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THE EFFECT OF STOCKING DENSITY ON THE SURVIVAL RATE OF SIAMESE CATFISH *(Pangasius hypophthalmus)* FINGERLINGS (3-5 CM) IN A CLOSED WET TRANSPORTATION SYSTEM

Pengaruh Kepadatan pada Sistem Transportasi Basah Tertutup Terhadap Kelangsungan Hidup Benih Ikan Patin Siam (*Pangasius hypophthalmus*) Ukuran 3-5 cm

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ABSTRACT

Siamese catfish (*Pangasius hypophthalmus*) is one of the leading freshwater commodities and has high economic value in Indonesia. Increasing cultivation intensity to meetdomestic and export market demand has direct implications for the high demand for quality seeds. Closed wet transportation is an important part of aquaculture activities. This method has significant advantages in terms of logistics efficiency. This study aims to assess the effect of density on closed wet transportation systems on the survival of Siamese catfish (*Pangasius hypophthalmus*) seeds with a size of 3-5 cm. This study is expected to provide recommendations for the transportation of the density of Siamese catfish (*Pangasius hypophthalmus*) in size 3-5 cm. This study uses the analysis method of normality tests in spss, variety homogeneity tests, variety fingerprints and the smallest real difference (BNT). Treatment A = Fish density 100 fish/liter (0) (Control Treatment, Treatment B = 150 fish/liter, Treatment C = 200 fish/liter, Treatment D = 250 fish/liter. From the study, the most optimal density of Siamese catfish (*Pangasius hypophthalmus*) is the highest which is 200 fish/liter with an average SR of 98.08%. With water quality including: water temperature: 26.1 °C – 26.8 °C, water pH: 6.1 – 6.9 and Dissolved Oxygen (DO): 2.0 – 6.3 ppm.

Keywords: Siamese catfish fingerlings measuring 3-5 cm, closed wet transportation, survival rate

ABSTRAK

Ikan patin siam (*Pangasius hypophthalmus*) adalah salah satu komoditas air tawar unggulan dan memiliki nilai ekonomis tinggi di Indonesia. Peningkatan intensitas budidaya untuk memenuhi permintaan pasar domestik dan ekspor berimplikasi langsung pada tingginya kebutuhan benih yang berkualitas. Transportasi basah tertutup merupakan bagian penting dalam kegiatan akuakultur. Metode ini memiliki keunggulan signifikan dalam aspek efisiensi logistik. Penelitian ini bertujuan untuk menilai Pengaruh Kepadatan Pada Sistem Transportasi Basah Tertutup Terhadap Kelangsungan Hidup Benih Ikan Patin Siam (*Pangasius hypophthalmus*) Ukuran 3-5 Cm. Penelitian ini diharapkan dapat memberikan rekomendasi transportasi kepadatan benih ikan patin siam (*Pangasius hypophthalmus*) ukuran 3-5 Cm. Penelitian ini menggunakan metode analisis uji normalitas dalam spss, uji homogenitas ragam, sidik ragam dan Beda Nyata Terkecil (BNT). Perlakuan A = Kepadatan ikan 100 ekor/liter (0) (Perlakuan Kontrol, Perlakuan B = 150 ekor/liter, Perlakuan C = 200 ekor/liter, Perlakuan D = 250 ekor/liter. Dari penelitian tersebut kepadatan paling optimal benih ikan patin siam (*Pangasius hypophthalmus*) tertinggi yaitu 200 ekor/liter dengan rata-rata SR 98,08 %. Dengan kualitas air meliputi: suhu air: 26,1 ˚C – 26,8 ˚C, pH air: 6,1 – 6,9 dan Oksigen terlarut (DO): 2,0 – 6,3 ppm.

Kata kunci: benih patin siam ukuran 3-5 cm, transportasi basah tertutup, tingkat kelangsungan hidup

INTRODUCTION

The aquaculture sector plays a crucial role in meeting global animal protein needs, and one of Indonesia's leading freshwater commodities is the Siamese catfish (Pangasius hypophthalmus) (Smith et al., 2020). High market demand for Siamese catfish, both for domestic consumption and export, has driven increased aquaculture intensity. This increase directly impacts the need for high-quality and sustainable Siamese catfish fry (Pratama et al., 2019).

In addition to its abundant productivity, its extraordinary adaptability to environmental variations adds value to the Siamese catfish farming business. Research by Firmansyah et al. (2021) indicates that Siamese catfish (Pangasius hypophthalmus) exhibit excellent growth performance in areas with optimal air and environmental quality, making it highly suitable for development in areas prone to fluctuations. However, the sustainability of this business still requires practical technological support. Rosmawati et al. (2025) emphasized that adopting tarpaulin ponds is a highly effective preventative measure to reduce the risk of pathogen transmission or fish disease.

In the aquaculture business chain, the seed transportation stage is a crucial link and often determines the success of seed distribution at the rearing location. Seed transportation, especially over long distances and over long periods, faces a major challenge: maintaining the highest possible seed survival rate (Davis, 2018). Failure during the transportation stage due to stress or seed mortality can result in significant economic losses for farmers.

The Siamese catfish (Pangasius hypophthalmus) seed transportation system is generally carried out in a closed wet system, utilizing plastic containers filled with pure oxygen and water. Environmental factors that significantly affect seed condition during transportation are (1) a decrease in dissolved oxygen (DO) concentration and (2) an increase in the concentration of toxic metabolites, such as ammonia (NH3) and carbon dioxide (CO2) (Wardoyo et al., 2021).

One of the most crucial technical factors in controlling changes in water quality and seed stress during transportation is packing density. Packing density is defined as the number of individual seeds per unit volume of transport water. Too low a density will reduce transportation efficiency and increase logistics costs (uneconomical), while too high a density will trigger the accumulation of metabolic waste and a rapid decrease in DO, leading to acute stress and mass mortality of the fry (Gusrina, 2022).

Based on the above description, a reference is needed to determine the appropriate density in a closed wet transportation system for Siamese catfish (Pangasius hypophthalmus) fry, especially for sizes 3-5 cm.

RESEARCH METHODS

Place and Time

This research was conducted on May 17, 2026, and completed on the same day at UD. Sumbermas Minajaya Barokah, Krecek Village, Badas, Kediri Regency, heading to the East Java BKHIT Office – Juanda Executing Unit.

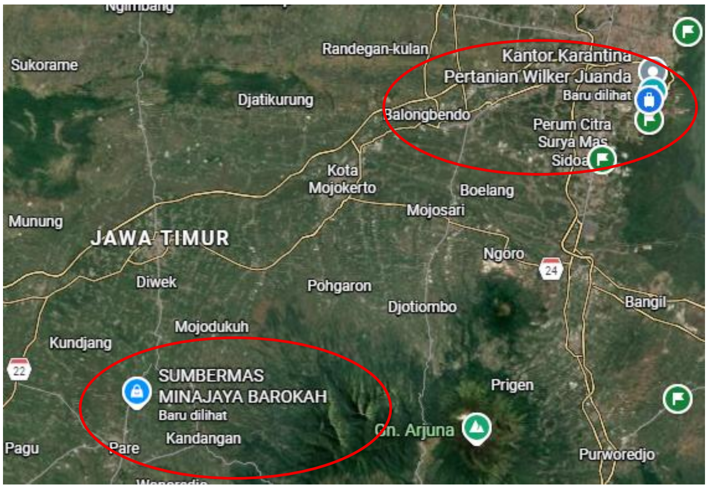

Figure 1. Map of research location (Googlemap, 2026)

Tools and Materials

The tools used in this study included an oxygen cylinder, a 1-liter measuring cup, a digital DO meter, a digital pH meter, a digital thermometer, a digital scale, and a seser. The materials used in this study included 3-5 cm Siamese catfish seeds, 40 x 60 cm polyethylene plastic bags, rubber bands, pure oxygen, fresh water, and Styrofoam.

Research methods

The experimental method used in this study was based on a Completely Randomized Design (CRD), which consisted of 4 treatment levels and was repeated 6 times. Based on (SNI 6483.2: 2016), the recommended stocking density for transporting Siamese catfish fry measuring 3-5 cm with a travel duration of less than 5 hours is 150-200 fry/liter. To determine the efficiency and tolerance limits of fry survival under and above the standard conditions, this study tested two additional density levels. Namely:

a) Treatment A : Siamese catfish seeds 100 tails/liter
b) Treatment B : Siamese catfish seeds 150 tails/liter
c) Treatment C : Siamese catfish seeds 200 tails/liter
d) Treatment D : Siamese catfish seeds 250 tails/liter

Research Procedures

The preparation stage for transporting Siamese catfish fry with a closed system includes a fasting process for 12-24 hours to reduce the metabolism of the fry during the transport process, then acclimatization of the fry from a pool temperature of 27˚C to 25˚C. Next, the implementation stage begins by putting the fry into polyethylene plastic bags filled with pure oxygen with a water and oxygen volume ratio of 1:3 (1 liter of water and 3 liters of oxygen), then the bags are neatly arranged in styrofoam and put into the transport fleet. Finally, there is the observation stage which includes measuring water quality before and after treatment for 4 hours of travel such as temperature, pH, and DO. After that, the Siamese catfish fry are observed by calculating the survival rate of each treatment bag and recording it for further data processing.

Data Analysis

In this study, one-way analysis of variance (ANOVA) was used with the following provisions:

a) If the calculated F value > F-table (or Sig. value < 0.05): then H0 is rejected (H1 is accepted, while H1 is rejected. This means that the difference in packing density has a significant effect on the survival of catfish seeds, so it is mandatory to continue to the Tukey HSD test, whereas if the calculated F ≤ F table (or Sig. value ≥ 0.05): then H0 is accepted. This means that there is no significant effect, and further BNT or Tukey HSD tests do not need to be carried out.

The ANOVA test shows a real or very real effect. The next step is to carry out further testing using the Least Significant Difference method or Tukey HSD.

Survival Rate

The survival rate (SR) is defined as the percentage of living organisms that survive out of the total number of organisms transported (Wangni et al., 2019). According to them, SR is the main indicator of the success of the fish seed delivery process, calculated using the formula:

$$SR\ \% = \frac{Final\ Fish\ Count}{Number\ of\ Fish} x\ 100$$

RESULT

Based on the results of the study on the effect of density in a closed wet transportation system on the survival rate of 3-5 cm Siamese catfish (Pangasius hypophthalmus) fry, the average results differed between treatments, as presented in Table 1 below.

Table 1. Range, average, and standard deviation of survival rates of 3-5 cm Siamese catfish fry at various densities

Treatment	Survival rate of Siamese catfish seeds measuring 3-5 cm (%)	Average (%)	Standard deviation (sd)
A 100 tails/liter	98 - 100	99,33	0,81
B 150 tails/liter	98 – 100	99,33	1,26
C 200 tails/liter	96,5 – 100	98,08	2,48
D 250 tails/liter	71,6 – 79,6	75,86	8,26

Based on Table 1, it can be explained that at low density, namely treatment A, the average survival rate was 99.33% with a very small standard deviation (0.81), indicating very stable results. Next, treatment B had an average survival rate of 99.33% but with a standard deviation slightly above treatment A (1.26). Treatment C had an average survival rate that decreased to 98.08% with a standard deviation of 2.48. An interesting thing happened in treatment D, where the average survival rate actually decreased sharply to 75.86% with a standard deviation of 8.26.

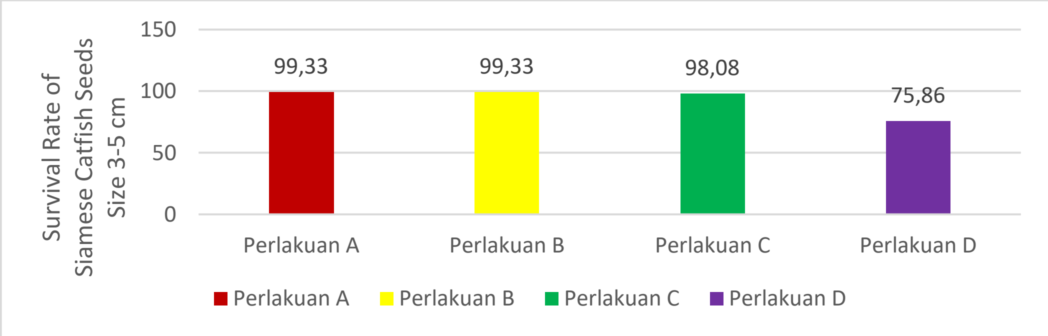

Figure 2. Graph of the average survival rate of 3-5 cm Siamese catfish fry in various treatments

A one-way ANOVA test was applied to identify significant differences between treatments, with detailed results presented in Table 2 below.

Table 2. One-way ANOVA test of survival rates of 3-5 cm Siamese catfish fry in various treatments

	Sum of squares	df	Mean square	F	Sig.
Between Groups	35886,458	3	11962,153	623,841	0,000
Within Groups	383,500	20	19,175		
Total	36269,958	23			

Based on Table 2, it can be seen that density significantly affects the survival rate of 3-5 cm Siamese catfish fry, as the Sig. value (0.000) is much smaller than 0.05. Furthermore, to determine the specific differences between each treatment, a post-hoc test was conducted. The average and notation for the survival rate of 3-5 cm Siamese catfish fry across various treatments can be seen in Table 3 below.

Table 3. Average and notation for the survival rate of 3-5 cm Siamese catfish fry across various treatments

Treatment	N	Subset for alpha = 0,05		
		1	2	3
D	6	75,86^{d}		
C	6		98,08^{c}	
B	6			99,33^{b}
A	6			99,33^{a}

Based on Table 3, different treatments significantly affected the survival rate of 3–5 cm Siamese catfish fry (alpha = 0.05). Treatments A and B demonstrated the highest survival rates and were in the same subset (subset 3), with a twin average of 99.33%. This indicates that the survival rates of treatments A and B were not significantly different from each other. Meanwhile, treatment C was next in subset 2 with an average of 98.08%, statistically significantly different from all other treatments. Conversely, treatment D (subset 1) had the lowest survival rate, reaching only 75.86%, making it the treatment with the most contrasting results compared to the other three treatments.

The results of water quality measurements after treatment were: water temperature: 26.1°C–26.8°C, water pH: 6.1–6.9, and dissolved oxygen (DO): 2.0–6.3 ppm.

DISCUSSION

Table 1 and Figure 2 show a clear dynamic that increasing the density of 3–5 cm Siamese catfish (Pangasius hypophthalmus) fry in a closed wet transport system is inversely proportional to their survival rate. Low to Medium Density (Treatment A and B): At stocking densities of 100 fry/liter (Treatment A) and 150 fry/liter (Treatment B), the fry survival rate was at a very high and identical figure, namely 99.33%. The relatively small standard deviation value (0.81 in Treatment A and 1.26 in Treatment B) indicates that the macro-environmental conditions inside the plastic packaging container during transport are still able to optimally and stably support the physiological needs of the fry. Densities of up to 150 fry/liter do not appear to have exceeded the carrying capacity threshold of the transport medium. When the stocking density was increased to 200 fish/liter (Treatment C), the average survival rate began to decline to 98.08%, with a standard deviation widening to 2.48. This phenomenon indicates increased competition for space and metabolic excretion, which began to stress fish homeostasis, although overall survival rates were still considered good for seed transportation. A drastic decline occurred in Treatment D, with a stocking density of 250 fish/liter, where the survival rate fell to 75.86%, with a very large standard deviation of 8.26. This spike in the standard deviation reflects the high mortality rate, which varied between packaging replicates. This demonstrates that the commodity's biological tolerance limits for movement space and oxygen availability had been significantly exceeded.

The results of the analysis of variance (one-way ANOVA) in Table 2 support this finding, with a significance value (Sig.) of 0.000, well below the critical threshold of alpha = 0.05. The F-count of 623.841 confirmed the highly significant effect of differences in packing density on the survival of Siamese catfish fry. To map specific differences between treatment groups, the DMRT (Post Hoc) test (Table 3) grouped the results into three distinct subsets. Treatment D (75.86d) was in subset 1 and Treatment C (98.08c) in subset 2, meaning they were statistically significantly different from each other and from the other treatments. Interestingly, Treatment B (99.33b) and Treatment A (99.33a) were placed together in subset 3. This statistically demonstrates that increasing the stocking density from 100 to 150 fry/liter did not significantly impact the survival rate of fry.

The correlation between water quality parameters and survival during transport is highly correlated, as the success of closed-system transport depends heavily on its ability to maintain stable water quality parameters within the container. Over time, the accumulation of fish metabolic waste in the form of ammonia (NH_3) and carbon dioxide (CO_2), accompanied by a decrease in dissolved oxygen (DO), becomes the main limitation. Temperature is the main regulator of the metabolic rate of aquatic organisms. In closed-system transportation, an increase in water temperature inside the plastic bag often occurs due to the influence of the external (ambient) temperature and the accumulation of heat from the kinetic energy of the movement of stressed fish fry. Based on research reported by Subandiyono et al. (2021) on the transportation of freshwater fish fry, the ideal temperature range to maintain metabolic stability is between 20°C – 24°C (for cold systems) or maintained at 26°C – 28°C if using a constant room temperature. If the water temperature increases beyond 30°C, the metabolism of catfish fry will increase sharply, triggering hyperactivity that leads to high mortality as indicated in Treatment D. Meanwhile, according to Syafriadiman (2020) in a study on optimizing local fish transportation media, a safe pH value for catfish fry during transportation ranges from 6.5 – 7.5. In extreme stocking density treatments (such as 250 fish/liter in Treatment D), abundant CO_2 production is certain to push the pH down towards strong acid (< 6.0), which results in a decrease in the affinity of hemoglobin for oxygen (Root effect), so that the fish experience asphyxia (failure to breathe) even though external oxygen may still be available.

At high densities (Treatments C and D), the collective oxygen consumption rate increases manyfold. When the DO supply drops to a critical level, the fry experience hypoxia. Pratama et al. (2022) emphasized that to maintain the viability of catfish fry above 90%, the minimum DO level during the voyage must not fall below 4.0 mg/L. In Treatment D, the high density (250 fry/liter) caused the oxygen consumption rate to exceed the rate of oxygen diffusion from the headspace into the water medium. As a result, local anoxia occurred inside the plastic bag, triggering rapid mass mortality of the fry.

CONCLUSION

Based on the results of the research above, it can be concluded that the increase in stocking density is inversely proportional to the survival rate of fish seeds, where Treatment A (100 fish/liter) and B (150 fish/liter) produced the highest average survival rate of 99.33%, followed by Treatment C (200 fish/liter) at 98.08%, and the sharpest decline occurred in Treatment D (250 fish/liter) which only reached 75.86%, whereas if viewed from the technical aspects of transportation and economic efficiency, Treatment C (200 fish/liter) is the most optimal density to be applied. Although biologically the average survival rate (98.08%) is slightly lower than Treatments A and B, the decline is not drastically significant if compensated by the volume of commodities successfully transported.

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