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OPTIMIZATION OF NURSERY TECHNIQUES FOR SILVER POMPANO (*Trachinotus blochii*) IN BPBL BATAM: ANALYSIS OF GROWTH PERFORMANCE, SURVIVAL RATE, AND WATER QUALITY

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ABSTRACT

The production of silver pompano (*Trachinotus blochii*) in Indonesia has declined sharply, highlighting persistent issues in its nursery stage, particularly the inability to promote rapid growth and high survival rates when water quality fluctuates. This research assessed intensive nursery techniques implemented at Balai Perikanan Budidaya Laut (BPBL) in Batam by systematically testing different stocking densities, feeding schedules, and key water-quality metrics. Over a twenty-one-day culture cycle, observers collected data daily and interpreted it using descriptive statistics. Fish length rose from an initial mean of 2.50 cm to 3.73 cm, and mean weight climbed from 0.50 g to 1.30 g, yielding an average specific growth rate of 2.5% per day, a survival rate of 83.7%, and a feed-conversion ratio of 2.1. During the trial, temperature (27.6 °C), pH (7.81), dissolved oxygen (5.7 mg/L), and salinity (30 ppt) consistently fell within national SNI 7901-2013 standards. Most deaths occurred during grading rather than through cannibalism, indicating that handling stress, rather than predatory behavior, was the primary cause of loss. Collectively, these results establish a reference point for nursery management of *T. blochii* and furnish Indonesian aquaculture planners with data needed to boost fish-seed output while strengthening coastal community livelihoods.

Keywords: Silver Pompano, Nursery Techniques, Growth Performance, Survival Rate

1. INTRODUCTION

Marine aquaculture plays a strategic role in supporting food security and economic growth in Indonesia, especially amid increasing global demand for high-value seafood commodities. One of the most promising species in this sector is the silver pompano (*Trachinotus blochii*), which has gained attention due to its rapid growth rate, resistance to diseases, ease of cultivation, and strong market demand both domestically and internationally, particularly in countries such as Singapore, Japan, Canada, and Hong Kong. These characteristics are consistent with previous findings reporting the species' excellent growth performance and adaptability across diverse culture environments[1]. The nutritional value of silver pompano, especially its high omega-3 fatty acid content, further enhances its economic and health appeal.

Despite its potential, silver pompano aquaculture in Indonesia faces significant challenges. National production declined sharply from 210,039 tons in 2020 to 128,635 tons in 2021, a 38.76% decrease[2]. This significant drop underscores the critical need to improve seed availability, particularly during the nursery phase, to produce high-quality fingerlings for grow-out operations. Studies have shown that the nursery stage is a biological bottleneck in many marine finfish species because

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survival and growth are highly sensitive to environmental and nutritional instability[3].

Although silver pompano has shown great promise as a cultured species, the nursery phase remains a significant bottleneck, with low survival rates and inconsistent juvenile growth performance. These constraints are commonly associated with improper stocking densities, suboptimal feeding strategies, and unstable water quality, as reported in field studies on pompano culture in India and Southeast Asia[1,3]. Field observations at the Marine Aquaculture Center (BPBL Batam) indicate that juvenile mortality is primarily due to handling stress during grading rather than cannibalism, suggesting that *T. blochii*, while non-aggressive, is highly sensitive to mechanical disturbances. Similar stress-related mortality during grading has been documented in nursery rearing of other non-carnivorous marine finfish species. Furthermore, the surrounding waters at BPBL Batam have shown signs of degradation due to increasing industrial activity and localized oil contamination, findings that align with environmental assessments showing that water-quality deterioration significantly affects marine aquaculture performance.

This study aims to evaluate the effectiveness of intensive nursery techniques for silver pompano at BPBL Batam, focusing on optimizing stocking density, feeding frequency, and environmental management. Specifically, the research seeks to: (1) establish size-specific stocking density benchmarks; (2) assess the impact of high-frequency feeding with vitamin supplementation on juvenile growth and feed utilization; and (3) profile the water quality parameters that support optimal survival and development under semi-commercial hatchery conditions. The emphasis on feeding management is supported by earlier studies showing that feed supplementation and feeding frequency significantly influence nutrient retention and growth efficiency in juvenile pompano[4].

Despite increasing interest in silver pompano farming, scientific studies on its nursery management in Indonesia remain limited, particularly those that address empirical benchmarks such as specific growth rate (SGR), feed conversion ratio (FCR), and stress-induced mortality in relation to stocking density and water quality. Moreover, existing literature rarely integrates biological performance with local environmental parameters, especially in semi-commercial hatchery settings operated by government institutions. This gap hampers the development of adaptive nursery management models suited for tropical aquaculture systems exposed to environmental fluctuations and anthropogenic stressors[5].

This study contributes a novel, field-based dataset on silver pompano nursery performance, including growth trends, survival rates, FCR, and water quality under operational conditions at BPBL Batam. It provides clear evidence that mechanical stress during grading, not cannibalism, is the primary factor affecting mortality during the nursery phase[6]. Furthermore, it offers baseline environmental thresholds and demonstrates the practicality of combining high-frequency feeding with vitamin supplementation to sustain growth under moderately polluted conditions. These findings are expected to serve as a scientific foundation for the development of robust nursery techniques that can be replicated across Indonesia's coastal aquaculture sector, ultimately supporting the growth of sustainable marine aquaculture and the livelihoods of coastal communities.

2. RESEARCH METHOD

Time and Place

This research was conducted from January to February, 2025 at the Marine Aquaculture Center (Balai Perikanan Budidaya Laut, BPBL) in Batam, located on Setoko Island, Bulang District, Batam City, Riau Islands Province, Indonesia. The site is located in the Barelang marine area, which features tropical coastal ecosystems with muddy-sandy substrates, coral reefs, seagrass beds, and mangrove forests, conditions that support marine aquaculture. The facility is equipped with hatchery systems, indoor and outdoor nursery tanks, and environmental monitoring equipment.

Method

A participatory observation method was employed, combining direct involvement in the nursery process with structured data collection. The study used a descriptive quantitative approach to analyze growth performance, survival rate, feed efficiency, and water quality of silver pompano juveniles reared under intensive nursery conditions.

Procedures

The research procedure consisted of several key stages: Tank preparation – Fiberglass tanks with volumes ranging from 1 to 6 tons were thoroughly cleaned using brushes and freshwater. After cleaning, the tanks were filled with filtered seawater using a sand-filter system, resulting in a water depth of 1 m. Aeration was provided continuously to maintain dissolved oxygen levels.

Stocking – Juveniles were stocked at different densities based on size: 400–500 individuals/ton for 2.5 cm juveniles; 300–400 individuals/ton for 4 cm juveniles; and 250 individuals/ton for 5 cm juveniles. Fish were acclimated before stocking to minimize stress.

Feeding management – Commercial pellets ranging from 300 to 2000 microns were administered six times daily at 07:00, 09:00, 11:00, 13:30, 14:30, and 16:00. Feed was supplemented with vitamins and mixed thoroughly before being broadcast into the tanks. Daily feed rations ranged from 6% to 10% of total biomass, depending on fish size.

Water quality monitoring – Key parameters, including temperature, pH, dissolved oxygen (DO), and salinity, were measured daily using a Lovibond SensoDirect 150 m. Ammonia (NH_3), nitrite (NO_2), nitrate (NO_3), and orthophosphate (PO_4) levels were monitored periodically to assess water quality stability.

Growth sampling – Growth measurements were taken every 5–7 days by randomly sampling 10 fish from each tank. Total length was measured using a ruler, and body weight was recorded with a digital scale.

Grading and harvesting – Grading was performed weekly using perforated trays to separate fish by size and minimize competition. Harvesting was conducted at the end of the 21 days once juveniles reached a marketable size (>4 cm), using partial draining and hand-netting techniques.

Data Analysis

Descriptive statistics were used to summarize all measured variables. Growth and production parameters were calculated as follows:

Absolute Length Gain (Lm) = Lt – Lo

Absolute Weight Gain (Wm) = Wt – Wo

Specific Growth Rate (SGR) = [(ln Wt – ln Wo) / T] × 100%

Survival Rate (SR) = (Nt / No) × 100%

Feed Efficiency (FE) = [(Wt + D) – Wo] / F × 100%

Feed Conversion Ratio (FCR) = F / [(Wt + D) – Wo]

Where: Lo = initial length (cm), Lt = final length (cm); Wo = initial weight (g); Wt = final weight (g); D = weight of dead fish (g); F = total feed given (g); T = rearing period (days); No = initial fish count; Nt = final live fish count. All results were compared to national water quality standards (SNI 7901.4:2013) to determine environmental suitability for nursery operations.

3. RESULT AND DISCUSSION

The results of the study indicate that the intensive nursery techniques implemented at BPBL Batam effectively supported the growth in length and weight of silver pompano juveniles over the 21-day rearing period. The average length increased from 2.50 cm on day 1 to 3.73 cm on day 20, while the average body weight rose from 0.50 g to 1.30 g during the same period (Table 1). The absolute length gain reached 1.23 cm, and the absolute weight gain was 0.8 g. The specific growth rate (SGR) was 2.5% per day, and the survival rate (SR) was 83.7% at the end of the nursery phase. The feed conversion ratio (FCR) was 2.1, which remains competitively efficient for silver pompano nursery standards, although slightly higher than the optimal FCR (<2) typically reported under ideal water-quality conditions.

Water quality measurements showed that the temperature averaged 27.6°C, pH was 7.81, dissolved oxygen (DO) was 5.7 mg/L, and salinity was 30 ppt, all of which remained within the acceptable limits set by the Indonesian National Standard (SNI 7901.4:2013) for marine fish nursery systems. However, ammonia concentrations were <0.041 mg/L, nitrite <0.007 mg/L, and orthophosphate 0.042 mg/L, indicating a mild accumulation of metabolic waste due to the relatively high stocking density and frequent feeding regime. Nonetheless, the overall water quality remained supportive of optimal growth for T. blochii juveniles at BPBL Batam.

The growth trends visualized in Figures 1 and 2 demonstrate relatively linear increases in both average length and body weight throughout the nursery period, reflecting a positive physiological response of the fish to the high-frequency feeding schedule (six times per day) combined with vitamin supplementation.

Table 1. Average length and weight of silver pompano juveniles

Day	Average Length (cm)	Average Weight (g)
1	2,50	0,50
5	2,97	0,75
10	3,04	1,00
15	3,36	1,20
20	3,73	1,30

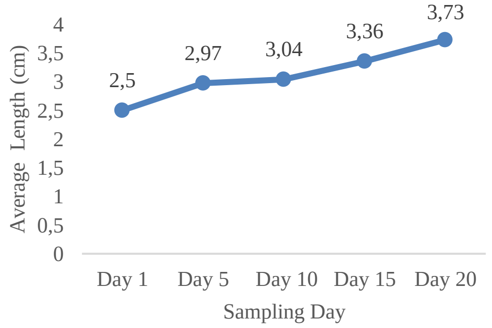

Figure 1. Average length of silver pompano juveniles

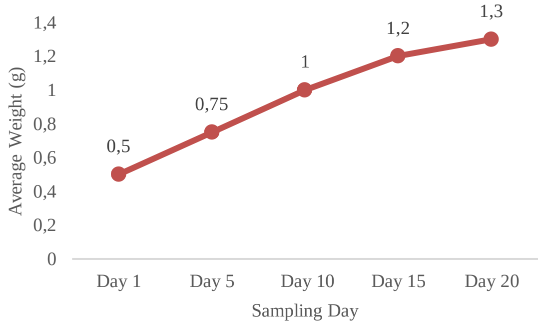

Figure 2. Average weight of silver pompano juveniles

The results of this study demonstrate that the application of intensive nursery techniques, including a high feeding frequency (six times per day) combined with vitamin supplementation, produced a positive growth response in silver pompano juveniles[7-9]. The average increase in length from 2.50 cm to 3.73 cm and the weight gain from 0.50 g to 1.30 g over a 21-day rearing period indicate that the fish's nutritional requirements were adequately met. The calculated specific growth rate (SGR) of 2.5% per day reflects favorable feeding management and water quality conditions. Moreover, the survival rate (SR) of 83.7%, achieved despite signs of localized pollution in the surrounding waters of BPBL Batam, suggests that *T. blochii* has a relatively good physiological tolerance to moderate environmental fluctuations[10-11]. These findings are consistent with those of Gephart & Golden[12], who reported that silver pompano can tolerate suboptimal culture environments when stocking density and feeding regimes are appropriately managed. However, the feed conversion ratio (FCR) of 2.1 recorded in this study was slightly higher than the ideal FCR of <2 commonly reported under stable and clean water conditions[13]. indicating that feed efficiency may still be improved by enhancing water quality and reducing mechanical stress during grading[7].

The findings also contribute significantly to both theoretical understanding and practical implementation of silver pompano nursery management in Indonesia. The observation that juvenile mortality was primarily caused by handling stress during grading, rather than cannibalism, supports the notion that *T. blochii* is a non-cannibal species but is highly sensitive to physical disturbance[14]. This contrasts with other carnivorous marine fish, such as Asian seabass or groupers, where cannibalism is a significant cause of mortality during the nursery stage.

On the practical side, the size-specific stocking density recommendations derived from this study (e.g., 400–500 fish/ton for 2.5 cm juveniles) offer an evidence-based reference for designing more efficient nursery systems[15]. Additionally, the confirmation that high-frequency feeding combined with vitamin enrichment can sustain optimal growth under fluctuating water quality provides a valuable benchmark for improving field-level nursery performance[16]. Thus, this study not only reinforces theoretical knowledge of silver pompano biology but also provides practical recommendations to enhance seed production performance in intensive aquaculture settings.

While the study successfully identifies effective stocking densities, growth performance, and water quality conditions for silver pompano nursery practices at BPBL Batam, several limitations should be acknowledged. First, the research was conducted over a single 21-day cycle. It therefore did not account for seasonal variability, which may affect water quality in tropical coastal systems influenced by rainfall and anthropogenic activity[11].

Second, the analysis relied on descriptive quantitative statistics without inferential testing, limiting the generalizability of the results to other ecological or operational contexts. Third, disease diagnosis was limited to visual identification of *Trichodina* sp. based on morphological features, without confirmation through molecular-based laboratory analysis, which could lead to potential biases in determining the exact etiology of infection and appropriate control measures[17]. These limitations suggest that, although the study provides valuable technical insights, future validation through longer-term, multi-season research with expanded diagnostic tools is warranted.

Given the results and limitations identified, future research should consider extending the nursery period and repeating trials across different seasonal cycles to evaluate the effects of environmental variability on growth, survival, and feed utilization[18]. Advanced analytical techniques, such as inferential statistics and multivariate models, are recommended to examine significant correlations among water quality parameters, stocking density, and fish performance[19]. Further investigation into the physiological responses and stress biomarkers of silver pompano juveniles to grading is also essential, ideally using tools from fish immunology and stress physiology to inform more refined handling protocols[20-21]. Molecular diagnostics for pathogen identification should be incorporated to support precision-based disease prevention strategies. Moreover, the implementation of digital water quality monitoring systems is encouraged to enable real-time detection of environmental shifts and to minimize the risk of mass mortality events due to deteriorating conditions[22].

This research also holds important social implications, particularly for small-scale coastal aquaculture producers. The adoption of optimized nursery techniques has the potential to improve juvenile quality, increase production yields, and ultimately enhance household income and livelihood resilience in coastal communities reliant on aquaculture[23-26]. The standards for stocking density, feeding management, and water quality established in this study may serve as technical references for government institutions and private-sector actors in developing more effective training and capacity-building programs[24,27].

However, equitable access to intensive nursery technologies must be ensured, particularly for traditional fish farmers with limited resources. Ethically, the use of digital monitoring tools must also consider the privacy and data security of producers, ensuring that information is not misused or used to leverage marginalized groups[28]. A participatory, inclusive approach to technology transfer and training will be essential to ensure that the outcomes of this research deliver broad, sustainable benefits to the national aquaculture sector and contribute meaningfully to food security and blue economy development.

4. CONCLUSION

This study demonstrates that the application of intensive nursery techniques, with a high feeding frequency of 6 times per day and vitamin supplementation, significantly supports the growth in length and weight of silver pompano juveniles, despite indications of localized water pollution at BPBL Batam. The average length of juveniles increased from 2.50 cm to 3.73 cm, and the average body weight rose from 0.50 g to 1.30 g. The specific growth rate (SGR) was calculated at 2.5% per day, with a survival rate (SR) of 83.7% and a feed conversion ratio (FCR) of 2.1. The findings also confirm that mortality was primarily caused by mechanical stress during grading, rather than cannibalistic behavior. Water quality parameters, including temperature, pH, dissolved oxygen, and salinity, remained within the thresholds set by the Indonesian National Standard (SNI 7901.4:2013), thereby supporting optimal juvenile development. The size-specific stocking density benchmarks obtained from this study can serve as a practical reference for intensive silver pompano aquaculture and provide valuable baseline data for nursery operations in Indonesia.

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