Jurnal Perikanan

Fisheries Journal, 16 (3), 1664-1673 (2026)
http://doi.org/10.29303/jp.v16i3.2212

THE EFFECT OF STOCKING DENSITY ON SURVIVAR RATE OF BAWAL FISH FRESHWATER (*Colossoma macropomum*) SEED FISH SIZE 2-3 CM IN EXPERIMENTAL TANKS

Efek Jumlah Padat Tebar Terhadap Tingkat Kelangsungan Hidup Benih Ikan Bawal Air Tawar (*Colossoma macropomum*) Ukuran 2-3 Cm di Bak-Bak Percobaan

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(Received May 3rd 2026; Accepted June 6th 2026)

ABSTRACT

Freshwater bawal (*Colossoma macropomum*) is a high-value fishery commodity, widely consumed due to its rapid growth and meat quality. However, bawal seeds sized 2-3 cm face high mortality rates, often influenced by stocking density. This study aims to determine the optimal stocking density to maximize the survival rate of these seeds.

The research was conducted over 14 days (January 10–24, 2026) using an experimental method with a Completely Randomized Design (CRD), consisting of five treatments and five replications. The treatments involved different stocking densities: A (5 fish/L), B (15 fish/L), C (25 fish/L), D (35 fish/L), and E (45 fish/L). The specimens were fed commercial pellets three times daily. Data were analyzed using one-way ANOVA followed by an HSD (Honestly Significant Difference) test at a 5% significance level.

The results indicate that stocking density significantly affects the survival rate. Treatment A (5 fish/L) yielded the highest survival rate at 98.0%. Water quality remained stable throughout the study, with temperatures at 27.5–27.9°C, dissolved oxygen at 3.8–4.0 ppm, and pH at 7.5–7.8.

Keywords: Freshwater Bawal, Stocking Density, Seed.

ABSTRAK

Ikan bawal air tawar (*Colossoma macropomum*) merupakan komoditas perikanan bernilai ekonomi tinggi yang kini populer sebagai ikan konsumsi karena pertumbuhannya yang cepat dan rasa daging yang gurih. Namun, benih berukuran 2-3 cm memiliki tingkat mortalitas yang tinggi, yang salah satunya dipengaruhi oleh faktor padat tebar. Penelitian ini bertujuan untuk menentukan padat tebar terbaik terhadap tingkat kelangsungan hidup benih bawal air tawar ukuran 2-3 cm.Penelitian dilaksanakan selama 14 hari, mulai 10 hingga 24 Januari 2026, menggunakan metode eksperimental dengan Rancangan Acak Lengkap (RAL) yang terdiri dari 5 perlakuan dan 5 ulangan. Perlakuan yang diuji adalah perbedaan padat tebar, yaitu: A (5 ekor/liter), B (15 ekor/liter), C (25 ekor/liter), D (35 ekor/liter), dan E (45 ekor/liter). Hewan uji diberi pakan pelet komersial tiga kali sehari. Data dianalisis menggunakan ANOVA satu jalur dan dilanjutkan dengan uji BNJ taraf 5%.Hasil penelitian menunjukkan bahwa perbedaan jumlah padat tebar memberikan pengaruh yang nyata terhadap tingkat kelangsungan hidup benih. Perlakuan A (5 ekor/liter) memberikan hasil tertinggi dengan tingkat kelangsungan hidup mencapai 98,0%. Selama penelitian, parameter kualitas air tetap terjaga pada kondisi optimal, dengan suhu berkisar 27,5 - 27,9°C, oksigen terlarut 3,8 - 4,0 ppm, dan pH 7,5 - 7,8. Berdasarkan hasil tersebut, padat tebar rendah sangat direkomendasikan untuk menekan tingkat mortalitas pada fase benih.

Kata Kunci: *Colossoma Macropomum*, Padat Tebar, Benih.

INTRODUCTION

The freshwater pompano (Colossoma macropomum) is a fishery commodity with significant economic value. Initially traded as an ornamental fish, freshwater pompano due to its relatively fast growth rate and delicious meat, it has become a popular food fish. The growing public interest in fish consumption has led many consumers to adopt freshwater pompano. This has led to an increase in the supply of pompano for consumption, which in turn has led to an increase in the supply of fry for rearing (Dewi Yulianti, 2008).

Continuous efforts are needed to ensure the availability of fry, both in terms of quantity and quality. Hatchery is a critical factor and plays a crucial role in ensuring business in the production and marketing of edible-sized fish. In general, the supply of freshwater pompano fry in Indonesia is influenced by the seasons; during the rainy season, fry stocks are abundant, while during the dry season, stocks decline drastically. In addition to these technical issues, a frequent technical obstacle in the cultivation of pomfret fry is the presence of pests and diseases, which are suspected of affecting the dynamics of freshwater pomfret fry production (Arie, 2000).

Dewi Yulianti (2008) stated that the mortality rate of freshwater pomfret fry measuring 2-3 cm is very high due to stocking density. Increasing stocking density will be followed by an increase in feed intake, metabolic waste, oxygen consumption, and can degrade water quality. Decreased water quality will stress the fish, resulting in decreased growth and increased susceptibility to death (Djarijah, 2001). Higher stocking densities of fish fry can lead to increased competition for space and increased energy requirements. Increased energy requirements lead to an increased metabolic rate, while an increased metabolic rate leads to increased production of metabolic waste products, such as NH_3 and free carbon dioxide. These metabolic waste products, in high concentrations, are toxic to fry, ultimately leading to death. Furthermore, oxygen deprivation may occur if the stocking densities of fish fry are too high. Conversely, a lower stocking density allows the fry to utilize their movement space better than a relatively high stocking density. As a result, the number of surviving fry increases. Increasing the stocking density beyond the carrying capacity will cause a decrease in growth rate and can even kill the fry. Hepher and Pruginin (1981) in Dewi Yulianti (2008) found that increasing the stocking density is followed by a decrease in growth and, at certain levels, can result in mortality.

Based on this, research is needed to examine the effect of stocking density on the survival rate of 2-3 cm freshwater pompano fry in experimental tanks.

This study aims to determine the effect of stocking density on the survival rate of 2-3 cm freshwater pompano fry (Colossoma macropomum) in experimental tanks. Furthermore, it is also important to determine the optimal stocking density for the survival rate of 2-3 cm freshwater pompano fry in experimental tanks.

RESEARCH METHODS

Place and Time

This research was conducted in Kalitengah Village, Tanggulangin District, Sidoarjo Regency, East Java Province. The study was estimated to last 14 days, from January 10, 2026, to January 24, 2026.

Tools and Materials

The equipment used in this study included 25 15 L plastic containers equipped with an aeration system as experimental units. Water quality was monitored using a pH meter, thermometer, and DO meter. Other supporting equipment included fishing nets, plastic bags, trays, measuring cups, stationery, and documentation equipment.

The test material used was 2,500 freshwater pompano fingerlings measuring 2-3 cm. The rearing medium used was settled freshwater. The commercial feed used was the PF-800 series from PT. Central Proteina Prima. Prior to use, all research containers were sterilized with detergent to maintain the hygiene of the media.

Animal Test Container.

The research containers used in this study were 5-liter plastic buckets, each filled with 4 liters of fresh water. Before use, the water was allowed to settle for 24 hours. This was to ensure the freshwater used as the research medium remained sterile, free from contaminants and disease-causing factors.

Feed and Feeding

The test feed used in this study was a commercial feed series PF-800 owned by PT. Central Proteina Prima. as a treatment. The feed was given using a dose of 5% of the biomass weight of the test animals. Feeding was carried out 3 times a day, in the morning at 07.00 WIB - finished, in the afternoon at 12.00 WIB - finished and in the afternoon at 16.00 WIB - finished. The amount of feed per tub/day depended on the treatment, namely treatment A 3 grams/day, treatment B 9 grams/day, treatment C 15 grams/day, treatment D 21 grams/day and treatment E 27 grams/day.

Research Design

This study used an experimental method with a Completely Randomized Design (CRD) consisting of 5 treatments and 5 replications (a total of 25 experimental units). The determination of the number of replications was based on the Federer formula $(t - 1)(n - 1) \geq 15$, to ensure the validity of control against confounding variables (Kusriningrum, 2010). The treatments tested included differences in stocking densities, namely: treatment A (stocking density of 5 fish/liter), treatment B (stocking density of 15 fish/liter), treatment C (stocking density of 25 fish/liter), treatment D (stocking density of 35 fish/liter), treatment E (stocking density of 45 fish/liter).

Research Procedure.

All experimental units (plastic buckets and holding tanks) were sterilized using detergent, rinsed with fresh water, and dried. The containers were arranged according to the research layout and filled with 4 liters of fresh water. Each unit was equipped with an even aeration installation to ensure stable dissolved oxygen content throughout the treatment. The pomfret fry were acclimatized for 24 hours to adapt to the environment before being spread. Commercial feed series PF-800 owned by PT. Central Proteina Prima was prepared according to the treatment dosage. The amount of feed given was 5% of the fish biomass. The feed was given 3 times a day: morning at 07:00 WIB - finished, afternoon at 12:00 WIB - finished, and evening at 16:00 WIB - finished. Each water in the experimental tank was subjected to water quality measurements. Water quality measurements included water temperature, dissolved oxygen, and acidity levels. Water quality measurements were conducted three times a day: in the morning at 7:00 a.m. and finished, in the afternoon at 11:00 a.m. and finished, and in the evening at 5:00 p.m. and finished. Water temperature was measured using a thermometer, acidity using a pH meter, and dissolved oxygen using an oxygen meter.

Data Analysis

The obtained data were statistically processed using one-way analysis of variance (ANOVA) to test the effect of the independent variables on the dependent variable. The testing criteria were carried out by comparing the calculated F value to the F table at the 5% and 1% confidence levels. If the analysis results showed a significant effect ($P < 0.05$) or very significant ($P < 0.01$), a further Least Significant Difference (LSD) test was conducted to determine the differences between treatments (Prayitno, 2012). The entire data computation process was assisted by the IBM SPSS Statistics 27 program.

Survival Rate Observation

The survival rate is the number of fish survival rates from the start of stocking to the end of maintenance. Zonneveld et al. (1991) argue that the survival rate can be calculated using the following formula:

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

Description:

SR = Survival rate of freshwater pomfret seeds (%).
Nt = The number of freshwater pomfret fish seeds at the end of the study (tail).
No = The number of freshwater pomfret fish seeds at the beginning of the study (tail).

RESULT

Based on the results of research on the effect of stocking density on the survival rate of 2-3 cm freshwater pompano fry in experimental tanks, different averages were obtained between treatments. The range, mean, standard deviation, and survival rate of 2-3 cm freshwater pompano fry for each treatment are shown in Table 1 below.

Table 1. Range, mean, standard deviation, and survival rate of 2-3 cm freshwater pompano fry

Treatment	Range of survival rates of test animals (%)	Average (%)	Standard deviation (sd)
A	95,0 – 100,0	98,0	2,7
B	76,7 – 83,3	81,3	3,0
C	60,0 – 75,0	65,0	6,1
D	42,9 – 57,1	50,0	6,7
E	27,8 – 36,1	32,2	3,1

Based on Table 1 above, it can be explained that treatment A showed the highest effect on the survival rate of 2-3 cm freshwater pomfret fry. Treatments B, C, D, and E sequentially had a decreasing effect on the survival rate of 2-3 cm freshwater pomfret fry. Figure 1 below presents a graph of the average survival rate of 2-3 cm freshwater pomfret fry for each treatment.

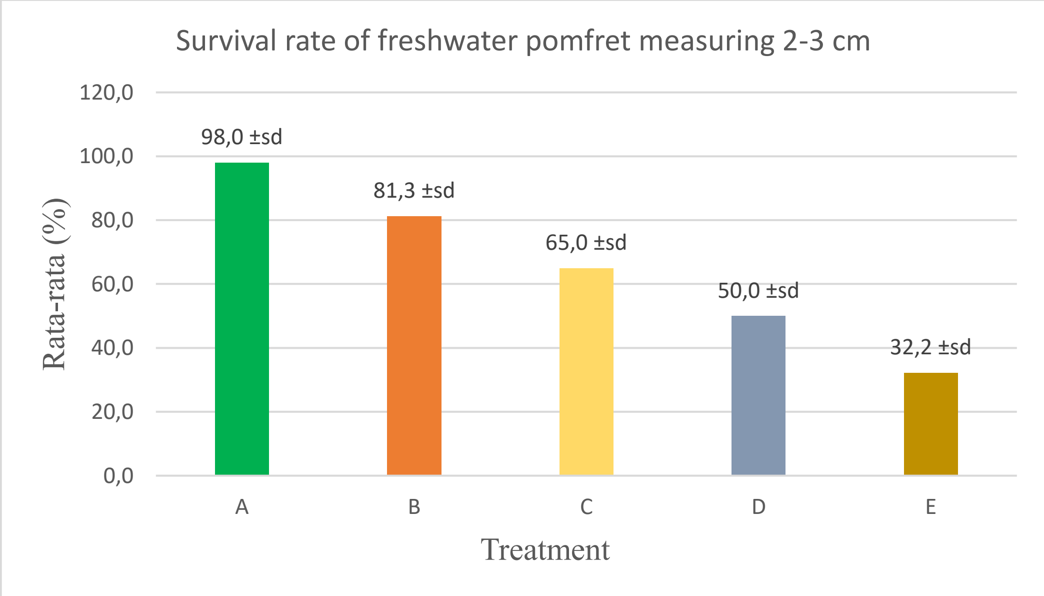

Figure 1. Graph of the average survival rate of freshwater pomfret fry measuring 2-3 cm for each treatment.

To determine whether there were significant differences between treatments, a one-way ANOVA test was conducted, and the results are shown in Table 2 below.

Table 2. One-way ANOVA test of survival rate of 2-3 cm freshwater pompano fry

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	13268,922	4	3317,231	153,738	0,000
Within Groups	431,544	20	21,577		
Total	13700,466	24			

Based on Table 2 above, it can be seen that the stocking density treatment significantly affected the survival rate of 2-3 cm freshwater pompano fry (F > Sign). Furthermore, to determine the level of difference between each treatment on the survival rate of 2-3 cm freshwater pompano fry, a 5% BNJ test was conducted. The average and notation for the survival rate of 2-3 cm freshwater pompano fry can be seen in Table 3 below.

Table 3. Average and Notation for the Survival Rate of 2-3 cm Freshwater Pompano Fry.

Treatment	N	Subset for alpha = 0,05				
		1	2	3	4	5
A	5	98,0[a]				
B	5		81,3[b]			
C	5			65,0[c]		
D	5				50,0[d]	
E	5					32,2[e]

Based on Table 4.3 above, it can be explained that treatment A is significantly different from treatments B, C, D and E. Furthermore, treatment B is significantly different from treatments C, D and E. Next, treatment C is significantly different from treatments D and E.

Likewise, treatment D is significantly different from treatment E. The range, average and standard deviation of the temperature of each treatment can be seen in Table 4. below.

Table 4. Range, average and standard deviation of water temperature levels for each treatment and replication.

Treatment	Water temperature range (^oC)	Average water temperature (^oC)	Standard deviation (sd)
A	27,5 - 27,9	27,7	0,2
B	27,5 - 27,8	27,7	0,1
C	27,6 - 27,8	27,7	0,1
D	27,5 - 27,8	27,6	0,1
E	27,5 - 27,8	27,6	0,1

Based on Table 4 above, it can be seen that the water temperature levels for each treatment showed relatively similar figures. To determine whether there were significant differences between the water temperature levels in each treatment, a one-way ANOVA test was conducted, the results of which can be seen in Table 5 below.

Table 5. One-way ANOVA test for water temperature levels

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	0,026	4	0,006	0,381	0,820
Within Groups	0,336	20	0,017		
Total	0,362	24			

Based on Table 5 above, it can be explained that water temperature levels did not have a significant effect on the survival rate of 2-3 cm freshwater pomfret fry (F < Sign.). The results of the study showed that dissolved oxygen levels ranged from 3.8 to 4.0 ppm. The range, average, and standard deviation of dissolved oxygen levels for each treatment can be seen in Table 6 below.

Table 6. Range, average, and standard deviation of dissolved oxygen levels for each treatment and replication.

Difference in stocking density (tail)	Dissolved oxygen range (ppm)	Average dissolved oxygen (ppm)	Standard deviation (sd)
A	3,8 - 4,0	3,9	0,1
B	3,8 - 4,0	3,9	0,1
C	3,8 - 4,0	3,9	0,1
D	3,8 - 4,0	3,9	0,1
E	3,8 - 3,9	3,9	0,1

Based on Table 6 above, it can be seen that the dissolved oxygen levels for each treatment were relatively similar. To determine whether there were significant differences between the dissolved oxygen levels in each treatment, a one-way ANOVA test was conducted, the results of which are shown in Table 7 below.

Table 7. One-way ANOVA test for dissolved oxygen levels

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	0,010	4	0,003	0,406	0,802
Within Groups	0,128	20	0,006		
Total	0,138	24			

Based on Table 7 above, it can be explained that dissolved oxygen levels did not significantly affect the survival rate of 2-3 cm freshwater pompano fry (F < Sign.). The research results showed that the acidity level ranged from 7.5 to 7.8. The range, average, and standard deviation of the acidity levels for each treatment can be seen in Table 8 below.

Table 8. Range, average, and standard deviation of acidity levels for each treatment and replication.

Treatment	Acidity range	Average acidity level	Standard deviation (sd)
A	7,5 - 7,8	7,6	0,1
B	7,5 - 7,8	7,6	0,1
C	7,5 - 7,8	7,7	0,1
D	7,5 - 7,8	7,7	0,1
E	7,5 - 7,8	7,6	0,1

Based on Table 8 above, it can be seen that the acidity levels for each treatment showed relatively similar values. To determine whether there were significant differences between the acidity levels in each treatment, a one-way ANOVA test was conducted, the results of which are shown in Table 9 below.

Table 9. One-way ANOVA test for acidity levels

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0,030	4	0,007	0,481	0,750
Within Groups	0,308	20	0,015		
Total	0,338	24			

Based on Table 4.9 above, it can be explained that the level of acidity does not have a real effect on the survival rate of freshwater pomfret fish seeds measuring 2-3 cm (F < Sign).

DISCUSSION

Based on research on the effect of different stocking densities on the survival rate of 2-3 cm freshwater pompano fry, treatment A resulted in a 98.0% survival rate for freshwater pompano fry, treatment B 81.0%, treatment C 65.0%, treatment D 49.4%, and treatment E 31.2%. A 5% ANOVA test showed that the differences in stocking densities for each treatment significantly affected the survival rate of 2-3 cm freshwater pompano fry.

Based on the 5% BNJ test, treatment A had the highest effect on the survival rate of 2-3 cm freshwater pompano fry compared to treatments B, C, D, and E. This is because the lower the stocking density, the lower the competition for oxygen, allowing each freshwater pompano fry to utilize oxygen freely for respiration. Furthermore, at a low stocking density, the freshwater pompano fry have sufficient room to move, thus reducing stress. As a result, all physiological processes, especially the metabolism of freshwater pompano fry, proceed normally, and only a small number die. Nurmi Yaningsih (2018) stated that the survival rate of fry increases with lower stocking densities. This is due to the fry having ample room to move, low competition for food, and minimal accumulation of freshwater pompano fry feces.

Treatments B, C, D, and E, in sequence, had a progressively lower survival rate for freshwater pompano fry measuring 2-3 cm. This is because higher stocking densities result in limited space for movement, making them susceptible to stress and rapid mortality. Diansari (2013) argues that stress in fry is caused by many factors, such as excessive stocking densities. If freshwater pompano fry experience stress, their bodies will exhibit signs indicating distress (Nurmi Yaningsih, 2018). This stressful condition can disrupt metabolic processes due to the increasing CO2 levels in the water, making the fish fry susceptible to hematopoiesis, which increases oxygen supply and accelerates CO2 excretion. Diansari (2013) states that high stocking densities also increase the ammonia levels released by the fish fry, which can trigger bacterial growth. The presence of these bacteria can cause various diseases. Bacterial diseases are characterized by a decrease in white blood cells, which can trigger a decline in the body's defense system. Nugroho, RA, et al. (2012) argue that excessive stocking densities disrupt the physiological processes and behavior of fish regarding movement, ultimately leading to a decline in their physiological condition and health. Consequently, food utilization, growth, and survival experience a drastic decline. This stress impacts the fish fry's immune system, leading to sudden death. Water quality conditions during the study were within the optimal range for the growth of pompano fry, with temperatures ranging from 2.75 to 27.8 oC, pH 7.5 to 7.8, and dissolved oxygen (DO) levels ranging from 3.8 to 4.0 ppm. These stable environmental parameters support optimal biological activity, metabolism, and feed conversion for the test animals (Hamid & Harmadi, 2023; Swain et al., 2020).

CONCLUSION

The stocking density significantly affected the survival rate of 2-3 cm freshwater pomfret fry, with treatment A providing the highest rate of 98.0%. Water quality data during the study showed a water temperature ranging from 27.5 to 27.8 oC, dissolved oxygen ranging from 3.8 to 4.0 ppm, and acidity ranging from 7.5 to 7.8. All water quality observation data were homogeneous, meaning that methodologically, they did not significantly affect the survival rate of 2-3 cm freshwater pomfret fry.

ACKNOWLEDGEMENT

The author would like to express his gratitude to the Faculty of Food and Fisheries Technology, Dr. Soetomo University, Surabaya, for the support and facilities provided during the research. He also thanks his supervisor for providing direction, guidance, and constructive feedback during the research and writing of this article. Furthermore, he would like to thank all parties who have assisted, both directly and indirectly, in ensuring the successful completion of this research.

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