Effect of temperature, pH, and salinity on body weight of Asian Seabass (*Lates calcarifer*) at different stockings

E Insivitawati$^{1,2}$, N Hakimah$^1$, and M S Chudlori$^1$

$^1$Polytechnic of Marine and Fishery, Sidoarjo, Indonesia

$^2$Corresponding author: einsivitawati@gmail.com

Abstract. The Asian Seabass farming can be successful with optimum environmental conditions. Water quality as a culture media must always be maintained to suppress the occurrence of pathogen attacks on fish. The study aims to determine the effect of temperature, pH, and salinity in the maintenance of body weight Asian Seabass (*Lates calcarifer*) at different stocking. The field experiment method was applied in this study using a 6.28 m$^3$ tank using 2 treatments, namely P1 (density 1000) and P2 (density 1400) fish measuring 2-3 cm for 30 days. Parameters observed included observations of growth and water quality (temperature, pH, and salinity). The result showed that there was an effect of temperature, pH, and salinity on the growth of Asian Seabass. The temperature, pH, and salinity showed an effect on body weight by P1 (35.2%) and P2 (28.9%). The conclusion of this study is that the density of 1000 shows a higher effect that the density of 1400 on the growth of Asian Seabass.

1. Introduction

The Ministry of Maritime Affairs and Fisheries (KKP) is working hard to develop the cultivation of Asian Seabass. It is estimated that around 3.6 million seeds are needed per year [1]. Asian Seabass has a high economic value because it has a good price and easy marketing, so Asian Seabass farming in Indonesia is a promising business. In addition, its growth is relatively fast, easy to maintain and has a high tolerance for change environment [2].

The success of the production process can be in the form of a high survival value or fast growth for fish rearing. Fish need a decent environment for their living and living. Decreasing water quality will disrupt growth and disease infections that grow and develop in low-quality waters [3].

Optimal water quality is considered prerequisite for the survival and growth as it influence the entire life processes in fish. Each water quality factor interacts and influences the other parameters, sometimes in complex ways. Among the various ecological factors, pH, hardness, temperature and salinity are considered as determining factors, which is perceived through receptors which may directly affect the growth in fishes [4]. This study aims to determine the effect of temperature, pH, and salinity in the maintenance of body weight Asian Seabass (*Lates calcarifer*) at different stocking.
2. Material and Method

2.1. Experimental design

The present study was conducted at the Brackishwater Aquaculture Development Center, Situbondo from March 2021 to May 2021. A total of 2400 uniform sized (2.9 ±1.2 grams) Asian Seabass seeds and stocked in two treatments (P1=1000 fish/tank; and P2= 1400 fish/tank). Each treatment tank was 6.28 m² x 1 m (round tank). Tank water was regulated by blending filtered water from the ocean and freshwater. Water was exchanged for the maintenance of the water quality by up to 100% every morning and up to 70% every afternoon. Fish were feed at 5% of body weight per day for 30 days and the feeding rate adjusted every week. The pellet (46% crude protein) was used for manual feeding at three times a day.

2.2. Data collection and sampling

Water quality parameters such as temperature, pH, and salinity were recorded daily using Celsius glass thermometer, digital pH meter, and hand held refractometer. The mean water temperatures measured in each tank throughout the experiment remained within the range ±0.5°C of the originally intended values. Sampling was done everyday over thirty days by weighing the fish using digital balance. Growth and survival were recorded after every sampling.

2.3. Statistical analysis

All data were analyzed using SPSS 25 software. Residuals were tested for normality (Kolmogorov-Smirnov Test) and homogeneity of variance (plot of residuals versus predicted values). The effect of temperature, pH, and salinity on the average body weight of Asian Seabass (Lates calcarifer) were analyzed using multiple linear regression followed by Durbin-Watson test. A significance level of p<0.05 was used for all statistical tests.

3. Result and Discussion

The Asian Seabass seeds (2-3 cm) used were acclimatized for 10-20 minutes to adjust to the ambient temperature. Furthermore stocked up in the morning that aims to be able to adapt to a new place. The Asian Seabass seeds maintained for 30th days to reach a weight of 2.9 ±1.2 grams.

In this study, the Asian Seabass seeds was fed with commercial fish pellets. The feed was given at 5% of the fish body weights [5]. A summary of the research results can be seen in Table 1. Based from the result obtained, those group stocked at 1000 pcs/tank (P1) exhibited the highest mean daily increment of 7.0± 1.5 gram followed by P2 with 5.0 ± 0.5 gram. The graph chart of average weight of Asian Seabass seed was shown in Figure 1.

Table 1. The performance variables of Asian Seabass seeds reared for 30th days at different stocking density as mean ± SD (standard deviation)

| Days | Temperature (°C) | pH    | Salinity (ppt) | Weight (gram) | Temperature (°C) | pH    | Salinity (ppt) | Weight (gram) |
|------|------------------|-------|----------------|---------------|------------------|-------|----------------|---------------|
| 5    | 27.1 ± 0.2       | 7.6 ± 0.1 | 11.4 ± 8.0    | 3.0 ± 1.2     | 27.1 ± 0.2       | 7.6 ± 0.1 | 10.4 ± 6.2    | 2.8 ± 0.4     |
| 10   | 28.1 ± 1.2       | 7.5 ± 0.2 | 12.3 ± 5.0    | 2.8 ± 1.3     | 28.0 ± 1.1       | 7.5 ± 0.1 | 13.4 ± 7.1    | 2.7 ± 0.4     |
| 15   | 28.6 ± 0.4       | 7.2 ± 0.2 | 10.8 ± 8.1    | 4.6 ± 0.9     | 28.5 ± 0.6       | 7.2 ± 0.1 | 12.4 ± 6.7    | 4.0 ± 0.4     |
| 20   | 27.6 ± 0.9       | 7.3 ± 0.1 | 10.2 ± 10.0   | 6.0 ± 1.2     | 27.5 ± 0.9       | 7.2 ± 0.3 | 9.8 ± 10.1    | 4.0 ± 0.5     |
| 25   | 27.1 ± 0.6       | 7.4 ± 0.2 | 3.2 ± 1.3     | 7.0 ± 1.6     | 27.0 ± 0.7       | 7.4 ± 0.3 | 3.4 ± 0.9     | 4.0 ± 0.8     |
| 30   | 27.6 ± 0.2       | 7.4 ± 0.1 | 2.6 ± 2.5     | 7.0 ± 1.5     | 27.5 ± 0.1       | 7.5 ± 0.0 | 2.4 ± 1.1     | 5.0 ± 0.5     |
In the current study, P2 (density 1400) showed no significant effect of stocking density on growth while P1 (density 1000) showed a great significant effect of stocking density on growth. The stocking density is one of the most important variables in aquaculture as it directly influences survival, growth, behaviour, health, water quality, feeding, and production. An increase in density leads to enhanced energy requirements due to stress causing reduced growth and food utilization [6]. If the stocking density is too low then the space utilization is not maximum and production will decrease [7]. Stress leads to increased cortisol production by even resting plasma cortisol and these increases with increasing stocking density, he continues that higher cortisol concentrations are considered as chronicle response to social stress due to high stockig density and this impairs fish growth due to mobilization of dietary energy by physiological alterations caused by stress [8]. The different stocking density treatments had a significant effect on the all test parameters such as absolute weight growth, length growth absolute, specific growth rate and survival.

Studies conducted, so far, have been demonstrated that thermal tolerance of Asian Seabass ranges between 26.3 – 29.8°C (P1) and 26 – 29.8°C (P2). The graph chart of average temperature of Asian Seabass seed was shown in Figure 2. The optimal temperatures for the best growth lies in between 28°C and 32°C [9]. Temperature is well known factor to have effects on biochemical and physiological activities of aquatic animals. Rising temperature up to a certain limit favours aquaculture production, but beyond optimum limit, the metabolic stress caused by temperature adversely affects growth, food consumption and/or health of the fish under culture [10].

Water pH is an important factor affecting the metabolism of fish. Fish grow slowly when exposed to very acidic or alkalines pHs. Studies conducted, showed water pH of about 7-7.8 (P1 and P2) was shown in Figure 2. According to the Indonesian National Standard (2014), water pH during rearing showed optimal in between 7.0-8.5. Reduced water pH can affect developmental, metabolic, and behavioral processes of some fish species. Likewise, an increase in pH may disturb acid-base balance, ammonia excretion, and ion loss over the gill. However, fishes appear to be relatively tolerant to mild increases or decreases in pH, as prolactin and cortisol play key roles when fish are exposed to acidic conditions [11].

![Figure 1. The average weight of Asian Seabass seeds observed for 30th days](image1.png)

![Figure 2. Graph chart of average temperature and pH of Asian Seabass seed](image2.png)
Figure 2. Temperature, pH and salinity of water were observed for 30th days

Based on the result of the study, showed salinity of about 27-1 ppt (P1 and P2). The results of this study proven that Asian Seabass can be cultivated in low salinity media because of the euryhaline nature of the Asian Seabass and most of its life span is two to three years in fresh waters such as lakes and rives [12]. However, Asian Seabass can increase in body weight with up to 0.5 gram/day if the salinity levels are in the interval of 28-32 gr/L [13]. Asian Seabass has the potential to cause problems if adapted to lower salinity waters. The decrease in salinity can affect the balance between the concentration of water and ions in the fish body, which is related to the osmoregulation process [14].

Multiple linear regression tests indicated a significant effect of temperature, pH, and salinity for body weight (P<0.05). Beside that, Durbin-Watson tests indicated that temperature, pH, and salinity showed an effect on body weight by P1 (35.2%) and P2 (28.9%). If the high stocking is not balanced with proper feeding and controlled water quality, it will cause a decrease in the growth rate of fish and if it reaches a certain limit, its growth will stop altogether [15].

4. Conclusion

From the overall result of this study, we can conclude that water quality (temperature, pH, and salinity) still within the permissible ranges to support aquatic life. The temperature, pH, and salinity showed an effect on body weight by P1 (35.2%) and P2 (28.9%). The conclusion of this study is that the density of 1000 shows a higher effect that the density of 1400 on the growth of Asian Seabass.

5. References

[1] Asdary M, Doni P, Yuliana, and Indah K JPBAP 14, 64-70.
[2] Putri D F, Limin S, and Suryadi S 2018 Berkala Perikanan Terubuk 46(2), 89-96.
[3] Caesar N R, Yanuhar U, Raharjo D K W P, and Junirahma N S 2021 IOP Conference Series: Earth and Environmental Science 718, 1-5
[4] Swain S, Paramita B S, Narinder K C, Chandaprajnadarsini E M, and Milind K 2020 Intl. Jour. of Chem. Stud. 8(4), 830-837.
[5] Diniyyah F 2018 JIPK 10(2), 65-69.
[6] Tibile R M, Paramita B S, Narinder K C, Wazir S L, Chandra P, Sambid S, and Kaustubh B 2016 Turkish Journal of Fisheries and Aquatic Sciences 16, 455-462.
[7] Walusi R, Syafruddin N, and Zulkifi 2019 JOM 6, 2-12.
[8] Ronald N, Bwanika G, and Eriku G 2014 J of Aqua. Res. & Dev. 5(222), 1-7.
[9] Indonesien National Standard 2014 Asian Seabass (Lates calcarifer, Bloch 1790) Seed Production (Jakarta: Badan Standardisasi Nasional)
[10] Yilmaz H A, Serhat T, Metin K, Orhan T, and Nafiye P 2019 Turkish Journal of Fisheries and
Aquatic Sciences 20(5), 331-340.

[11] Shuangyao W, Zhiqiang J, Mingguang M, Shoukang M, Yang S, and Youzhen S 2018 Iranian Jour. of Fish. Sci. 17(4), 675-689.

[12] Wijayanto D, Azis N B, Ristiawan A N, Faik K, and Didik B 2020 AACL-Bioflux 13(6), 3706-3712.

[13] Sari L, Mohamad F, Maheno S, Lutfiatunnisa, and Fitri S 2010 AACL-Bioflux 13(5): 2445-2451.

[14] Rayes D N, Wayan I S, Nanda D, and Apri I 2013 Jur. Kel. 6(1), 47-56.

[15] Tarwiyah 2001 Hatchery of Tiger Grouper (Ephinephellus fuscoguttatus) Larva hatchery (Jakarta: Kantor Deputi Menegristek Bidang Pendayagunaan dan Pemasyarakatan Ilmu Pengetahuan dan Teknologi).