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Research Article

Growth performance of white seabass (Lates calcarifer) cultivated using recirculation aquaculture system (RAS)

Helena Afia Sahusilawane[1,*], Jacomina Metungun[1], Henny Fitrinawati[1], Juliana Ester Kilmanun[2]

[1] *Lecturer of Study Programme* Aquaculture Technology Study Program, Tual State Polytechnique of Fisheries, Tual*, Street. Langgur Km 6,Tual, 97233, Indonesia*
[2] *Student of Study Programme* Aquaculture Technology Study Program, Tual State Polytechnique of Fisheries, Tual*, Street. Langgur Km 6,Tual, 97233, Indonesia*
** corresponding author: helenafia17@gmail.com*

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ABSTRACT

White seabass (*Lates calcarifer*) is classified as a fishery commodity that has a high selling value with an easy cultivation method. However, water quality is an obstacle in the fish cultivation process. Therefore, it is necessary to implement an appropriate cultivation system, including a recirculation aquaculture system (RAS). RAS is reuse of water that has been used through a filter so that fish with high growth and survival are obtained. The aim of the research was to analyze the growth performance of white seabass cultivated with RAS. The research was conducted at the Mariculture Laboratory of the Aquaculture Technology Study Program, Tual State Polytechnic of Fisheries in June to August 2024. The research was used a descriptive type with initial length measurements (4 and 5 cm) and was repeated 3 times. A total of 10 fish were kept in a hapa in a rearing tank and equipped with RAS using sand and charcoal filters. Growth performance were measured included body length, body weight, growth rate, and survival rate. The research results show that the RAS system determines the growth performance of white seabass. This is evidenced by the increasing average increase in length and body weight. At an initial length of 4 cm, the average increase was 6.5 cm and 4.25 g, while at an initial length of 5 cm it was 8.3 cm and 6.5 g. The average survival rate was 75% at an initial fish size of 4 cm and 86% at an initial fish size of 5 cm. Thus, the RAS system can be applied in white seabass cultivation.

Keywords: growth performance**,** RAS, survival rate, white seabass

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INTRODUCTION

White seabass (*Lates calcarifer*) is one of the leading marine communities in Indonesia (Windarto et al. 2019). Nurmasyitah et al. (2018) stated that sea bass is one of the marine fish with high economic value and is a consumption fish with high nutritional content. To meet high market demand, cultivation efforts need to be increased through providing seeds of the right quality, size, quantity and time (Permana et al. 2019). However, in its application, sea bass cultivation often encounters obstacles, including water quality management and the presence of pathogen infections. Disturbed water quality can be caused by waste from excretion and excessive accumulation of feed. This can have an impact on fish mortality rates (Klanian et al. 2013). On the other hand, the supply of white seabass seeds still comes from wild catches and is also limited from government hatcheries (Ibrahim et al. 2024).

One improvement effort to increase the production of white seabass seeds is to use a recirculation aquaculture system (RAS). Elinah & Sadisasmita (2024) stated that RAS is a promising innovative solution. Prama & Kurniaji (2022) stated that water use in RAS is more efficient than conventional methods by recycling water through a sophisticated filtration and processing system. In implementing this system, the nitrification process runs smoothly so that the water can be reused (Pungrasmi et al. 2016). This system can be used for fish rearing in a controlled environment (Timmons et al. 2002). Drengstig & Bergheim (2013) found that the application of RAS can maintain water quality and minimize the risk of disease attacks. Good water quality is a crucial factor in fish growth and health (Simanjuntak et al. 2021). By reducing fresh water use and optimizing nutrient use and controlling waste, RAS can help maintain environmental parameters that support healthy aquatic life (Elinah & Sadisasmita 2024).

Noor & Aziz (2023) show that the survival of yellowtail seabass in RAS systems offers a sustainable option for the market. On the other hand, Gulian-Klanian & Aramburu-Adame (2013) stated that rearing tilapia fish at high densities using RAS applications can cause a reduction in the efficiency of biological filters. In its application, it is necessary to use natural materials as absorbents for waste filtration results. Materials that can be used include charcoal and palm fiber. According to Mangkurat et al. (2019) coconut shell charcoal can be an adsorbent that reduces nitrogen levels in cultivation systems because it contains active carbon. Fitrniawati & Utami (2023) also stated that the growth performance of white seabass cultivated in cages was quite good (SR=100%; SGR 1.06 ± 0.73%).

In Indonesia, the RAS application has not been widely used, especially in water quality and response in sea bass cultivation. Thus, the aim of this research is to analyze the growth performance of white seabass (*Lates calcarifer*) cultivated using a recirculation aquaculture system (RAS).

METHODS

The research was conducted in June to August 2024 at the Marinculture Laboratory of the Aquaculture Technology Study Program, Tual State Polytechnic of Fisheries, Langgur-Maluku. White seabass size 4 cm and 5 cm was obtained from the Tual Marine Cultivation Center. RAS system was made from drum tank using sand, charcoal, palm fiber filters; maintenance tank (fiber glass) size 1 ton; hapa size 40x40x40 cm; megami feed was obtained from the Ambon Marine Cultivation Fisheries Center. The materials was used for to measure growth performance namely digital scales; calipers with an accuracy of 0.01 mm; pH meter and refractometer (ATC 0-100%).

Research procedures

a. RAS system and hapa design

RAS is made from a drum tank using sand, fiber and charcoal filters and is equipped with a running water pipe that is connected and inserted into a maintenance tank. Furthermore, for rearing white sea bass, hapa is used which is made from pipes and waring. Then put it in the maintenance tank.

b. Seed collection and maintenance

Collection of white seabass seeds size 4 cm and 5 cm. Fish seeds measuring 4 cm and 5 cm were placed in 3 different hapa with 10 fish each. Feed is given at satiation with a frequency of 3 times a day at 08.00, 12.00, 16.00 WIT. Hapa cleaning and water quality measurements are carried out every 2 weeks. Observations on growth performance included measurements of total length, body weight, survival length rate (SLR), daily survival weight rate (SWR), and fish survival rate. Calculation of growth rate and survival rate follows the formula (Effendie 2002) below:

$$\mathrm{SLR}\left(\frac{\%}{\mathrm{day}}\right) = \frac{\ln Lt - \ln L0}{\mathrm{t}} \times 100$$

$$\mathrm{SWR}\left(\frac{\%}{\mathrm{day}}\right) = \frac{\ln Wt - \ln W0}{\mathrm{t}} \times 100$$

$$\text{Survival rate }(\%) = \frac{number\ of\ fish\ alive\ at\ the\ end\ experiment}{\text{Total fish}} \times 100$$

RESULTS AND DISCUSSION

Based on the results of research on white seabass hatcheries cultivated in the RAS system, good growth performance was obtained. Figure 1 below. After one week of rearing, the growth in total length of the white seabass, which initially measured 4 cm, increased to 4.35 cm and in the seventh week it had a final total length of 6.50 cm. In fish with an initial total length of 5 cm, it increased to 5.35 cm in the first week, while in the seventh week it became 8.30 cm. This shows that white sea bass reared using the RAS system showed increased total length growth performance during the seven weeks of observation.

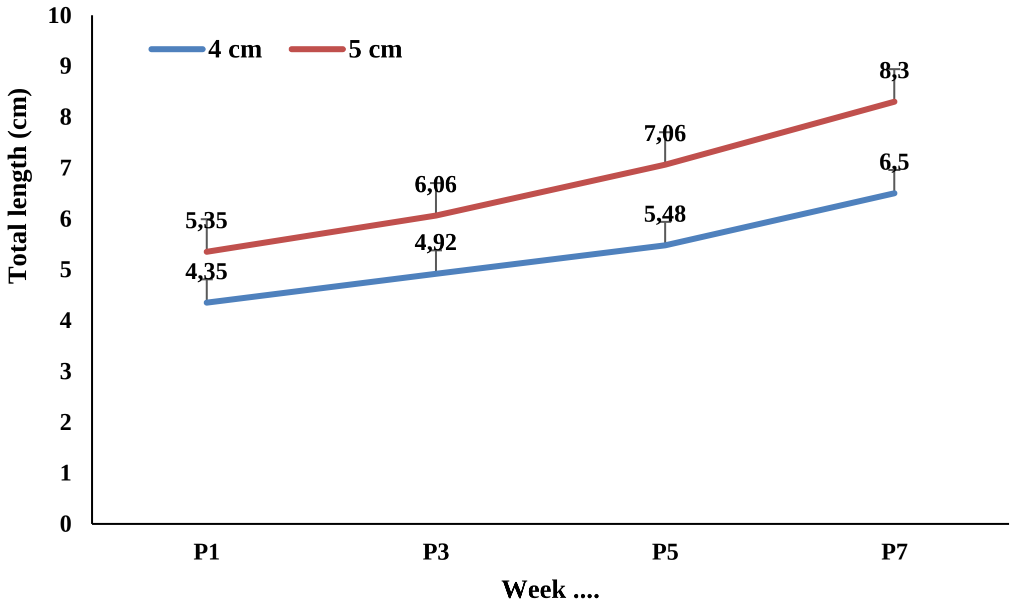

Figure 1. Growth performance of total length of white seabass cultivated with RAS

The results of measuring the body weight of white seabass cultivated using the RAS system are shown in Figure 2. The body weight of white seabass with an initial size of 4 cm was 2.17 g in the first week and in the seventh week it had a final body weight of 4.25 g. Fish with an initial size of 5 cm had a body weight of 2.97 g in the first week while in the seventh week it increased to 6.50 g. This shows that white sea bass reared using the RAS system also showed increased body weight growth performance during observation.

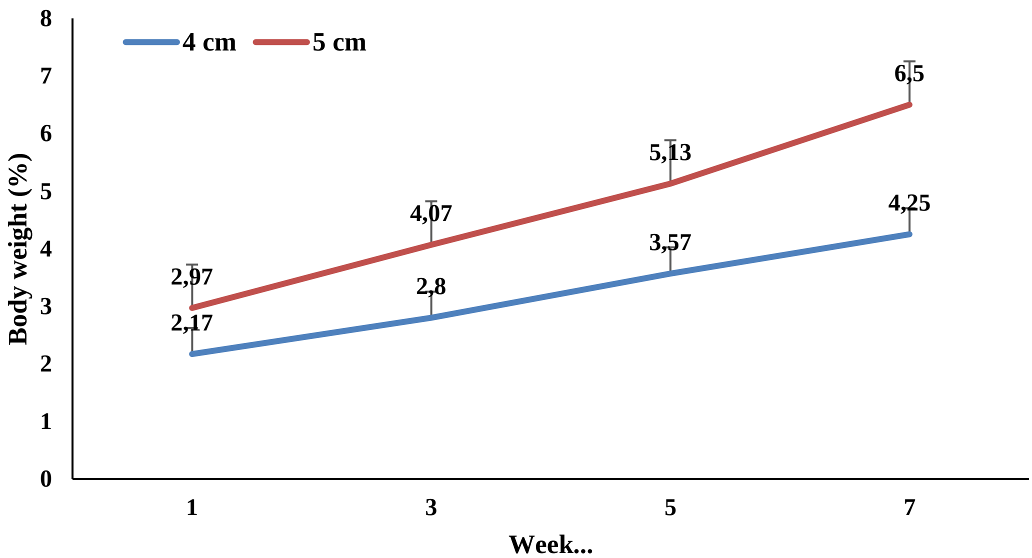

Figure 2. Growth performance of body weight of white seabass cultivated with RAS

The results of the analysis of growth rates in length and body weight are as shown in Table 1. The growth rates in length and body weight after 60 days of rearing in white seabass fish which have an initial size of 5 cm are larger than fish measuring 4 cm. The calculation results also show that the growth rate of body weight has a greater value than the growth rate of total length.

Tabel 1. Growth rate of white seabass cultivated with RAS

Nu	Initial size	SLR (cm/hari)	SWR (g/hari)
1	4 cm	0,669	1,12
2	5 cm	0,732	1,31

The results of calculating the survival rate every 2 weeks for those cultivated with RAS showed that there was a decrease. Seabass fish measuring 5 cm have a higher survival rate than fish measuring 4 cm. A graph of the survival rate of white seabass during 2 months of rearing can be seen in Figure 3 below.

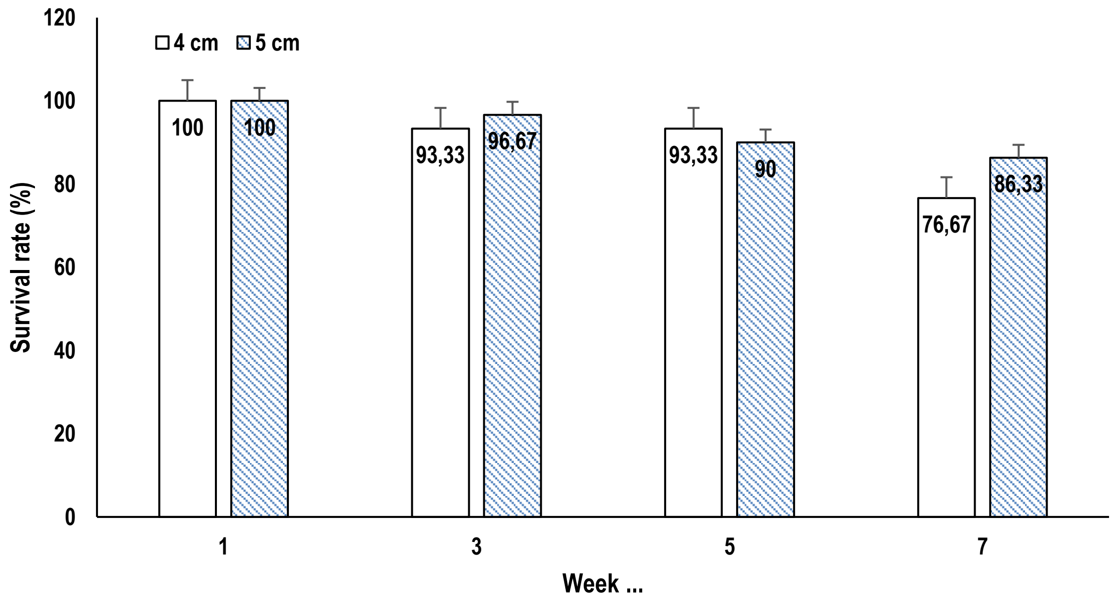

Figure 3. Survival rate of white seabass cultivated with RAS

Elinah & Sandisasmitha et al. (2024) stated that currently the RAS application is a global thing in efforts to sustainably cultivate fisheries. RAS influences water quality and fish production in modern aquaculture (Susanti et al. 2021). Water quality is controlled by reducing the use of clean water and optimizing waste in aquaculture through sophisticated filtering and processing systems so that fish growth is optimal (Hapsari et al. 2020). On the other hand, the use of RAS can reduce the risk of pollution at cultivation sites so that environmental quality is maintained for aquatic organisms.

According to Samara et al. (2022), the RAS application has been proven to be able to increase fish productivity efficiently. This can be achieved if the cultivation environment is routinely controlled and proper nutrition is provided and health factors are handled well. or the quality of the fish produced. This process involves the use of simple technologies in RAS such as filtration systems to remove organic waste and hazardous chemicals. On the other hand, to maintain water quality such as temperature, pH and dissolved oxygen which is optimal for fish growth and health (Candra et al. 2023). This is in line with this research that the RAS application uses a mechanical filtering system including sand, charcoal and palm fiber so that water quality is maintained for fish growth. Matodang et al. (2021) stated that charcoal treatment as a filter can reduce the level of ammonia reduction compared to other treatments. This is in accordance with the opinion of Alem et al. (2018) that ammonia that meets the requirements can improve fish growth and survival. This is reinforced by Permana's (2019) statement that the capacity of RAS to remove nitrogen waste is also determined by the capacity of its compartment.

According to Gusrina (2008) growth is a change in size in length, weight or volume over a certain period of time. This growth is physically expressed by changes in the number or size of cells that make up body tissue over a certain period of time. In growth, there are several influencing factors, namely internal factors and external factors. Cultivation methods include external factors other than feed and environmental factors. This can be seen in this research that white seabass fish reared using the RAS method or system show increased performance in total length and body weight compared to their original size. Fish that have a large initial size also have a large final size. This is also shown in the higher rate of growth in length and weight in fish with a large initial size. Compared to the growth rate in length, the growth rate in weight has a higher value.

Ibrahim et al. (2024) stated that the movement space and number of individuals in each hapa greatly impact fish growth. This is in line with this research in that the hapa used had a relative size and the number of individuals was 10 per hapa. Rayes et al. (2013) stated that fish have high growth due to the use of energy for activities which is less than the energy stored. The space for the hapa to move and the number of individuals of 10 per hapa causes a lack of competition so that little energy is used and the fish do not experience stress. This is also in accordance with Santoso's (2015) statement that competition for good space for food can result in fish not experiencing stress and growing well during maintenance.

Apart from growth, the success of the RAS method application can be proven by the survival rate. According to Matodang et al. (2021), survival rate is an indicator of the success of cultivation activities. Survival rate is also defined as the number of fish that survive after being reared for a certain period of time (Effendi et al. 2022). The results of the study showed that the survival rate of sea bass cultivated using the RAS system was more than 75% at the end of the observation. This is caused by the ability of fish to adapt to the environment, especially the RAS environment where water quality is maintained. This is in line with Sukoso (2020), the survival rate of fish is influenced by good cultivation management, including stocking water quality and feed quality. This is also in accordance with the statement of Chen et al. (2018) who explained that high or low fish survival is largely determined by the quality and size of fish seeds, management systems and water quality. In this research, the fish kept were 4 and 5 cm in size and were still growing and supported by adequate management and water quality. Effendie (2002) states that the life cycle of fish determines its growth phase. Fish that are in the fry cycle are experiencing optimal growth, whereas adult fish experience minimal growth to the point of death.

CONCLUSION

White seabass cultivated with RAS has good growth performance based on growth rate and survival rates. RAS has the potential to increase the effectiveness and efficiency of fish farming and improve the quality of the farming environment. Thus, the RAS application can be developed as a sustainable solution for managing fisheries resources.

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