate for the cultivation of bronze featherback. This research was conducted from June to July 2019 in a fish pond in Sungai Geringging Village, Kampar Kiri District, Riau. The design used in this study was a completely random design with two factors (stocking density and type of feed), with three replications. Stocking densities were: 5, 10 and 15 fish/m³. While the types of feed included: commercial feed pellets plus vitamin E, trash fish and local mussel. Results showed that a density of 5 fish / m³ fed with trash fish produced the best fish growth in terms of absolute weight (6.98 ± 1.49 g), absolute length (3.61 ± 0.20 cm), daily growth rate (0.83 ± 0.30%) and larval survival rate (86.67 ± 11.55%).

Keywords: Bronze featherback, *Notopterus notopterus*, stocking density, type of feed and growth

1. Introduction

Bronze featherback (*Notopterus notopterus*, Pallas 1769) is one of Indonesia's endemic fish which has high economic value. High-fat content makes bronze featherback have a delicious and distinctive taste. In addition to the high-fat content, this fish also has high protein and vitamin A content. In Indonesia, especially bronze featherback is one of the economical fish that is very popular with the community for consumption and ornamental fish. Community needs for these fish are still obtained solely from catches in public waters[1]. Aquaculture activities are suitable solutions to reduce fish exploitation from nature for human consumption [2]. With the cultivation of bronze featherback, the community's need for these fish can be met and the number of catches in nature reduced.

Stocking density is the amount (biomass) of seeds sown per unit area or volume [3]. Stocking density affects stress levels in fish and continues to physiological activities in fish that have an impact on fish welfare status divided into primary, secondary and tertiary responses. The primary stress response influences neuro-hormonal stimulation which increases catecholamine and corticosterone secretion [4]. The secondary stress response influences the hydromineral balance, increased heart rate, oxygen absorption, and energy mobilization to meet high energy demand [5]. The tertiary stress response involves changes in growth, reduction in feed consumption, impaired fish health and immunity, reproduction and survival of individuals or [6]. Until now, the best stocking density is not yet known for the cultivation of bronze featherback.

Feed management is an important part of the fish culture [7]. In fish farming it is important, optimization of feed is important to ensure profitability. Bronze featherback is a type of carnivorous fish, [8]. Carnivorous fish have a lower ability to utilize carbohydrates in the feed compared to
herbivorous fish and omnivorous fish [9]. Based on the results of research on the intestinal content of bronze featherback, it is known that bronze featherback in nature eat organic detritus, fish scales, insects, fish, shrimp, sand and plant litter [10]. Until now not yet known the best type of food for bronze featherback in aquaculture activities. Fish growth is the ultimate goal of the fish farming process Therefore, it is necessary to know the best stocking densities and the best types of feed that can be applied in the cultivation of bronze featherback.

2. Research Methods

This research was conducted in June to July 2019 in the fish pond of Sungai Paku Village, Kampar Kiri District, Kampar Regency, Riau Province. The treatment in bronze featherback culture technology research was stocking density consisting of 5, 10 and 15 fish / m³ and type of feed consisting of pellet + vitamin E feed, trash fish feed and local mussel feed given at a dose of 5% / body weight. The design used was a Completely Randomized Design with two factors and 3 replications.

Fish were kept in cages (size 1 x 1 x 1 m) and are fed 3 times a day (morning, afternoon and evening) at a dose of 5% per weight of fish biomass. Fish were measured in length and weight every 10 days. The fish length was measured using graph paper and fish weight was measured by Shimadzu ELB600 type analytical chart.

The variables measured in this study were absolute weight growth determined using the formula: Absolute weight growth = fish weight at the end of the study - fish weight at the beginning of the study, Absolute length growth = fish length at the end of the study - fish length at the beginning of the study, Daily Growth Rate (SGR) = Ln fish weight at the end of the study - Ln fish weight at the beginning of the study / time x 100% and Survival rate = number of fish at the end of the study / number of fish at the beginning of the study x 100%.

The data obtained were tabulated and performed a statistical test using the SPSS 16 application. The statistical test conducted was homogeneity of variances test and one-way analysis of Variance (ANOVA). If the ANOVA test results show a significant difference (P <0.05), further tests are performed using the SNK test to determine differences between treatments.

3. RESULTS AND DISCUSSION

The growth value of bronze feather back based on stocking density and type of feed given is presented in Table 1.
Table 1. Growth value of bronze featherback in each parameter

| Treatment | Initial Weight (g) | Final Weight (g) | Absolute Weight (g) | Initial Length (cm) | Final Length (cm) | Absolute Length (cm) | SGR (%) | SR (%) |
|-----------|--------------------|------------------|---------------------|---------------------|-------------------|----------------------|---------|--------|
| Pellet + vitamin E | 4.37a | 4.74a | 0.37a | 9.31a | 9.58a | 0.27a | 0.73a | 86.67a |
| Trash fish | 4.25a | 11.22d | 6.98d | 9.24a | 12.85c | 3.61d | 0.83d | 86.67a |
| Local mussel | 4.25a | 10.54c,d | 6.29c,d | 9.27a | 12.60c | 3.33d | 0.77c,d | 80a |
| Pellet + vitamin E | 4.27a | 4.85a | 0.58a | 9.22a | 9.44a | 0.23a | 0.60a | 80a |
| Trash fish | 4.28a | 9.69b,c,d | 5.41b,c | 9.29a | 12.59c | 3.30d | 0.76c,d | 93.33a |
| Local mussel | 4.17a | 8.42b | 4.25b | 9.01a | 11.98b | 2.97c | 0.71c | 83.33a |
| Pellet + vitamin E | 4.23a | 4.95a | 0.72a | 9.18a | 9.34a | 0.16a | 0.05a | 64.47a |
| Trash fish | 4.25a | 9.19b,c | 4.95b,c | 9.24a | 11.95b | 2.72b | 0.64b | 91.1a |
| Local mussel | 4.28a | 9.1b,c | 4.78b,c | 9.26a | 11.82b | 2.56b | 0.61b | 95.53a |

Note: Values followed by different letters represent significant differences (P <0.05)

The value entered is the average value of three replications

3.1. Weight Growth of Bronze Featherback

The growth of bronze featherback at various stocking densities and different types of feed resulted in varying growth rates. The data is presented in Figure 1. Weight of bronze featherback at various stocking densities and feed types. It can be seen that the highest growth was observed in fish at a stocking density of 5 fish/m3 fed trashfish, while the lowest growth was observed in fish stocked at 5/m3 fed with commercial feed pellets + vitamin E. Growth of bronze featherback weight based on stocking density is presented in Figure 1 a. While the growth of bronze featherback weight based on the type of feed presented in Figure 1 b. The highest growth of bronze featherback weight based on stocking density was found in the 5 stock / m3 stocking density treatment while the highest growth of bronze featherback weight based on feed was obtained in trash fish treatment.

![Figure 1](a) Growth graph of bronze featherback weight based on stocking density
(b) Growth graph of bronze featherback weight based on feed

3.2. Length Growth of Bronze Featherback

The highest increments in length of bronze featherback length was obtained at a stocking density of 5 fish / m3 fed with commercial feed pellets + vitamin E while the lowest increment was observed at a stocking density of 15 fish/m3 stocking (Figure 2).
From Figure 2 it can be seen that the weights growth of bronze featherback during the first 20 days of culture is not very significant. This is due to the initial culture of the bronze featherback that were treated were still in the period of adaptation to the environment and the feed provided. The bronze featherback have experienced a significant increase in weight growth starting on the 20th day until the 40th day. This is because the bronze featherback have passed the adaptation phase. But the growth of bronze featherback in the treatment that was fed with pellets + vitamin E was not so significant. Based on observations in the field this is due to bronze featherback not having a good response to the pellet feed + vitamin E given. Pellet feed + vitamin E gave are only a small portion that is eaten by fish, so much of the feed is left.

Based on Figure 2, it can be seen that the growth of bronze featherback during the initial 20 days of rearing is not very significant. The growth of bronze featherback looks very significant starting from the 20th day to the 70th day. This is due to the initial culture of the bronze featherback is still in the adaptation period. However, in the treatment of pellet feed + vitamin E, the growth of bronze featherback was not so significant from the beginning of the study until the 70th day. This was due to the lack of response of the bronze featherback to the pellet feed + vitamin E given. The growth chart of bronze featherback is in line with the growth chart of bronze featherback weight. This is consistent with the growth pattern of bronze featherback which has a positive relationship between fish length and weight \(^{(11)}\). The growth of bronze featherback is highest in trash fish and local mussel treatment because in natural bronze featherback eat organic detritus, fish scales, insects, fish, shrimp, sand and litter plants \(^{(10)}\).

### 3.3. Absolute Weights Growth of Bronze featherback

The absolute weights of bronze featherback at various stocking densities and different types of feed are presented in Figure 3.

![Figure 3](image_url)

**Figure 3.** Absolute Weight Growth of Bronze featherback.
Based on Figure 3, it can be seen that the growth of absolute weight of fish was highest at a stocking density of 5 fish/m³ fed with trash fish. Lowest absolute weight was obtained in fish at a density of 15/m³ and fed with commercial feed pellets + vitamin feedE (0.37 g). Analysis of variance showed that stocking density and type of feed gave a very significant effect (P <0.01) on the growth of absolute weight of bronze featherback. The results of the interaction analysis between stocking solid treatment with the treatment of feed type showed that the interaction of both of them significantly affected the growth of absolute weight of bronze featherback. The highest absolute weight growth value of bronze featherback was obtained in low stocking densities, this is the same as the results of research obtained in catfish (Clarias gariepinus) and Chinese Sturgeon (Acipenser sinensis) fish\[12\].

3.4. Absolute Length Growth

The absolute length of bronze featherback reared in various stocking densities and types of feed are shown in Figure 4.

![Figure 4](image_url)

**Figure 4.** Absolute Length of bronze featherback at different stocking densities and types of feed.

Highest absolute was observed in fish at a stocking density of 5/m³ fed with trash fish feed (8.20 cm). Solid treatment stockLowest absolute length was obtained in fish at a stocking density of 15/m³ fed with commercial feed pellets + vitamin E feed (0.42 cm). Based on the ANOVA, the stocking densities and feed types as well as their interactions had a significant effect (P < 0.01) on the absolute length of the fish. The higher the stocking density, the lower the absolute length growth of bronze featherback. This is caused negative effects on fish welfare at high stocking densities as these can harm the fish growth, immune status and health [13]. Bronze featherback (Notopterus chitala) that are kept in polyculture with tilapia for 6 months is 16.5 cm.

3.5. Specific Growth Rate (SGR)

The specific growth rates(SGR) of bronze featherback reared in various stocking densities and feed types are shown in Figure 5.
Highest daily growth rate of the fish was obtained in fish stocked at a stocking density of 5/m³ and fed with local mussel meat (2.27%). On the other hand, lowest SGR was obtained in fish stocked at 5/m³ and fed with commercial feed pellets + vitamin E feed (0.20%).

ANOVA test showed that stocking density, feed types and their interactions had significant effects (P < 0.01) on the specific growth rate (SGR) of the fish. The highest SGR value for this fish in the present study was lower than the value obtained when they reared bronze featherback in polyculture with tilapia for 6 months.

3.6. Survival Rate (SR)

Based on Figure 8 it can be seen that the survival value of bronze featherback was highest when fish were stocked at 15/m³ and fed with mussel meat (95.60%). Lowest survival rate was obtained at a stocking density of 15/m³ and fed with commercial feed pellets + vitamin feed E (64.40%). Statistical test results showed that stocking density treatment, feed type treatment, and their interaction had no significant on survival (P> 0.05). Comparable results were also obtained [14] in their studies on jumbo catfish (*Clarias gariepinus*),

4. CONCLUSION

It can be concluded that both stocking density and the type of feed significantly influenced the growth of bronze feather back. The best treatments to ensure maximum growth of the fish is were: 5 fish / m³ stocking density and fed with trash fish On the other hand, stocking densities and feed types do not have significant influence on the survival of bronze featherback.
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REFERENCES

[1] Yulindra A, Lumbantoruan R P, Zulkifli, and Sukendi. 2017. Effect Of Granting Ovaprim With Different Dosage to Ovulation and Egg Quality of Knife Fish (Notopterus notopterus). International Journal of Oceans and Oceanography. 11 (2). pp. 189-199.

[2] Anderson, S.C., Flemming, J.M., Watson, R., Lotze, H.K., 2011. Serial exploitation of global sea cucumber fisheries. Fish. 12, 317–339.

[3] Hepher B and Pruginin Y. 1981. Commercial Fish Farming With Specific Reference To Fish Culture In Israel. John Wiley and Sons. California pp. 261.

[4] Foo, J.T.W., Lam, T.J., 1993. The serum cortisol response to stress management and the effect of cortisol implantation on testosterone levels in tilapia, Oreochromis mossambicus. Aquaculture 115, 145–158.

[5] Wendelaar Bonga, S.E., 1997. The stress response in fish. Physiol. Rev. 77, 591–625.

[6] Ellis, T., North, B., Scott, A.P., Bromage, N.R., Porter, M., Gadd, D., 2002. The relationships between stocking density and welfare in farmed rainbow trout. J. Fish Biol. 61 (3), 493-531.

[7] Ullman G, Rhodes M. A., Davis D. A., 2019. Feed management and the use of automatic feeders in the pond production of Pacific white shrimp Litopenaeus vannamei. Aquaculture 498 (2019), 44-49.

[8] Shillewar K. S. and Nanware S. S. 2009. Food and feeding habits of freshwater fish Notopterus notopterus (Pallas) from Godavari river, Nanded, Maharashtra. Biomedical and Pharmacology Journal. 2 (2). 489-490 p.

[9] NRC, 2011. Carbohydrates and Fiber, in Nutrient Requirements of Fish and Shrimp. The National Academies Press, Washington DC, 135–162.

[10] Srivastava S. M, Singh S. P, and Panday A K. 2012. Food and Feeding Habits of Threatened Notopterus notopterus in Gomti River, Lucknow (India). J. Exp. Zool India. Vol 15. No. 2. PP. 395-402.

[11] Kaur V and Rawal Y K. 2017. Length-Weight Relationship (LWR) in Notopterus notopterus (Pallas) from Sukhna Lake, Chandigarh. IOSR Journal of Pharmacy and Biological Sciences. 12 (4). 63-65 pp

[12] Long L, Zhang H, Ni Q, Liu H, Fan W, Wang X. 2019. Effects of stocking density on growth, stress, and immune responses of juvenile Chinese sturgeon (Acipenser sinensis) in a recirculating aquaculture system. Comparative Biochemistry and Physiology, Part C. 219 (2019) 25-34.

[13] Ardiansyah, Fotedar, R., 2016. Water quality, growth and stress responses of juvenile barramundi (Lates calcarifer Bloch), reared at four different densities in integrated recirculating aquaculture systems. Aquaculture 458, 113-120

[14] Shoko A P, Limbu S M, and Mgaya Y D. 2016. Effect of stocking density on growth performance, survival, production, and financial benefits of Africansharptooth catfish (Clarias gariepinus) monoculture in earthen ponds. Journal of Applied Aquaculture. 28 (3). pp. 220-234.