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The Effect Of Stocking Densities On Growth And Survival Rate Of Thai Mahseer (*Tor Tambroides*) During Nursery Stage.

A N Indra[1], N N Dewi[2,4], G Mahasri[2], B S Rahardja[2], O Z Arifin[3]

[1]Program Study of Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Surabaya 60115 Indonesia
[2]Department of Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Surabaya 60115 Indonesia
[3]National Research and Inovation Agency, Bogor 16915 Indonesia

[4]Corresponding author: ninanurmaliadewi@fpk.unair.ac.id

Abstract. *Tor* Fish are freshwater fisheries resources that have the potential to be found in Indonesia. Tor fish has been in high demand among entrepreneurs and the broader public. *Tor tambroides* (Sapan fish or Thai mahseer fish seed fish), *Tor douronensis* (Semah or Garing fish), *Tor soro* (Soro, Lempon, or Dewa fish), and *Tor tambra* are the four kinds of *Tor* fish native to Indonesia. *Tor* fish is a native indigenous freshwater fish from Indonesia that is on the verge of extinction. The *Tor tambroides* fish population in nature has declined and is on the verge of extinction as a result of widespread poaching for eating and trade as an ornamental fish. Thai mahseer fish seed fish cultivation activities include hatchery, nursery and enlargement. To protect populations of Thai mahseer fish seed fish from scarcity, Thai mahseer fish seed fish cultivation needs to do to prevent the scarcity of Thai mahseer fish seed fish in their natural habitat and Thai mahseer fish seed fish have high potential as freshwater fish in the aquaculture sector. This research aims to determine the impact of various stocking densities on growth and survival rates for Thai mahseer fish seeds, as well as the optimal density to support growth and survival rates. The study used a Random Design Complete (RDC) with four treatments and five replications. Feeding was provided ad libitum in the morning and evening. Given differences in the stocking density of Thai mahseer fish seeds, the results revealed a significant impact on all treatments. Treatment 1 had the greatest daily growth rate with a stocking density of 2 seeds/L and a yield of 0.015±0.003; specific growth rate. The highest absolute weight growth obtained was in Treatment 1 with a yield of 1.01gr; the highest absolute length growth obtained was in Treatment 1 with a yield of 2.9cm; and the highest survival rate for Thai mahseer fish seeds was obtained in Treatment 1 with a yield of 80%.

1. Introduction

Tor fish is an endemic freshwater fish native to Indonesia whose population is starting to be threatened with extinction. Based on the red list of endangered species published by IUCN in 2022, it explains that the species of *Tor tambroides* fish has decreased [1]. The population of *Tor tambroides* fish in nature has decreased and is heading towards extinction due to the large number of poaching of this fish for consumption and sale as ornamental fish [2]. The distribution of thai mahseer fish seed fish can be found in Southeast Asian countries including Malaysia, Indonesia, Thailand, Vietnam, China, and Brunei Darussalam [3]. The demand for thai mahseer fish seed fish for both consumption and ornamental fish continues to increase. In Malaysia, thai mahseer fish seed fish is sold at a price of RM750/kg for the local market while for the international market it reaches a price of RM800-RM850/kg resulting in a decline in the thai mahseer fish seed fish population in its natural habitat due to the increasing exploitation rate in nature. Several fish species of the Tor genus, including thai mahseer fish seed fish, are threatened with extinction due to overfishing and habitat destruction in the form of deforestation by human activities [2,4].

The higher market demand for thai mahseer fish seed fish both starting from seeds to broodstock will result in increasingly critical thai mahseer fish seed fish populations in nature and the absence of thai mahseer fish seed fish farming activities, so research is carried out that leads to sustainable utilization

efforts through the process of nursery. At the stage of fish farming activities of the genus *Tor*, including thai mahseer fish seed fish farming, before enlargement, it is necessary to carry out nursery activities [5]. Fish breeding is a controlled seeding activity within a certain time to enlarge fish in ponds or in floating net cages. Fish breeding is a controlled hatchery activity within a certain time to enlarge fish in ponds or in floating net cages.

Stocking density is the number of fish stocked or reared in a certain unit area [6]. Factors that affect the stocking density for fish seed include water quality, feeding, and size differences in fish [7]. Giving high stocking density to fish seed can result in limited space for movement so that there is competition between fish seeds for oxygen and feed and result in growth in fish seed being inhibited and making fish seeds experience stress [8]. The increase of fish seeds in optimal environmental conditions will occur physiological responses of fish seeds in the form of growth rate, absolute length gain, absolute weight and high survival rate [9].

Thai mahseer fish seed have a slender cylindrical body shape, a strong muscular tail, and thick hypertrophied lips to help swim and withstand heavy currents in their habitat. The scale color of the thai mahseer fish seed fish is yellowish with slightly bluish fins for juvenile fish and in adult fish it is yellowish with blackish fins [10]. The main distribution habitat of thai mahseer fish seed fish species is spread in the rivers of Borneo and Malaysia. The original habitat of thai mahseer fish seed fish in the upper reaches that are passed by the main river flow that is not touched by human activities in the form of development near the river [11]. Besides being spread in Indonesia and Malaysia, thai mahseer fish seed fish are also spread in several countries in Southeast Asia and China [2].

In the business of raising god fish with pond maintenance media, fish feed needs are met by feeding commercial feed containing a protein range of 28-30%. The natural food habits of thai mahseer fish seed fish are omnivorous, including eating aquatic plants, insects, crabs, shrimp, snails, and moss in their natural habitat. Thai mahseer fish seed fish are active at night but because thai mahseer fish seed fish have been breeding in aquaculture ponds, thai mahseer fish seed fish are accustomed to being given commercial artificial feed in the form of pellets to trigger gonad maturity in adult thai mahseer fish seed fish [5].

The purpose of this study was to determine the effect of stocking density on the growth and survival rate at the thai mahseer fish seed fish breeding stage. To determine the optimal stocking density to support the growth and survival rate at the thai mahseer fish seed fish breeding stage.

Based on the results of this study, it is hoped that it can produce new knowledge on thai mahseer fish seed fish enlargement activities and determine the effect of giving different stocking densities to thai mahseer fish seeds during seeding so that it can be useful information for scientists, students, and farmers.

2. Materials and Methods

2.1. Time and Place

This research activity was carried out at the Freshwater Aquaculture Germplasm Research Installation (IRPNBPAT) Cijeruk, Bogor Regency, West Java from September to November 2021.

2.2. Tools and Materials

The tools used in this study are as follows aquarium measuring 30x25x25cm with a volume of 10 liters as many as 20 pieces, pH meter, DO meter, analytical scales, millimeter blocks, ruler, stationery, documentation tools, basin containers, petridish, blower, aeration hose, aerator stone, spoon, tool for siphon, foam sponge, and fish scraping.

Materials used in this study include thai mahseer fish seeds measuring 1.6-1.8cm, and silk worms (*Tubifex sp*.).

2.3. Experimental Design

The research method used was an experimental method with a completely randomized design (CRD) consisting of 4 treatments and 5 replicates of different stocking density treatments as follows:

Treatment 1 = Stocking density of 2 seeds/liter.
Treatment 2 = Stocking density of 4 seeds/liter.
Treatment 3 = Stocking density of 8 seeds/liter.
Treatment 4 = Stocking density of 16 seeds/liter.

Determination of stocking density is determined based on research by Ullah et al. in 2018 on the provision of different stocking densities on *Tor macrolepis* fish seeds using an aquarium measuring 60x45x30cm with 3 treatments and 4 replicates [12].

2.4. Aquarium Preparation

Aquariums as maintenance containers that will be used for research are cleaned by brushing the inside and then filled with clean water from the water pump filter water as much as 10 liters per aquarium. Each aquarium was given an aeration hose, aerator stone, and labeled with treatment information [13].

2.5. Thai Mahseer Fish Seed Acclimatization

Acclimatization is a process of effort in physiological adjustment or adaptation of an organism to a new environment that will be occupied [14]. Acclimatization is related to the adjustment process between two different environmental conditions so that these conditions do not cause stress to the fish [15]. Acclimatization aims to make thai mahseer fish seed survive the changes in stocking density tested. Acclimatization of fish seed was carried out by placing fish with a density of 500 fish in an aquarium measuring 90x50x40cm for one week before the study was conducted.

2.6. Thai Mahseer Fish Seed Maintenance

Thai mahseer fish seed were reared in 20 aquariums measuring 30x25x25cm with a water volume of 10 liters. Each aquarium contained 20, 40, 80, and 160 fish seed. An aeration hose was installed at the edge of the aquarium to circulate oxygen. During the study, thai mahseer fish seeds were given live feed of silk worms (*Tubifex sp*.) twice a day for 67 days of rearing every morning and evening, feeding thai mahseer fish seed is done ad libitum (as full as possible) by taking silk worms (*Tubifex sp*.) and then given to the aquarium containing thai mahseer fish seed. Ad libitum feeding is usually given to the larval stage up to the size of fish seed. This is because the capacity of the digestive system and the size of the mouth opening of larvae or fish seed are still very small and not fully developed. So by providing feed ad libitum where feed is always available in unlimited quantities, the larvae or fish seed can eat at any time according to the needs of the larvae or fish seed [16].

Ad libitum feeding is feeding fish where the amount of feed is not limited and according to the wishes of fish seeds [17]. Water quality measurements were taken once a day every morning during the three-month study period and water quality conditions were considered such as pH, DO and temperature. Watering or changing water is done every day or if the water looks cloudy, this aims to minimize the chances of diseases that will interfere with the growth of seeds.

2.7. Research Parameters

Parameters in this study include daily growth rate, specific growth rate, absolute weight growth, absolute length growth, survival rate of thai mahseer fish seed, and water quality.

A. Growth Rate

The daily growth rate is calculated using the following formula [18]:

$$GR = \frac{Wt - Wo}{t}$$

Description:

- GR = Growth rate (g/day)
- Wt = Final average weight (g/seed)
- Wo = Starting average weight (g/seed)
- t = Time/ maintenance duration (day)

B. *Spesific Growth Rate*

Spesific growth rate is calculated using the following formula [19]:

$$SGR = \frac{LnWt - LnWo}{t} \times 100\%$$

Description:

- SGR = Spesific growth rate (%/day)
- Wt = Final average weight (g/seed)
- Wo = Early average weight (g/seed)
- t = Maintenance time/length (day)

C. Absolute Weight Growth

Absolute weight growth is calculated using the following formula [20]:

$$Wm = Wt - Wo$$

Description:

- W = Absolute weight growth (g)
- Wt = Weight of biomass at the end of the research (g)
- Wo = Weight of biomass at the beginning of the research (g)

D. Absolute Length Growth

Absolute length growth is calculated using the following formula [20]:

$$Pm = Lt - Lo$$

Description:

- Pm = Absolute length growth (cm)
- Lt = Final average length (cm)
- Lo = Early average length (cm)

E. Survival Rate

Survival rate is calculated using the following formula [20]:

$$SR = \frac{Nt}{No} \text{ x } 100\%$$

Description:

- SR = Survival rate (%)
- N0 = Total fish seeds at the beginning of the research (seed)
- Nt = Total fish seeds at the end of the research (seed)

F. Water Quality

The water quality measured in this research includes the degree of temperature (°C) measured using a DO meter, pH levels measured using a pH meter, and dissolved oxygen (DO) content measured using a DO meter. Water quality measurements in the aquarium were carried out every day in the morning during this study.

2.8. Data Analysis

Data analysis in this research uses excel average data test analysis, Analysis of Variance (ANOVA) test and further tests in the form of Duncan test or Duncan Multiple Range Test (DMRT) using the SPSS version 23 program [12].

3. *Result and Discussion*

3.1.1. Growth Rate

Table 1. Daily Growth Rate of Thai Mahseer Fish Seeds

Treatment	GR (g/day) ± SD
T1	0.015^{c}±0.003
T2	0.008^{b}±0.002
T3	0.007^{ab}±0.003
T4	0.004^{a}±0.002

Notes: Different superscript letter notation (abc) in the same column indicates that there is a significant difference ($p<0.05$) in each treatment T1 (stocking density 2 seeds/L), T2 (stocking density 4 seeds/L), T3 (stocking density 8 seeds/L), and T4 (stocking density 16 seeds/L).

The test results during the 67 days maintenance period of thai mahseer fish seeds found that the treatment that has the highest daily growth rate is Treatment 1 at 0.015g/day. While the treatment that has the lowest daily growth rate is Treatment 4 at 0.004g/day.

The test results using ANOVA (Analysis of Variance) analysis (Table 1) showed that the provision of different stocking densities on thai mahseer fish seeds in all treatments gave significantly different results.

The results of further tests using Duncan or Duncan Multiple Range Test (DMRT) on all treatments of stocking density on thai mahseer fish seeds show that the largest results obtained are Treatment 1 which is significantly different from all treatments, Treatment 2 is significantly different from Treatment 4, and Treatment 3 which is not significantly different from Treatment 2 and Treatment 4.

3.1.2. Spesific Growth Rate

Table 2. Spesific Growth Rate (SGR) Thai Mahseer Fish Seeds

Treatment	SGR (g/%) ± SD
T1	5.322^{c}±0.267
T2	4.354^{b}±0.399
T3	4.031^{b}±0.585
T4	3.271^{a}±0.787

Notes: Different superscript letter notation (abc) in the same column indicates that there is a significant difference ($p<0.05$) in each treatment T1 (stocking density 2 seeds/L), T2 (stocking density 4 seeds/L), T3 (stocking density 8 seeds/L), and T4 (stocking density 16 seeds/L).

The test results during the 67 days maintenance period of thai mahseer fish seeds found that the treatment that has the highest specific growth rate is Treatment 1 at 5.322%. While the test results of the treatment of thai mahseer fish seeds that have the lowest daily growth rate is Treatment 4 at 3.271%.

The test results using ANOVA (Analysis of Variance) analysis (Table 2) showed that the provision of different stocking densities on thai mahseer fish seeds in all treatments gave significantly different results.

The results of further tests using Duncan or Duncan Multiple Range Test (DMRT) on all treatments of stocking density on thai mahseer fish seeds show that the results obtained are Treatment 1 which is significantly different from all treatments, Treatment 2 is not significantly different from Treatment 3, and Treatment 3 is significantly different from Treatment 4.

3.1.3. Absolute Weight Growth

Table 3. Absolute Weight Growth Thai Mahseer Fish Seeds

Treatment	AWG (gram) ± SD
T1	1.01^{c} ±0.188
T2	0.521^{b}±0.127
T3	0.436^{ab}±0.197
T4	0.258^{a}±0.131

Notes: Different superscript letter notation (abc) in the same column indicates that there is a significant difference ($p<0.05$) in each treatment T1 (stocking density 2 seeds/L), T2 (stocking density 4 seeds/L), T3 (stocking density 8 seeds/L), and T4 (stocking density 16 seeds/L).

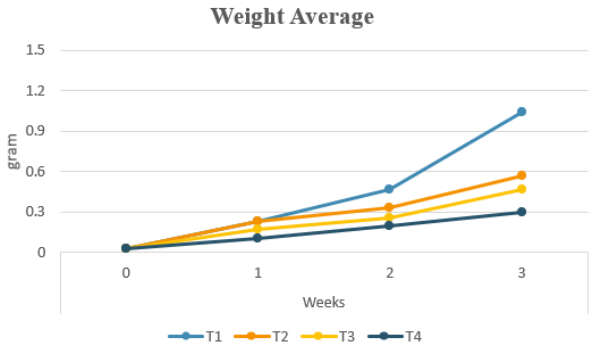
The test results during the 67 days maintenance period of thai mahseer fish seeds on Absolute Weight Growth obtained treatment that has the highest results is Treatment 1 of 1.01g. While the test results of the treatment of thai mahseer fish seeds with the lowest results are Treatment 4 at 0.258g.

The test results using ANOVA (Analysis of Variance) (Table 3) showed that the provision of different stocking densities on thai mahseer fish seeds in all treatments gave significantly different results.

The results of further tests using Duncan or Duncan Multiple Range Test (DMRT) on all treatments of stocking density of thai mahseer fish seeds show that the results obtained are on stocking density Treatment 1 which is significantly different from all treatments, Treatment 3 which is not significantly different from Treatment 2 and Treatment 4.

3.1.4. Weight Average

Figure 1. Weight Average Thai Mahseer Fish Seeds (g)



Based on Figure 1 during the 67 days maintenance period, the average weight of thai mahseer fish seeds obtained shows an increase every week. At the end of the maintenance period, based on the test results of thai mahseer fish seeds, the highest average weight of thai mahseer fish seeds is Treatment 1 of 1.039g and the lowest average weight of thai mahseer fish seeds is Treatment 4 of 0.298g.

3.1.5. Absolute Length Growth

Table 4. Absolute Length Growth Thai Mahseer Fish Seeds

Treatment	ALG (cm) ± SD
T1	2.9^{c}±0.22
T2	2.2^{b}±0.21
T3	1.8^{ab}±0.44

T4	1.4[a]±0.37

Notes: Different superscript letter notation (abc) in the same column indicates that there is a significant difference ($p<0.05$) in each treatment T1 (stocking density 2 seeds/L), T2 (stocking density 4 seeds/L), T3 (stocking density 8 seeds/L), and T4 (stocking density 16 seeds/L).

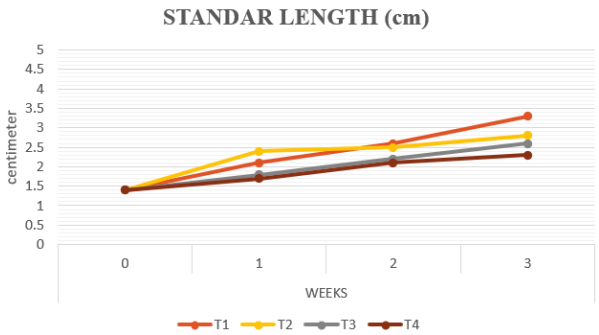
The test results of thai mahseer fish seeds on Absolute Length Growth obtained treatment that has the highest results is Treatment 1 at 2.9cm. While the treatment of thai mahseer fish seeds that have the lowest results is Treatment 4 at 1.4cm.

The test results using ANOVA (Analysis of Variance) (Table 4) showed that the provision of different stocking densities on thai mahseer fish seeds in all treatments gave significantly different results.

The results of further tests using Duncan or Duncan Multiple Range Test (DMRT) on all treatments of stocking density on thai mahseer fish seeds show that the results obtained are Treatment 1 which is significantly different from all treatments, Treatment 2 which is significantly different from Treatment 4, and Treatment 3 which is not significantly different from Treatment 2 and Treatment 4.

3.1.6. Standar Length

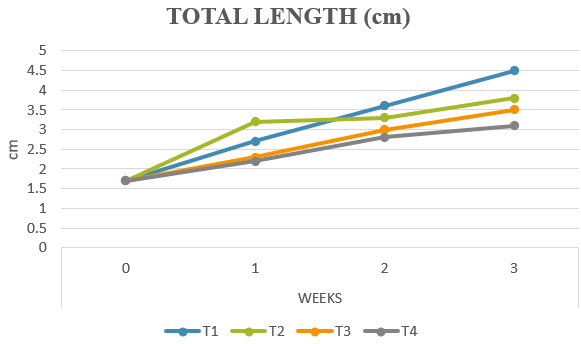
Figure 2. Standar Length Thai Mahseer Fish Seeds (cm)



Based on Figure 2 during the 67-days maintenance period, the average standard length of thai mahseer fish seeds is obtained which shows an increase every week. At the end of the maintenance period, based on the test results of thai mahseer fish seeds, the highest average standard length of thai mahseer fish seeds is Treatment 1 at 3.3cm and the lowest average standard length of thai mahseer fish seeds is Treatment 4 at 2.3cm.

3.1.7. Total Length

Figure 3. Total Length Thai Mahseer Fish Seeds (cm)



Based on Figure 3 during the 67-days maintenance period, the average total length of thai mahseer fish seed is obtained which shows an increase every week. At the end of the maintenance period, based

on the test results of thai mahseer fish seed, the highest average standard length of thai mahseer fish seed is Treatment 1 at 4.5cm and the lowest average standard length of thai mahseer fish seed is Treatment 4 at 3.1cm.

3.1.8. Survival Rate

Table 5. Survival Rate Thai Mahseer Fish Seeds

Treatment	Survival Rate (SR) (%) ± SD
T1	80%[a]±2.92
T2	76%[a]±4.56
T3	61%[a]±12.56
T4	34%[b]±38.07

Notes: Different superscript letter notation (abc) in the same column indicates that there is a significant difference ($p<0.05$) in each treatment T1 (stocking density 2 seeds/L), T2 (stocking density 4 seeds/L), T3 (stocking density 8 seeds/L), and T4 (stocking density 16 seeds/L).

Based on Table 5 during the 67-days maintenance period, the average survival rate of thai mahseer fish seeds given the treatment of differences in stocking density is 34%-80% with the highest survival rate found in Treatment 1 which is 80% and the lowest survival rate found in Treatment 4 which is 34%.

The test results using ANOVA (Analysis of Variance) (Table 5) show that the provision of different stocking densities on thai mahseer fish seeds in all treatments gives significantly different results.

The results of further tests using Duncan or Duncan Multiple Range Test (DMRT) on all treatments of stocking density on thai mahseer fish seed show that the results obtained are Treatment 1, Treatment 2, and Treatment 3 which are significantly different from Treatment 4, and Treatment 1 which is not significantly different from Treatment 2 and Treatment 3.

3.1.9. Water Quality

The water quality parameters measured in this research include dissolved oxygen (DO) content, temperature, and pH levels. The results of the water quality data test during the research can be seen in Table 6.

Table 6. Water Quality Data on Thai Mahseer Fish Seeds Fish Seed Raising Aquarium

Parameters	Treatment				References
	T1	T2	T3	T4	
DO (mg/L)	5.6−6.0	5.5−6.0	5.8−6.1	5.6−6.0	>5 mg/L (Arifin et al., 2019).
Temperature (°C)	23.1−23.4	23.0−23.2	23.0−23.3	23.0−23.3	20-30°C (Riar and Nur, 2021).
pH	8.1−8.4	8.1−8.4	8.0−8.5	8.0−8.5	6,5 – 8,5 (KKP, 2020).

Table 6 shows the test results of water quality data during the research were in the normal range and met the quality standards of *Tor* fish cultivation. The dissolved oxygen (DO) content in each treatment ranged from 5.5-6.1mg/L. The temperature content in each treatment ranged from 23.0-23.4°C. The pH content of each treatment ranged from 8.0-8.5.

3.1.10. Discussion

Absolute growth in fish seeds is the difference between weight and length data at the end of maintenance and the initial data of maintenance by looking at changes in length and weight in fish seeds in units of time [21]. Growth in length and weight is influenced by several factors including water quality, age, quantity and quality of feed [22]. Growth in fish can be seen from changes in the size of fish in weight, length and volume over a certain period of time or during the maintenance period caused by changes in muscle cell tissue and bones that divide, causing additional weight and length in fish [23].

Daily growth rate is the speed of growth as time increases. The daily growth rate explains that fish are able to utilize feed nutrients to be stored in the body and convert these nutrients into energy [23]. Specific growth rate in fish seeds is the increase in body weight/day to see any significant differences in results [24].

The results obtained from the treatment test on thai mahseer fish seeds are in the form of a high daily growth rate obtained from Treatment 1 of 0.015gr / day. While the treatment that has the lowest daily growth rate is Treatment 4 at 0.004gr/day. The results obtained from the treatment test of thai mahseer fish seeds in the form of a high specific growth rate obtained from Treatment 1 of 5.322%. While the test results of the treatment of thai mahseer fish seeds that have the lowest daily growth rate is Treatment 4 of 3.271%. This can occur because by giving differences to stocking density, it can interfere with the physiological process and behavior of fish seeds towards space which in turn can reduce health conditions, physiological functions, food utilization, growth and survival rates in fish seeds [8].

The provision of higher stocking density can cause lower growth due to competition between space, dissolved oxygen, and feed [25]. Giving different stocking densities to fish seeds also has a certain effect on survival rate (SR), specific growth rate (SGR), and Feed Conversion Ratio (FCR). Low stocking density can increase better fish growth due to the absence of limitations on space, dissolved oxygen, and food competition [26].

Fish growth is influenced by several factors including age, size, density and space. Each type of fish has a certain daily growth rate value that depends on water quality [27]. Higher stocking densities can cause a lack of space for fish seeds in the rearing medium, resulting in a higher mortality rate for fish seeds.

Based on the research of Ullah et al. in 2018 on *Tor macrolepis* fish seeds by giving different stocking density differences, the effect on each treatment is due to competition for space, food competition, and also water quality between each seed even though the feed dose is given in the same ratio. This shows that the higher the density of seeds given, the lower the daily growth rate [12].

Measurement of absolute length in fish seed is the difference between the length of the fish between the tip of the head to the tail end of the body at the end of the study and the body length at the beginning of the study. Low stocking densities of fish seed show higher length growth compared to higher stocking densities, due to competition in seeds for space, food competition and water quality [28]. The results of absolute length growth in thai mahseer fish seeds observed obtained T1 results are greater than T4, this is due to the provision of higher stocking densities that can cause fish to experience stress. Based on research conducted by Ullah et al. in 2018 regarding the stocking density of *Tor macrolepis* seeds, the lower stocking density of fish seeds is suitable for cultivation in aquarium media [12].

The average survival rate of thai mahseer fish seeds treated with different stocking densities is 34%-80% with the highest survival rate found in Treatment 1 which is 80% and the lowest survival rate found in Treatment 4 which is 34%. Based on the observation of the survival rate carried out during the study, it can be seen that the provision of different stocking density treatments has a significant effect on the survival rate of thai mahseer fish seeds.

This can occur because the maintenance of thai mahseer fish seeds in this study uses different stocking density differences for each treatment so that there is competition for feed, space and water quality which has a significant effect on the survival rate of thai mahseer fish seeds.Survival rate is the main parameter in fish farming activities because the number of living fish can affect the value of production in aquaculture. Fish naturally have the ability to adapt to changes that occur in the environmental conditions of the water media where they live [29].

The survival rate of seed is used to determine how much tolerance and ability to live fish during the research activities [30]. Stocking density is closely related to the competition for food, space, and water quality so that it can have an impact on the performance of growth and survival of fish that take place quickly or [30]. Determination of stocking density is very important to consider in fish farming activities to minimize the negative effects of factors that occur on growth rates, survival rates and also

consideration of economic aspects in order to achieve optimal cultivation activities between growth and profits obtained from cultivation activities [31].

Fish growth is influenced by several factors including age, size, density and space. Each type of fish has a certain daily growth rate value that depends on water quality [27]. Higher stocking densities can cause a lack of space for fish seed in the rearing medium resulting in a greater mortality rate in fish seed. With an increase in stocking density, it will be able to interfere with the physiological processes and behavior of fish seeds towards movement space which in turn can reduce health conditions, physiological functions, food utilization, growth and survival rates in fish seeds [7].

The water quality parameters measured in this study include dissolved oxygen (DO), temperature, and pH levels. The measurement results obtained in this study are in the normal range and meet the quality standards in the thai mahseer fish seed fish farming system.

Dissolved oxygen (DO) levels in each treatment in this study ranged from 5.5-6.1mg/L. The measurement results of water quality parameters show that the DO content in this study is still in the normal range and in accordance with the water quality requirements for the maintenance of thai mahseer fish seeds, namely the minimum level of dissolved oxygen (DO) which is optimal for the growth and survival rate of thai mahseer fish seeds is above 3mg/L. The lower the level of dissolved oxygen (DO) in the water body, it will cause fish to experience hypoxic conditions and can reduce their metabolic rate, so the higher the stocking density given, the lower the level of dissolved oxygen (DO) in the water body [32,33].

The temperature content in each treatment ranged from 23.0-23.4°C. The results of the measurement of water quality parameters show that the temperature content in this study is in the normal range and in accordance with the water quality requirements for the maintenance of thai mahseer fish seeds, namely for optimal temperatures to support growth and survival rates are in the range of 20-30°C. The temperature parameter experienced fluctuations that changed according to environmental and weather conditions. However, there was no drastic change in temperature during the maintenance period [28].

The content of pH levels in each treatment ranged from 8.0-8.5. These results are still included in the optimal pH range for thai mahseer fish seed fish, this is supported by the optimal pH range for Tor fish which ranges from 7-8.5 [34]. The tolerance limit of aquatic organisms to pH varies, the presence of changes in pH value in a maintenance medium / water for aquatic organisms has certain limits with varying pH values, depending on water temperature, dissolved oxygen concentration and the presence of anion and cation content [35].

4. Conclussion

Based on the results of research that has been conducted on the effect of different stocking densities on the growth and survival rate of thai mahseer fish seeds (*Tor tambroides*) fingerlings, it can be concluded that different stocking densities have a significant effect on daily growth rate (GR), specific growth rate (SGR), absolute weight growth (AWG), absolute length growth (ALG), and do not have a significant effect on the survival rate of thai mahseer fish seed fish fingerlings. The optimal stocking density for thai mahseer fish seeding activities obtained is 2 fish/L.

5. References

[1] The International Union for Conservation of Nature (IUCN) 2022 https: //www.iucnredlist. org/search/grid Diakses pada 17 Januari 2023 1 hal.
[2] Kottelat M, Pinder A and Harrison A 2018 *Tor tambroides* Journal The International Union for Conservation of Nature (IUCN) Red List of Threatened pp 1-8.
[3] Redhwan A I, Satya N R, Nurul A M Z, Asmad K, Ahmad S K, Norshida I, Nguang S I, Ha H C, Yong F H and Connie F K 2022 Mahseer in Malaysia A Review of Feed for

Cultured *Tor tambroides* and *Tor tambra* Journal by Innovative Scientific Information and Services Network 19: 349-359.

[4] Lee K Soon, Samuel L, Famila F G D, Kathleen M M, Felecia C and Ng K Hua 2014 Microbiological And Physicochemical Analysis Of Water From Thai mahseer fish seed Fish (*Tor tambroides*) Farm In Kuching Sarawak Malaysian Borneo International Journal of Scientific and Technology Research 3(6): 285-292.

[5] Arifin O Z, Subagja J, Asih S, dan Kristanto, A H 2019 Budidaya Ikan Dewa PT Penerbit IPB Press 122 hal

[6] Diansari RR V R, Endang A, dan Tita E 2013 Pengaruh Kepadatan Yang Berbeda Terhadap Kelulushidupan dan Pertumbuhan Ikan Nila (*Oreochromis niloticus*) Pada Sistem Resirkulasi Dengan Filter Zeolit Journal of Aquaculture Management and Technology 2(3): 37-45.

[7] Azhari A, Zainal A M dan Irma D 2017 Pengaruh Padat Penebaran Terhadap Kelangsungan Hidup dan Pertumbuhan Benih Ikan Seurukan (*Osteochilus vittatus*) Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah 2(1): 12-19.

[8] Sihite E R, Rosmaiti, Andika P dan Agus P A S 2020 Pengaruh Padat Tebar Tinggi Terhadap Kualitas Air dan Pertumbuhan Ikan Mas (*Cyprinus carpio*) Dengan Penambahan Nitrobacter Jurnal Ilmiah Samudra Akuatika 4(1): 10-16.

[9] Taufik I 2018 Perbedaan Padat Tebar Pada Budi Daya Ikan Mas Dengan Sistem Akuaponik Prosiding Seminar Nasional Ikan Balai Riset Budidaya Air Tawar Bogor 6: 281-291.

[10] Entri D A 2013. Determination of *Tor tambroides* (Thai mahseer fish seed) Growth Rate using Different Feed System Thesis Resource Biotechnology Programme Faculty of Resource Science and Technology Universiti Malaysia Sarawak 24p.

[11] Jaafar F, Uthairat N N, Prapansak S, Thumronk A, Thuy-Yen D, Maria M, Gonzales Plasus, Duc-Huy H and Ishwar S P 2021 A Current Update on the Distribution, Morphological Features, and Genetic Identity of the Southeast Asian Mahseers *Tor* Species. Biology Journal 10(286): 1-30.

[12] Ullah K, Arslan E and Muhammd Z A 2018. Effect of Stocking Density on Growth Performance of Indus Mahseer (*Tor macrolepis*) International Journal of Fisheries and Aquatic Studies 6(3): 49-52.

[13] Larasati A 2022. Pertumbuhan dan Sintasan Larva Ikan Dewa (*Tor soro* Valenciennes, 1842) yang Dipelihara Dengan Fotoperiode Berbeda. Skripsi. Program Studi Biologi Fakultas Sains dan Teknologi Universitas Islam Negeri Syarif Hidayatullah. Jakarta 57 hal.

[14] Lubis M Z dan Sri P 2013 Pengaruh Aklimatisasi Kadar Garam Terhadap Nilai Kematian dan Tingkah Laku Ikan Guppy (*Poecilia reticulata*) Sebagai Pengganti Umpan Ikan Cakalang (*Katsuwonus pelamis*) Jurnal Teknologi Perikanan dan Kelautan 4(2): 123-129.

[15] Arianto R M, Aristi D P F dan Bogi B J 2018 Pengaruh Aklimatisasi Kadar Garam Terhadap Nilai Kematian dan Respon Pergerakan Ikan Wader (*Rasbora argyrotaenia*) Untuk Umpan Hidup Ikan Cakalang. Journal of Fisheries Resources Utilization Management and Technology 7(2): 43-51.

[16] Syahputra D A 2017. Rancang Bangun Pemberi Pakan Ikan Otomatis pada Kolam Ikan Berbasis Arduino Tugas Akhir Fakultas Teknologi dan Informatika Institut Bisnis dan Informatika STIKOM Surabaya 100 hal.

[17] Poto L M A 2019 Memberi Pakan. Kementerian Pendidikan dan Kebudayaan Jakarta hal 1-62.

[18] Rahman H and Arifuzzaman 2021 An Experiment on Growth Performance Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) of Rohu (*Labeo rohita*) and Tilapia (*Oreochromis niloticus*) in Tank Based Intensive Aquaculture System Journal of Aquaculture and Fishery Sciences Bangladesh.7(4): 35-41.
[19] Tacon A G J 1993. Feed Ingredients for Wrom Water Fish Fish Meal and Other Processed Feedstuffs. FAO Fisheries Circulator No. 856 Rome 64 Pp.
[20] Effendie M I 1997 Biologi Perikanan Yayasan Pustaka Nusatama 162 hal.
[21] Christin Y, I Wayan Restu dan Gde Raka Angga K 2021. Laju Pertumbuhan Ikan Nila (*Oreochromis niloticus*) pada Tiga Sistem Resirkulasi yang Berbeda Current Trends in Aquatic Science. 4(2): 122-127.
[22] Mulqan M, Sayyid A E R dan Irma D 2017 Pertumbuhan dan Kelangsungan Hidup Benih Ikan Nila Gesit (*Oreochromis niloticus*) Pada Sistem Akuaponik Dengan Jenis Tanaman Yang Berbeda. Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah 2(1): 183-193.
[23] Selfiana 2020 Pengaruh Pertumbuhan Benih Ikan Mas (*Cyprinus carpio*) Dengan Pemberian Pakan Kombinasi Pellet Dan Lemna (*Lemna perpusilla*) di Balai Benih Ikan Kabupaten Langkat Kecamatan Bahorok Skripsi Program Studi Biologi Fakultas Sains dan Teknologi Universitas Islam Negeri Sumatera Utara. Medan 69 hal.
[24] Baglodi V, E G Jayaraj, M Nesara and P B Abhiman 2015 Effect Of Dietary Incorporated Aflatoxin (Afb1) On The Survival and Growth Performance of *Labeo rohita* Journal Zoologi India 18(2): 603-607.
[25] Mutia, Hanisah dan Muhammad F I 2020. Pengaruh Perbedaan Padat Tebar Terhadap Pertumbuhan dan Kelulushidupan Ikan Koi (*Cyprinus carpio*) Jurnal Ilmiah Samudra Akuatika 4(2): 50-57.
[26] Li L, Shen, Y, Yang W, Xu X and Li J 2021 Effect of Different Stocking Densities on Fish Growth Performance A Meta-analysis Aquaculture Journal 544: 1-8.
[27] Putri S A 2014 Pemanfaatan Bakteri Heterotrof Terhadap Sr (*Survival Rate*) dan Laju Pertumbuhan Ikan Lele Dumbo (*Clarias* sp.) Dengan Sistem Tanpa Pergantian Air Skripsi Fakultas Perikanan Dan Kelautan Universitas Airlangga 68 hal.
[28] Riar G S and Nur A R 2021 Effect of Stocking Density on Growth Performance and the Survival of Golden Mahseer, *Tor putitora* (Hamilton) Fry Journal of Fisheries and Livestock Production 9(9): 1-4.
[29] Setijaningsih L dan D Puspaningsih 2022 The Impact of Aeration Rate on Mahseer *Tor Soro* Seed Culture Biological Performance and Blood Profile IOP Conf Series Earth and Environmental Science 1-4.
[30] Fadir R M, Teuku Fadlon H, Suri P F, Tri H P dan Wahyulia C 2022. Dinamika Kualitas Air Pada Pemeliharaan Ikan Jurung (*Tor soro*) yang Dipelihara Pada Berbagai Sistem Resirkulasi Acta Aquatica Aquatic Sciences Journal 9 (2): 103-110.
[31] Subagja J, Otong Z A, Kurniawan dan Vitas A P 2021 Performa Pertumbuhan Benih Ikan Semah (*Tor douronensis*) Generasi Pertama Dengan Padat Tebar Berbeda di Karamba Jaring Apung Jurnal Media Akuakultur 16(1): 7-12.
[32] Duangjai E and Jittra P 2018. Growth Performance of Mahseer Fish (*Tor tambroides*) in Different Types of Cultured Environments Eau Heritage Journal Science and Technology 12(3): 225-235.
[33] Prihadi T H, Teuku Fadlon H, Brata P, Yohanna R W, Otong Z A, Wahyulia, C, Irin I K, Deni R, Kurniawan K, Jojo S, Adang S, Vitas A P and Idil A 2022 Determining Oxygen Consumption of Indonesian Mahseer (*Tor soro*) Fingerlings at Different Size and Stocking Density Journal of Hunan University (Natural Sciences) 49(3): 60-67.

[34] Pasaribu S 2011. Kepadatan Ikan Jurung (*Tor* sp.) Serta Keterkaitan Dengan Kualitas Perairan di Sungai Raniate Kabupaten Tapanuli Selatan Thesis Sekolah Pascasarjana Universitas Sumatera Utara 75 hal.
[35] Supriatna, Mohammad M, Muhammad, M dan Kusriani 2020 Hubungan pH Dengan Parameter Kualitas Air Pada Tambak Intensif Udang Vannamei (*Litopenaeus vannamei*) Journal of Fisheries and Marine Research 4(3): 368-374.

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