



PERFORMANCE OF DIFFERENT STOCKING DENSITIES ON SURVIVAL RATE, FCR, AND GROWTH OF BILEH FISH (*Rasbora sp.*) REARED IN AQUARIUM

PERFORMA PADAT TEBAR BERBEDA TERHADAP KELANGSUNGAN HIDUP, FCR, DAN PERTUMBUHAN IKAN BILEH (*Rasbora sp.*) PADA PEMELIHARAAN DI AKUARIUM

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Abstract

Stocking density is a key factor in the culture of bileh fish (*Rasbora sp.*) because it affects water quality, growth, feed conversion, and survival. This study aimed to evaluate the effect of different stocking densities on survival rate, feed conversion ratio (FCR), and growth of bileh fish reared in aquaria. The experiment was conducted for 40 days using a Completely Randomized Design (CRD) with four stocking density treatments (5, 10, 15, and 20 fish/m³) and three replicates. The results showed that stocking density significantly affected ($P<0.05$) absolute weight gain, absolute length gain, daily growth rate, feed efficiency, and FCR, with the best performance obtained at a stocking density of 5 fish/m³ (daily growth rate of 0.97%/day; feed efficiency of 24.95%; FCR of 4.16). Survival rate after 40 days of rearing was not significantly different ($P>0.05$) among treatments, with the highest value of 93.33% recorded at a stocking density of 5 fish/m³. Increasing stocking density increased competition for space and feed, thereby reducing growth performance and feed utilization efficiency.

Keywords: Bileh fish; Stocking density; FCR; Survival rate

1. Introduction

Bileh fish (*Rasbora sp.*) is a freshwater fish species of considerable economic and ecological importance in Southeast Asia, particularly in the waters of West Aceh (Rahmayanti *et al.*, 2022; Zulfadhli *et al.*, 2024). In addition to its potential as an ornamental fish, bileh fish is also commonly consumed as food by local communities and is known for its delicious taste, which is popular among the Acehnese people (Nurfaizah *et al.*, 2024). Several studies have been conducted to optimize bileh fish culture techniques, including research on feeding frequency, lysine amino acid supplementation, and the use of local

Abstrak

Padat tebar merupakan salah satu faktor kunci dalam budidaya ikan bileh (*Rasbora sp.*) karena memengaruhi kualitas air, pertumbuhan, konversi pakan, dan kelangsungan hidup. Penelitian ini bertujuan mengkaji pengaruh padat tebar yang berbeda terhadap kelangsungan hidup, rasio konversi pakan (FCR), dan pertumbuhan ikan bileh yang dipelihara dalam akuarium. Penelitian dilaksanakan selama 40 hari menggunakan Rancangan Acak Lengkap (RAL) dengan 4 taraf perlakuan padat tebar (5, 10, 15, dan 20 ekor/m³) dan 3 ulangan. Hasil penelitian menunjukkan bahwa padat tebar berpengaruh nyata ($P<0,05$) terhadap bobot mutlak, panjang mutlak, laju pertumbuhan harian, efisiensi pakan, dan FCR, dengan kinerja terbaik diperoleh pada perlakuan padat tebar 5 ekor/m³ (laju pertumbuhan harian 0,97%/hari; efisiensi pakan 24,95%; FCR 4,16). Kelangsungan hidup ikan bileh setelah 40 hari pemeliharaan tidak berbeda nyata ($P>0,05$) antarperlakuan, dengan persentase tertinggi pada padat tebar 5 ekor/m³ sebesar 93,33%. Peningkatan padat tebar meningkatkan kompetisi ruang dan pakan sehingga menurunkan kinerja pertumbuhan dan efisiensi pemanfaatan pakan.

Kata Kunci: Ikan Bileh; Padat Tebar; FCR; Kelangsungan Hidup

raw materials in formulated feed (Gustria *et al.*, 2024). However, efforts toward the domestication and culture of this fish still face various challenges, including a lack of information on optimal management, such as the appropriate stocking density needed to support its growth and survival (Islama *et al.*, 2021).

Stocking density is one of the key factors in fish culture because it directly affects water quality, growth performance, and feed conversion rate (*Feed Conversion Ratio/FCR*), as well as fish survival rate (Akbarurrasyid *et al.*, 2024). Excessively high stocking density can increase stress, resource competition, and water quality deterioration, whereas excessively low stocking density

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can reduce the efficiency of space and resource utilization (Mengistu *et al.*, 2019). Yustiati *et al.* (2020) found that different stocking densities in tilapia produced varying FCR values, with the best FCR of 1.19 ± 0.13 obtained at a stocking density of 15 fish/15 L in a round tank with a water-current and venturi aeration system. This indicates that optimizing stocking density can improve feed efficiency in fish culture.

Scientific research on the optimal stocking density for bileh fish is needed, particularly for aquarium-based rearing systems, which tend to have limited space and require more intensive water quality management. Febrina *et al.* (2023) found that fish survival rate was actually higher at higher densities, although increased density also resulted in higher ammonia levels with the potential to affect fish health in the long term. In general, higher stocking density tends to increase FCR values, as shown in a study on turbot (Liu *et al.*, 2016). However, the specific effect of stocking density on the FCR of bileh fish (*Rasbora* sp.) has not been widely studied. Based on the above, this study aimed to examine and evaluate the effect of different stocking densities on the survival, feed conversion (FCR), and growth of bileh fish reared in an aquarium system, in order to determine the most efficient and optimal stocking density to support the sustainable development of bileh fish culture.

2. Materials and Methods

2.1 Time and Location of the Study

This study was conducted for 40 days, from 15 July to 25 August 2025. The bileh fish were reared at the Hatchery of the Faculty of Fisheries and Marine Science, Universitas Teuku Umar.

2.2 Experimental Design

This study was conducted experimentally using a Completely Randomized Design (CRD) with 4 stocking density treatments and 3 replicates for each treatment, namely: P1 = stocking density of 5 fish/m³; P2 = stocking density of 10 fish/m³; P3 = stocking density of 15 fish/m³; and P4 = stocking density of 20 fish/m³.

2.3 Research Procedure

The containers used were 12 aquarium units, which were cleaned with a 5 ppm chlorine dose for two days, then rinsed and air-dried before being filled with 30 L of water. The test animals used were bileh fish fry (*Rasbora* sp.), totaling 150 individuals, with an initial length of 2.90 ± 0.18 cm/fish and an initial weight of 0.40 ± 0.2 g/fish, which were then stocked into the aquaria according to the treatment stocking density. During the rearing period, the fish were fed commercial pellet feed three times daily, at

08:00, 12:00, and 16:00 local time (WIB), *at satiation* (according to the fish's consumption needs). Sampling was carried out every 10 days on 3 fish from each aquarium, selected by (*random sampling*), covering measurements of length, weight, and water quality.

2.4 Test Parameters

Absolute Weight Gain (AWG) was calculated using the following formula (Saputra and Mahendra, 2019):

$$AWG = Bt - Bo$$

Where:

AWG = weight gain (g);

Bt = mean final fish weight (g);

Bo = mean initial fish weight (g).

Absolute Length Gain (ALG) was calculated using the following formula:

$$ALG = Pt - Po$$

Where:

ALG = length gain (mm);

Pt = mean final fish length (mm);

Po = mean initial fish length (mm).

Daily Growth Rate (DGR) was calculated using the following formula (Zonneveld *et al.*, 1991):

$$DGR = \left(\frac{Wt}{Wo} \right)^{\frac{1}{t}} - 1$$

Where:

DGR = daily growth rate (%);

Wt = mean final weight (g);

Wo = mean initial weight (g);

t = rearing period (days).

Feed Efficiency (FE) was calculated using the equation of Takeuchi (1988):

$$FE(\%) = \left[\frac{(Wt + Wd) - Wo}{F} \right] \times 100$$

Where:

Wt = final fish biomass (g);

Wo = initial fish biomass (g);

Wd = biomass of fish that died during the study (g);

F = amount of feed given (g).

Survival Rate (SR) was calculated using the following formula (Saputra *et al.*, 2020):

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

Where:

SR = survival rate (%);

Nt = final number of fish (individuals);

No = initial number of fish (individuals).

2.5 Data Analysis

The data obtained were tabulated using Microsoft Excel 2016 and analyzed using *Analysis of Variance* (ANOVA) using IBM SPSS Statistics 22.0 at a 95% confidence interval. Treatments showing significant

effects were further tested with Duncan's test (DMRT) to determine the best treatment.

3. Results and Discussion

3.1 Growth Performance and Feed Efficiency of Bileh Fish

The results showed that different stocking densities had a statistically significant effect ($P < 0.05$) on the absolute weight gain, absolute length gain, daily growth rate, feed efficiency, and feed conversion ratio (FCR) of bileh fish (*Rasbora* sp.). The values of each parameter are presented in Table 1.

Table 1.

Growth performance and feed efficiency of bileh fish at different stocking densities

Treatment	AWG (g)	ALG (cm)	DGR (%/day)	FE (%)	FCR
P1 (5 fish/m ³)	0.263±0.05 ^b	1.073±0.09 ^b	0.970±0.28 ^b	24.96±5.75 ^b	4.16±1.02 ^a
P2 (10 fish/m ³)	0.133±0.02 ^a	0.896±0.04 ^a	0.56±0.06 ^a	12.74±2.65 ^b	8.05±1.49 ^b
P3 (15 fish/m ³)	0.123±0.02 ^a	0.926±0.01 ^a	0.523±0.09 ^a	10.54±1.61 ^a	9.64±1.61 ^b
P4 (20 fish/m ³)	0.130±0.01 ^a	0.866±0.02 ^a	0.536±0.03 ^a	10.53±0.85 ^a	9.53±0.80 ^b

Note: AWG = absolute weight gain; ALG = absolute length gain; DGR = daily growth rate; FE = feed efficiency; FCR = feed conversion ratio. Different superscript letters within the same column indicate significant differences among treatments ($P < 0.05$). Values are presented as mean ± standard deviation.

Stocking density is one of the most important factors in aquaculture, including bileh fish culture, because high stocking density tends to increase production output (Priadi and Irawan, 2021) but affects individual growth performance. Fish growth is influenced by several factors, including feed availability and environmental conditions; optimal conditions and sufficient feed provide energy for body maintenance as well as growth and reproduction.

Stocking density had a significant effect ($P < 0.05$) on absolute weight gain, with the optimal result obtained in treatment P1 (5 fish/m³) at 0.26 g, significantly different from the other treatments. A similar pattern occurred in absolute length gain, with the highest value in P1 at 1.07 cm. This is thought to be because high stocking density creates competition for feed, so that the average weight and length gain of the fish at the end of rearing was not maximal (Tambunan *et al.*, 2021).

Daily growth rate of bileh fish was also significantly affected ($P < 0.05$) by stocking density, with the optimal value in P1 at 0.97%/day based on Duncan's follow-up test. This condition is consistent with patterns found in several other commodities tested at different stocking densities, such as whiteleg shrimp (Pratiwi *et al.*, 2021), cantang grouper (Folnuari *et al.*, 2017), and tilapia (Riana *et al.*, 2021). Energy obtained from feed is used by fish for metabolism, growth, and reproduction (Effendie, 2002);

the higher the daily feed consumption rate, the higher the resulting growth variables (Saputra *et al.*, 2013; Sihite *et al.*, 2020).

Feed efficiency was significantly affected ($P < 0.05$) by the stocking density treatment, with the optimal value in P1 at 24.95%, significantly different from P2, P3, and P4. Feed efficiency values are closely related to feed digestibility; the higher the digestibility, the higher the feed nutrients that can be utilized for growth (Hanief *et al.*, 2014). At lower densities, fish can utilize the available feed more efficiently because of greater freedom of movement and activity (Sudarmayasa *et al.*, 2018). According to Liu *et al.* (2016), stocking density also affects fish aggressiveness; at high densities, growth is relatively slower due to higher competition and the accumulation of metabolic waste, which reduces the dissolved oxygen content in the water.

The feed conversion ratio (FCR) of bileh fish over the 40-day rearing period also differed significantly ($P < 0.05$) among treatments, with the best (lowest) value in P1 at 4.16, significantly different from P2, P3, and P4. The higher the stocking density, the higher the resulting FCR value, consistent with the findings reported by Becerra-Dorame *et al.* (2012), Xu and Pan (2012), and Weldon *et al.* (2021). This indicates that the FCR of bileh fish is influenced by several factors, including feed protein quality, the environment, and the fish's own physiological condition; the lower the FCR value, the better the efficiency of feed utilization by the fish (Monica and Sa'diyah, 2023).

3.2 Survival Rate

Survival rate of bileh fish after 40 days of rearing showed no significant effect ($P > 0.05$) from the stocking density treatment (Figure 1). The highest survival percentage was obtained in treatment P1 (5 fish/m³) at 93.33±11.54%, followed by P2 (10 fish/m³) at 90.00±10.00%, P3 (15 fish/m³) at 88.89±10.18%, and P4 (20 fish/m³) at 86.66±7.63%.

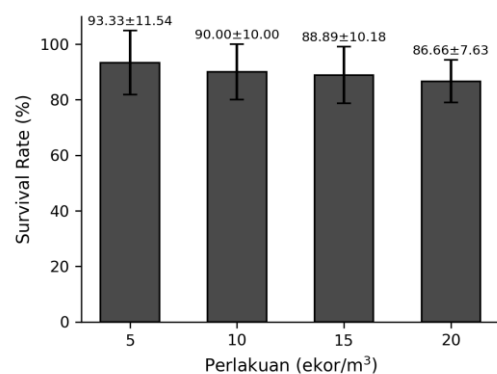


Figure 1. Survival rate percentage (survival rate) of bileh fish at different stocking densities

The high and not significantly different survival rate values in this study are thought to be because the range of

stocking densities tested was still relatively low, so it did not cause significant competition for space, oxygen, or feed (Sudarmayasa *et al.*, 2018). The success of survival is also determined by the adequacy of feed nutrition, including protein, fat, vitamin, carbohydrate, and mineral content (Mile *et al.*, 2023). Under conditions without significant competition, the physiological processes and growth of the fish are not disrupted, so feed utilization can proceed optimally (Prihatini and Febrianto, 2021).

3.3 Water Quality

Table 2.
Water quality parameters of the rearing media

Parameter	Measured	Natural Habitat
Temperature (°C)	27	30.8
pH	6.8	6.1
DO (mg/L)	5.2	4.7

In addition to stocking density, the growth and survival of bileh fish are also influenced by internal factors (seed quality) and external factors (feed management and rearing media) (Aan *et al.*, 2017). Yustianti *et al.* (2013) stated that feed management and water quality are the factors that most influence survival. Based on observations, the temperature, pH, and DO values during the study remained within the range tolerable to bileh fish (Nurfaizah *et al.*, 2024; Gustria *et al.*, 2024; Zulfadhli and Fadhillah, 2019), so that the physiological processes of the fish could proceed properly and support high survival across all treatments.

4. Conclusion

Stocking density had a significant effect on the absolute weight gain, absolute length gain, daily growth rate, feed efficiency, and feed conversion ratio (FCR) of bileh fish, with the most optimal performance obtained at a stocking density of 5 fish/m³ (P1). Survival of bileh fish did not differ significantly among treatments, but the highest percentage was also obtained at a stocking density of 5 fish/m³ at 93.33%. These results indicate that a stocking density of 5 fish/m³ is the most optimal stocking density for rearing bileh fish in an aquarium system.

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