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FIELD-BASED EVALUATION OF INTEGRATED CAGE MANAGEMENT FOR SILVER POMPANO (*Trachinotus blochii*) GROW-OUT IN MARINE FLOATING NET CAGES

Evaluasi Lapangan Manajemen Terintegrasi pada Pembesaran Ikan Bawal Bintang (*Trachinotus blochii*) di Keramba Jaring Apung Laut

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ABSTRACT

Silver pompano Trachinotus blochii is a high-value marine fish with strong potential for tropical mariculture, but its grow-out success in floating net cages depends on integrated management of seed, feeding, cage sanitation, water quality, and fish health. This study evaluated the grow-out management and production performance of silver pompano cultured in a marine floating net cage at the Marine Aquaculture Fisheries Center of Batam, Indonesia. A descriptive field-based approach was applied for 108 days through direct observation, active participation in husbandry activities, growth sampling, water quality measurement, and production data recording. A total of 1,428 juveniles were stocked in a 4 m × 4 m × 3 m floating net cage and fed commercial pellets adjusted to fish biomass. Periodic cage maintenance, grading, and preventive health management were also conducted. The results showed that mean body weight increased from 22.5 g to 214.4 g, while mean total length increased from 10.8 cm to 23.1 cm. Absolute weight gain, absolute length gain, and specific growth rate were 191.9 g, 12.3 cm, and 2.0% day^{-1}, respectively. Feed conversion ratio was 1.8, and survival rate reached 99.2%. Water quality parameters remained within suitable ranges for marine fish culture. These findings indicate that integrated floating net cage management supported favorable growth, efficient feed utilization, and high survival of silver pompano during the early to intermediate grow-out phase.

Keywords: feed conversion ratio; floating net cage; grow-out performance; marine aquaculture; Trachinotus blochii

ABSTRAK

Ikan bawal bintang *Trachinotus blochii* merupakan komoditas ikan laut bernilai ekonomis tinggi yang berpotensi dikembangkan dalam marikultur tropis. Namun, keberhasilan pembesaran di keramba jaring apung sangat bergantung pada pengelolaan terpadu yang mencakup kualitas benih, pemberian pakan, sanitasi keramba, kualitas air, dan kesehatan ikan.

Penelitian ini bertujuan mengevaluasi manajemen pembesaran dan performa produksi ikan bawal bintang yang dipelihara di keramba jaring apung laut Balai Perikanan Budidaya Laut Batam, Indonesia. Penelitian dilakukan selama 108 hari menggunakan pendekatan deskriptif berbasis lapangan melalui observasi langsung, partisipasi aktif dalam kegiatan pemeliharaan, sampling pertumbuhan, pengukuran kualitas air, dan pencatatan data produksi. Sebanyak 1.428 ekor benih ditebar pada keramba jaring apung berukuran 4 m × 4 m × 3 m dan diberi pakan pelet komersial berdasarkan penyesuaian biomassa. Pemeliharaan keramba, grading, dan manajemen kesehatan preventif dilakukan secara berkala. Hasil penelitian menunjukkan bahwa bobot rata-rata ikan meningkat dari 22,5 g menjadi 214,4 g, sedangkan panjang total rata-rata meningkat dari 10,8 cm menjadi 23,1 cm. Pertumbuhan bobot mutlak, pertumbuhan panjang mutlak, dan laju pertumbuhan spesifik masing-masing sebesar 191,9 g, 12,3 cm, dan 2,0% hari^{-1}. Rasio konversi pakan sebesar 1,8, sedangkan tingkat kelulushidupan mencapai 99,2%. Parameter kualitas air berada dalam kisaran yang sesuai untuk budidaya ikan laut. Temuan ini menunjukkan bahwa manajemen terpadu keramba jaring apung mendukung pertumbuhan, efisiensi pakan, dan kelulushidupan ikan bawal bintang pada fase pembesaran awal hingga menengah.

Kata Kunci: akuakultur laut; ikan bawal bintang; keramba jaring apung; performa pembesaran; rasio konversi pakan

INTRODUCTION

Marine finfish aquaculture has become an increasingly important strategy to meet the growing demand for high-quality aquatic protein while reducing pressure on capture fisheries. Global aquatic food production continues to expand as aquatic foods play a strategic role in food security, nutrition, and livelihoods, particularly in regions where fish is a major source of animal protein (FAO, 2024). Aquaculture has also become increasingly integrated into the global food system, with improvements in feed efficiency, fish nutrition, technology, and production governance contributing to its rapid development over the last two decades (Naylor et al., 2021). However, the expansion of aquaculture must be accompanied by technically sound and environmentally responsible production systems to ensure that productivity gains do not generate new ecological pressures. Therefore, the development of efficient marine finfish grow-out technology remains essential for supporting sustainable aquaculture production.

Silver pompano Trachinotus blochii is one of the promising marine finfish commodities for tropical aquaculture because of its fast growth, high market value, good flesh quality, and adaptability to various culture environments. This species, also commonly referred to as snubnose pompano, has been considered a suitable candidate for Indo-Pacific mariculture due to its tolerance to a wide range of salinity, acceptance of formulated feed, high consumer preference, and availability of hatchery-produced seed (Chavez et al., 2011; Prabu et al., 2020). Previous nutritional studies have also shown that T. blochii responds well to formulated diets when dietary protein and essential amino acids are adequately balanced, indicating its potential for intensive and semi-intensive aquaculture systems (Prabu et al., 2020). These biological and economic attributes make silver pompano a strategic species for the diversification of marine aquaculture commodities.

In Indonesia, silver pompano culture is particularly relevant because hatchery-produced seed and grow-out technology have been developed by marine aquaculture centers to support the expansion of high-value marine fish farming. The availability of seed is a critical factor in the development of marine finfish aquaculture because grow-out production depends on a continuous supply of healthy, uniform, and adaptable juveniles. Cahyanurani et al. (2022) reported that hatchery and larval rearing performance of silver pompano in Indonesian marine aquaculture facilities supports the development of this species as a prospective aquaculture

commodity. In this context, technical documentation from aquaculture centers such as BPBL Batam is important because it provides practical information on how hatchery-produced seed performs under real grow-out conditions in marine floating net cages. Recent field documentation on silver pompano nursery at BPBL Batam showed that growth performance, survival rate, feed conversion, and water quality are critical indicators for evaluating the success of early culture stages of T. blochii (Khalidah et al., 2025).

Floating net cage culture provides a practical grow-out system for silver pompano because it allows natural seawater exchange, efficient space use, and direct application in coastal marine areas. Marine cage culture has been widely used for high-value finfish because it enables fish to be reared in open-water environments with continuous water renewal, provided that the site, cage design, stocking density, feeding regime, and husbandry practices are properly managed. Chavez et al. (2011) showed that silver pompano could be cultured successfully in high-density polyethylene floating cages, with growth, feed conversion, survival, and production being strongly influenced by stocking density. Similarly, Kalidas et al. (2022) demonstrated that stocking density affects growth rate, specific growth rate, feed conversion, and yield of *T. blochii* in marine floating cages. These findings indicate that floating net cage culture is technically feasible for silver pompano, but its success depends on accurate production management.

Despite its aquaculture potential, the success of silver pompano grow-out culture is strongly determined by technical factors such as seed quality, stocking management, feeding regime, cage sanitation, water quality, grading, and disease prevention. Poor management of any of these factors may reduce growth, increase feed conversion ratio, elevate stress, and increase mortality risk. Stocking density, for example, determines the available swimming space and affects competition for feed, while feeding management determines whether fish obtain sufficient nutrients without excessive feed waste (Chavez et al., 2011; Kalidas et al., 2022). In addition, cage sanitation and net condition influence water exchange within the cage, which is essential for maintaining dissolved oxygen and removing metabolic waste. Thus, grow-out performance should be evaluated as the outcome of an integrated husbandry system rather than a single technical variable.

Feeding management is one of the most critical components of silver pompano production because feeding rate, feeding frequency, pellet size, and biomass adjustment directly affect growth, feed efficiency, production cost, and environmental load. Hamed et al. (2016) reported that feeding rate and feeding frequency significantly influenced weight gain, specific growth rate, and feed conversion in juvenile silver pompano. Prabu et al. (2022) further demonstrated that modified feeding strategies could improve growth, metabolism, nutrient utilization, and feeding economics in T. blochii. Because feed represents a major operational cost in aquaculture, feeding practices must be adjusted according to fish size, biomass, feeding response, and growth stage. In floating net cage systems, excessive feeding may also contribute to organic loading and water quality deterioration, making efficient feed management important not only for production performance but also for environmental control. In marine cage grow-out systems, feeding strategy and environmental monitoring are essential to maintain growth performance, feed efficiency, and survival of cultured marine fish (Bella & Lesmana, 2025).

Water quality control and cage maintenance are essential in open marine cage systems because temperature, dissolved oxygen, salinity, pH, water exchange, and net biofouling influence fish metabolism, feeding activity, stress response, and survival. Environmental conditions in floating net cages are affected by natural water movement, stocking biomass, feed input, suspended materials, and biofouling organisms that accumulate on cage nets. Fitridge et al. (2012) emphasized that biofouling can reduce water exchange, alter cage performance, increase operational costs, and affect cultured organisms in marine aquaculture systems. Price

et al. (2015) also noted that marine cage culture can influence water quality and primary production depending on feed input, nutrient discharge, hydrodynamics, and farm management practices. Therefore, routine net cleaning, net replacement, water quality monitoring, and appropriate feeding are central to maintaining a stable rearing environment for silver pompano.

Recent studies on Trachinotus blochii have mainly focused on optimizing stocking density, feeding strategy, dietary protein, salinity tolerance, and controlled aquaculture systems, but field-based documentation integrating growth performance, feed conversion, survival, water quality, and operational cage management under Indonesian marine farming conditions remains limited. Studies on stocking density in marine cages have clarified the trade-off between individual growth and production yield (Chavez et al., 2011; Kalidas et al., 2022), while feeding studies have examined the effects of feeding frequency, feeding rate, dietary protein, and modified feeding schedules on growth and nutrient utilization (Hamed et al., 2016; Prabu et al., 2020, 2022). Other studies have evaluated the physiological response of silver pompano to salinity variation and the performance of the species in recirculating aquaculture systems (Babu et al., 2022; Ezraneti et al., 2019). Although these studies provide important scientific foundations, integrated field-based information from operational floating net cage units remains necessary to bridge experimental findings with practical grow-out management.

Therefore, a descriptive field-based study is needed to provide practical and scientific information on how integrated grow-out management practices influence the production performance of silver pompano in floating net cages. Such a study is valuable because commercial and institutional aquaculture operations involve multiple interacting factors, including seed condition, acclimatization, feeding schedule, cage preparation, water quality, grading, disease prevention, and harvesting strategy. Unlike controlled experiments that isolate one variable, field-based evaluation can capture how these components operate together under real production conditions. This approach is especially useful for generating technical recommendations that are directly applicable to farmers, aquaculture technicians, extension workers, and marine aquaculture institutions.

This study aimed to evaluate the grow-out management and production performance of silver pompano Trachinotus blochii cultured in a floating net cage at BPBL Batam based on growth, feed utilization, survival, water quality, and operational husbandry practices. The study specifically documented cage preparation, seed stocking and acclimatization, feeding management, water quality monitoring, fish health prevention, sampling, grading, feed conversion, survival, and growth performance during the observation period. The findings are expected to provide baseline technical information for improving silver pompano grow-out management in Indonesian floating net cage systems and to support the development of evidence-based recommendations for sustainable marine finfish aquaculture.

RESEARCH METHOD

Study Site and Research Design

This study was conducted at the Marine Aquaculture Fisheries Center of Batam, locally known as Balai Perikanan Budidaya Laut (BPBL) Batam, located on Trans Barelang Road, Bridge III, Setokok Island, Bulang District, Batam City, Riau Islands Province, Indonesia. The field observation was carried out from 10 August to 10 December 2025, with a 108-day observation period on silver pompano Trachinotus blochii cultured in floating net cage unit 13A. This study used a descriptive field-based approach through direct observation, active participation in grow-out activities, interviews with technical staff, growth sampling, water quality measurement, and production data recording.

Fish, Cage System, and Stocking

Silver pompano juveniles used in this study were obtained from the hatchery unit of BPBL Batam. A total of 1,428 juveniles were stocked in one floating net cage measuring 4 m × 4 m

× 3 m. Prior to stocking, the juveniles were acclimatized for approximately 10 minutes by gradually mixing cage water into the transport container to reduce handling and environmental stress. Stocking was conducted in the morning to minimize temperature-related stress. The cage was prepared by washing, drying, inspecting, repairing, and installing polyethylene nets on the floating cage frame. Net mesh size was adjusted according to fish size, and net replacement was conducted periodically to maintain water exchange and reduce biofouling accumulation. The initial mean body weight and total length of the stocked fish were 22.5 g and 10.8 cm, respectively.

Feeding and Husbandry Management

Fish were fed commercial pellet feed, and the daily ration was adjusted based on fish biomass and sampling results. During the early grow-out phase, feeding was conducted four times per day at 08.00, 11.00, 14.00, and 16.00 Western Indonesian Time. Pellet size and feeding rate were adjusted according to fish body size, with smaller fish receiving smaller pellets and a higher feeding rate. Cage maintenance, grading, and preventive health management were conducted periodically. Preventive fish health management included routine net cleaning and replacement, freshwater immersion when needed, and feed supplementation using vitamins or multivitamins to support fish condition.

Growth Sampling and Water Quality Measurement

Growth sampling was conducted twice per month to determine mean body weight, mean total length, biomass, and feed requirement. Fish samples were collected using scoop nets, weighed using a digital scale, and measured using a ruler. Grading was conducted when size variation was observed to improve size uniformity and reduce feed competition. Water quality was monitored directly at the floating net cage and through laboratory analysis at BPBL Batam. The observed parameters included temperature, pH, dissolved oxygen, and salinity. Water quality data were used to evaluate the suitability of the culture environment for silver pompano grow-out. Descriptive performance evaluation using growth, survival, and water quality parameters has been widely applied to assess nursery performance of high-value marine fish under controlled aquaculture systems (Ramadhani & Lesmana, 2025).

Data Analysis

The collected data were tabulated and analyzed descriptively. Production performance was evaluated using absolute weight gain, absolute length gain, specific growth rate, feed conversion ratio, and survival rate. Absolute weight gain was calculated as the difference between final and initial mean body weight, while absolute length gain was calculated as the difference between final and initial mean total length. Specific growth rate was calculated using the natural logarithm of final and initial mean body weight divided by the culture period and multiplied by 100. Feed conversion ratio was calculated by dividing total feed intake by biomass gain, while survival rate was calculated by dividing the final number of fish by the initial number of fish and multiplying by 100. The results were interpreted to describe the effectiveness of integrated floating net cage management on the grow-out performance of silver pompano.

Absolute weight gain (AWG), absolute length gain (ALG), specific growth rate (SGR), feed conversion ratio (FCR), and survival rate (SR) were calculated using the following equations: $AWG = Wt - W0$; $ALG = Lt - L0$; $SGR = [(\ln Wt - \ln W0) / t] \times 100$; FCR = total feed intake / biomass gain; and $SR = (Nt / N0) \times 100$, where Wt and W0 are final and initial mean body weight, Lt and L0 are final and initial mean total length, t is the culture period, and Nt and N0 are final and initial fish population.

RESULT

Growth and Production Performance

Silver pompano Trachinotus blochii cultured in floating net cage 13A showed positive growth during the 108-day observation period. Mean body weight increased from 22.5 g to 214.4 g, while mean total length increased from 10.8 cm to 23.1 cm. The absolute weight gain and absolute length gain were 191.9 g and 12.3 cm, respectively. The specific growth rate reached 2.0% day^{-1}. At the beginning of culture, 1,428 fish were stocked, and 1,417 fish remained at the end of the observation period, resulting in 99.2% survival. Total feed consumption during the observation period was 491.4 kg, with a feed conversion ratio of 1.8.

Table 1. Growth and production performance of silver pompano Trachinotus blochii during 108 days of grow-out culture.

Parameter	Value
Culture period	108 days
Initial population	1,428 fish
Final population	1,417 fish
Mortality	11 fish
Initial mean body weight	22.5 g
Final mean body weight	214.4 g
Absolute weight gain	191.9 g
Initial mean total length	10.8 cm
Final mean total length	23.1 cm
Absolute length gain	12.3 cm
Specific growth rate	2.0% day^{-1}
Total feed consumption	491.4 kg
Feed conversion ratio	1.8
Survival rate	99.2%

Growth increased consistently throughout the sampling period. Mean body weight rose from 22.5 g at the first sampling to 214.4 g at the eighth sampling, while mean total length increased from 10.8 cm to 23.1 cm. The highest increase in body weight occurred after the sixth sampling, indicating improved biomass accumulation during the later observation period.

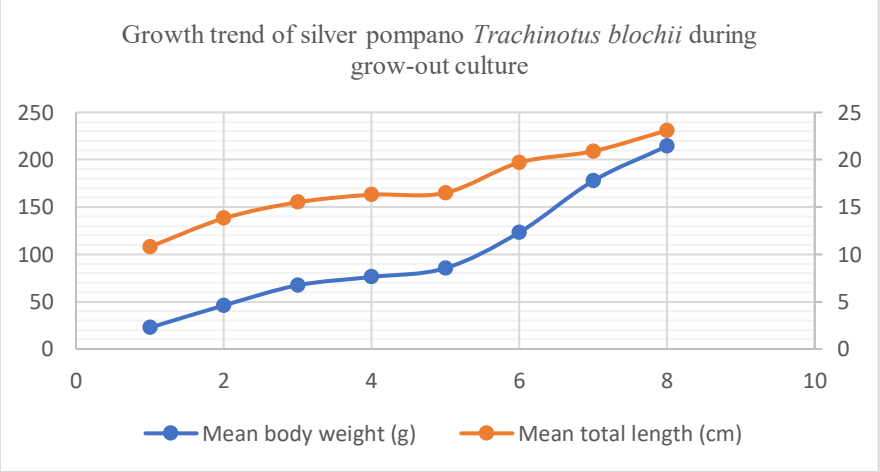

Figure 1. Growth trend of silver pompano Trachinotus blochii based on mean body weight and mean total length during the 108-day grow-out observation period

Feed Use, Survival, and Water Quality

Feed use increased with fish biomass during the observation period. Daily feed amount increased from 1.6 kg day^{-1} at the first sampling to 9.5 kg day^{-1} at the seventh sampling, before decreasing to 8.2 kg day^{-1} at the eighth sampling due to a lower feeding rate. The feeding rate was gradually reduced from 5.0% to 2.7% of biomass per day as fish size increased. Mortality was low and occurred sporadically, with no mass mortality recorded during the observation period.

Water quality parameters remained within suitable ranges for marine fish culture. Temperature was 29.7°C, pH was 8.04, dissolved oxygen was 5.5 mg L^{-1}, and salinity was 30 ppt. These values indicate that the floating net cage environment was suitable to support the growth and survival of silver pompano.

Table 2. Water quality parameters during silver pompano Trachinotus blochii grow-out culture compared with recommended ranges for marine fish culture

Parameter	Observed value	Recommended range	Suitability
Temperature	29.7°C	26–32°C	Suitable
pH	8.04	7.5–8.5	Suitable
Dissolved oxygen	5.5 mg L^{-1}	≥4 mg L^{-1}	Suitable
Salinity	30 ppt	10–32 ppt	Suitable

Overall, silver pompano cultured in the floating net cage showed favorable production performance, as reflected by consistent growth, efficient feed utilization, high survival, and suitable water quality conditions during the early to intermediate grow-out phase.

DISCUSSION

Silver pompano Trachinotus blochii cultured in floating net cage 13A showed favorable grow-out performance during the 108-day observation period. The increase in mean body weight from 22.5 g to 214.4 g and mean total length from 10.8 cm to 23.1 cm indicates that the fish adapted well to the floating net cage environment. The absolute weight gain of 191.9 g, absolute length gain of 12.3 cm, and specific growth rate of 2.0% day^{-1} suggest that the applied husbandry practices supported active somatic growth. This growth response was likely associated with good seed quality, proper acclimatization, adequate cage space, regular sampling, and feeding adjustment based on biomass. Previous studies have also shown that growth performance of T. blochii is strongly influenced by stocking density, culture environment, and feeding management (Chavez et al., 2011; Kalidas et al., 2022).

Feed management was an important factor supporting the observed growth and production performance. In this study, fish were fed commercial pellets, and the feeding rate was gradually adjusted according to fish size and biomass. The feed conversion ratio of 1.8 indicates that feed utilization was relatively efficient for marine fish grow-out under field conditions. This result suggests that the combination of appropriate pellet size, feeding frequency, and biomass-based ration adjustment helped reduce feed waste and improve feed conversion. Hamed et al. (2016) reported that feeding rate and feeding frequency significantly affected growth and feed conversion of juvenile silver pompano, while Prabu et al. (2022) emphasized that feeding strategy influences growth, metabolism, and feeding economics in T. blochii. Therefore, the feeding approach applied in the present study was consistent with the biological requirement of silver pompano during the early to intermediate grow-out phase. Similar field-based evidence in marine cage culture has shown that commercial-diet feeding combined with

environmental monitoring can support feed efficiency and survival in high-value marine fish (Bella & Lesmana, 2025).

This high survival was likely associated with proper seed acclimatization, routine net maintenance, freshwater immersion, feed supplementation, and regular water quality monitoring. Mortality was low and occurred sporadically, with no indication of mass mortality or major disease outbreak during the observation period. This high survival was likely supported by proper seed acclimatization, routine net maintenance, freshwater immersion, feed supplementation, and regular water quality monitoring. Preventive health management is essential in marine cage culture because disease occurrence is often related to interactions among host condition, pathogen presence, and environmental stress. The absence of severe mortality in this study suggests that the preventive management applied at BPBL Batam was effective in maintaining fish health during the observation period. The importance of integrated feeding and health management in marine cage systems has also been reported in humpback grouper culture, where feed supplementation and periodic freshwater immersion supported high survival under floating net cage conditions (Diandra & Lesmana, 2025). Structured feeding and supplementation practices have been reported to support fish condition and environmental stability in Indonesian marine hatchery systems (Lesmana et al., 2025).

Water quality conditions also contributed to the favorable growth and survival of silver pompano. Temperature, pH, dissolved oxygen, and salinity were within suitable ranges for marine fish culture, indicating that the floating net cage environment was able to support fish metabolism, feeding activity, respiration, and osmoregulation. Salinity is particularly important for silver pompano because this species shows physiological responses to different salinity levels, and suitable salinity conditions allow more energy to be allocated for growth rather than osmoregulatory stress (Ezraneti et al., 2019; Pathak et al., 2019). The dissolved oxygen level recorded in this study was also adequate to support the respiratory demand of silver pompano, which is an active swimming marine fish. The present grow-out results complement previous nursery-stage findings at BPBL Batam, where growth, survival, feed conversion, and water quality were also identified as key indicators of silver pompano culture performance (Khalidah et al., 2025).

Cage maintenance and net management played an important role in maintaining culture stability. Routine net cleaning and replacement helped maintain water exchange, reduce biofouling, and prevent the accumulation of organic materials around the cage. Biofouling in marine aquaculture can restrict water flow, reduce oxygen availability, increase disease risk, and affect cage performance (Fitridge et al., 2012). In this study, the adjustment of mesh size according to fish size also helped maintain water circulation while preventing fish escape. Regular sampling and grading further supported production management by improving biomass estimation, feed calculation, and size uniformity among cultured fish.

Overall, the results indicate that silver pompano grow-out in floating net cages can perform well when supported by integrated management of seed, feeding, cage sanitation, water quality, and fish health. However, this study was observational and conducted in one cage unit, so the findings should be interpreted as field-based technical evidence rather than experimental treatment effects. Further studies using replicated cage units, longer observation until market size, and more complete environmental and economic analyses are needed to strengthen production recommendations. Nevertheless, the present study provides useful baseline information for improving silver pompano grow-out management in Indonesian marine floating net cage systems.

CONCLUSION

The grow-out culture of silver pompano Trachinotus blochii in floating net cage 13A at BPBL Batam showed good production performance during the 108-day observation period.

The fish reached a final mean body weight of 214.4 g and mean total length of 23.1 cm, with a specific growth rate of 2.0% day^{-1}, feed conversion ratio of 1.8, and survival rate of 99.2%. Water quality parameters remained within suitable ranges for marine fish culture, indicating that the floating net cage environment supported fish growth and survival. These findings suggest that integrated management involving biomass-based feeding, routine sampling, grading, cage sanitation, water quality monitoring, and preventive health management is technically feasible for silver pompano grow-out. Further full-cycle studies with replicated cage units and economic analysis are required to strengthen production recommendations.

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