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HIGH INFLUENCE OF WATER AND ENVIRONMENTAL QUALITY ON RESPONSE, BEHAVIOUR AND GROWTH BATAK FISH FRY (*Neolissochilus thienemanni*)

Pengaruh Tinggi Air dan Kualitas Lingkungan Terhadap Respon, Tingkah Laku dan Pertumbuhan Benih Ikan Batak (*Neolissochilus thienemanni*)

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ABSTRACT

Batak fish (*Neolissochilus thienemanni*) is an endemic species that has important ecological, economic, and cultural values for the local people of North Sumatra. However, the population of this fish has experienced a drastic decline due to environmental factors such as water quality, climate change, and pressure from human activities, such as overfishing and water pollution. One of the important aspects in Batak fish cultivation is environmental conditions, especially water height or water depth factors. Water height plays a big role in determining the quality of fish habitats, including water temperature, dissolved oxygen levels. The purpose of this study is to determine the effect of water height variations on the response, behavior and growth of Batak fish in the aquaculture environment. The study was conducted with an experimental design using a Complete Random Design (CRD) consisting of three water height treatments: 15 cm, 20 cm, and 25 cm. Observations were made every 10 days to measure the weight, length of fish, and water quality. The results showed that the water height had a significant influence on the growth of the weight and length of Batak fish. Treatment with a water height of 25 cm indicates optimal growth, while treatment with a water height of 15 cm and 20 cm indicates lower growth. The results of the study obtained where the P3 treatment (25 cm) provided the average value of the growth rate of both weight and absolute length of the highest per treatment. In other words, the average P3 is different from P1 and P2. The water level of different cultivation media affects the total water volume and movement space for Batak fish in the same cultivation container on the aquatic environmental conditions and behavior of Batak fish.

Keywords: Batak Fish, Behavior, Growth, Response, Water Height

ABSTRAK

Ikan Batak (*Neolissochilus thienemanni*) merupakan spesies endemik yang memiliki nilai ekologis, ekonomi, dan budaya yang penting bagi masyarakat lokal Sumatera Utara. Akan

tetapi populasi ikan ini mengalami penurunan drastis akibat faktor lingkungan seperti kualitas air, perubahan iklim, serta tekanan dari kegiatan manusia, seperti overfishing dan pencemaran air. Salah satu aspek penting dalam budidaya ikan Batak adalah kondisi lingkungan, terutama faktor tinggi air atau kedalaman air. Tinggi air berperan besar dalam menentukan kualitas habitat ikan, termasuk suhu air, kadar oksigen terlarut. Tujuan penelitian ini untuk mengetahui pengaruh variasi tinggi air terhadap respon, tingkah laku dan pertumbuhan ikan Batak dalam lingkungan budidaya. Penelitian dilakukan dengan desain eksperimen menggunakan Rancangan Acak Lengkap (RAL) yang terdiri dari tiga perlakuan tinggi air: 15 cm, 20 cm, dan 25 cm. Pengamatan dilakukan setiap 10 hari untuk mengukur bobot, panjang ikan, dan kualitas air. Hasil penelitian menunjukkan bahwa tinggi air memiliki pengaruh signifikan terhadap pertumbuhan bobot dan panjang ikan Batak. Perlakuan dengan tinggi air 25 cm menunjukkan pertumbuhan yang optimal, sedangkan perlakuan dengan tinggi air 15 cm dan 20 cm menunjukkan pertumbuhan yang lebih rendah. Hasil penelitian yang diperoleh dimana Perlakuan P3 (25 cm) memberikan nilai rata-rata laju pertumbuhan baik bobot maupun panjang mutlak tertinggi pertiap perlakuan. Dengan kata lain rata-rata P3 berbeda dari P1 dan P2. Tingkat ketinggian air media budidaya yang berbeda mempengaruhi total volume air dan ruang gerak bagi ikan Batak dalam wadah budidaya yang sama terhadap kondisi lingkungan perairan dan perilaku ikan Batak.

Kata Kunci: Ikan Batak, Tingkah Laku, Pertumbuhan, Respon, Tinggi Air

INTRODUCTION

Batak fish (*Neolissochilus thienemanni*), is one of the endemic freshwater fish species in the waters of Sumatra, especially in the Lake Toba area and its surroundings. This fish has important ecological, economic, and cultural value for the local community. In addition to being a significant source of protein, Batak fish are also often associated with the cultural rituals of the Batak people, making them an inseparable part of social life and local wisdom (Rumondang & Fuah, 2023).

However, in recent decades, the Batak fish population has declined drastically. Various environmental factors such as water quality degradation, climate change, and pressure from human activities, such as overfishing and water pollution, are the main causes of this phenomenon (Rumondang & Fuah, 2023). In an effort to maintain the Batak fish population, cultivating this fish is one of the solutions that is relied on to ensure the survival of this species to meet the economic needs of the surrounding community.

One important aspect in Batak fish cultivation is environmental conditions, especially the water level or pond depth factor. Water depth plays a major role in determining the quality of fish habitat, including water temperature, dissolved oxygen levels, and the distribution of nutrients needed by these fish. Therefore, knowing the effect of water height on the growth and survival of Batak fish is very important, especially in efforts to increase the effectiveness of Batak fish cultivation (Rumondang et al., 2023).

Water depth or height is one important aspect that has rarely been studied in depth regarding Batak fish cultivation. Inappropriate water height can cause stress to fish, slow growth rates, and increase mortality rates. Conversely, proper water level regulation can increase growth efficiency and extend the life span of Batak fish in aquaculture environments (Nursihan et al., 2020).

The purpose of this study was to determine the effect of variations in water height on the physiological conditions of fish and the growth of Batak fish seeds in aquaculture environments. By knowing the most optimal water height for Batak fish growth, it is hoped that this study can provide an important contribution to the development of more effective and sustainable Batak fish cultivation. Proper management will support optimal growth and

reduce stress, increasing productivity and success of Batak fish cultivation (Fitriyah, 2023).

METHODS

Time and Place

This activity was carried out for a period of 80 days, starting from April to July 2024. This time span was chosen to observe the growth of Batak fish in stable conditions and long enough to obtain representative data related to the effect of water level on the response, behavior, and growth of Batak fish seeds. Periodic observations will be carried out every 10 days to monitor changes in physical and chemical parameters of the water and fish conditions. This research was conducted in Jampalan Lapangan Village, Mela II Village. Tapian Nauli District, Central Tapanuli Regency for 80 days. The selection of the location was based on several considerations including the availability of adequate cultivation facilities, accessibility and support from experts, as well as ease of sampling and monitoring during the study.

Tools and Materials

The tools used are 1 m x 2 m x 40 cm fiber container, circulation pump, aerator, digital scale, ruler, scoop, thermometer, DO meter and pH meter. While the materials used are Batak fish seeds, feed and water.

Research Methods

This study used a Completely Randomized Design (CRD) with three treatments of water height variations and three replications per treatment. Each treatment pond will be filled with the same number of fish, and each treatment is given uniform feeding conditions and pond management, except for water height variations. Treatments P1 (15 cm), P2 (20 cm), P3 (25 cm) refer to Haris et al. (2020).

Research Stages

The research stages include:

1. Preparation of ponds and equipment
   -The ponds used for the research are prepared and cleaned before being filled with water.
   -Water level measurements are carried out using a water level measuring device to ensure that the water level in each pond is in accordance with the predetermined treatment.
   -Aerators are installed in each pond to maintain air circulation and oxygen levels in the water.
2. Procurement of Batak fish seeds
   -Batak fish seeds measuring 6-7 cm in length and weighing 2-3 grams are obtained from P2MKP AMPHIBI Padang Lancat Sisoma Village.
   -Batak fish seeds will be placed randomly in each treatment pond with a density of 20 fish/pond.
3. Adaptation of Batak fish
   -Adaptation is a biological, physical, or behavioral process that allows living things to adapt to their environment to increase their chances of survival. For the adaptation of test fish, it is carried out 10 days after transportation.
   -The purpose of this adaptation is to adapt the test fish to their new environment, increase their chances of survival, and reduce environmental stress.
4. Feeding
   -The feed given is MS Prima Feed pellets (PF 1000) with a protein content of 39%, by adsorption
   -The frequency of feeding is 3 times a day with a dose according to the needs of the fish.

5. Parameter observation

-Observation of the response, behavior, and growth of fish is carried out every 10 days by measuring the length and weight of the fish.

-To carry out the measurement, the fish are taken using a net and weighed using a digital scale.

-Measurement of water quality parameters such as temperature, pH, and dissolved oxygen is also carried out periodically to ensure that environmental conditions continue to support fish growth.

Research Parameters

The parameters measured are:

1. Response and behavior

Observations made include:

a. Fish swimming patterns
b. Fish position
c. Response to current
d. Fish response when fed
e. Fish response when schooling

2. Growth

a. Absolute weight

The growth of absolute weight can be calculated using the Effendie formula (1985):

$$\mathbf{Wm = Wt - Wo}$$

Description:

Wm: Absolute Weight Growth (gr)
Wt : Final Weight (gr)
Wo : Initial Weight (gr)

b. Absolute length

Absolute length growth can be calculated using the Effendie formula (1985) as follows:

$$\mathbf{Lm= Lt - Lo}$$

Description:

Lm : Absolute length growth (cm)
Lt : Final length (cm)
Lo : Initial length (cm)

3. Water Quality

The water quality parameters observed in this study include temperature, dissolved oxygen, and pH. Water quality measurements were carried out every 10 days in the morning, afternoon and evening.

Data Analysis

To determine whether there is a significant difference in fish growth (both weight and length) between treatments, a one-way ANOVA test was conducted. If there is a significant difference, a further test (post-hoc) will be conducted. Meanwhile, water quality data is displayed in tabular form and analyzed descriptively.

RESULT

1. Response and Behavior

From the results of the research conducted, the responses and behavior of Batak fish were obtained in Table 1 below:

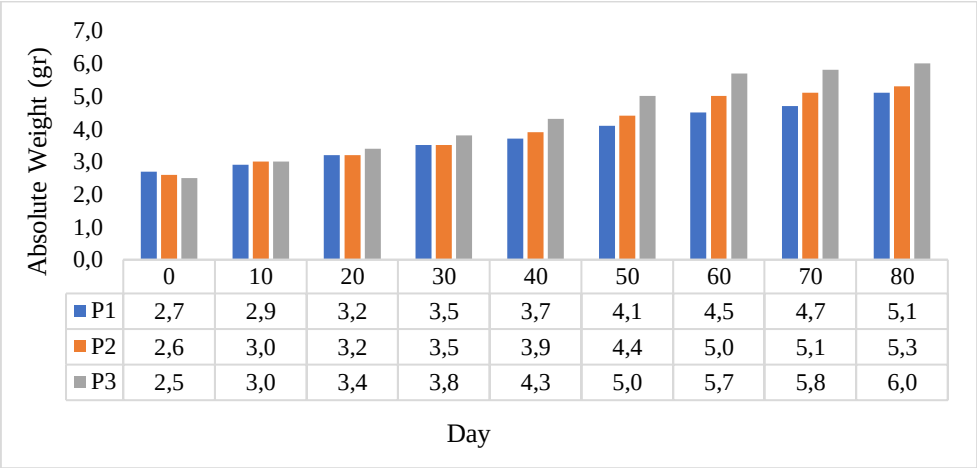
Table 1. Results of the Responses and Behavior of Batak Fish (*Neolissochilus thienemanni*)

No.	Observed Parameters	Treatment		
		P1 (15 cm)	P2 (20 cm)	P3 (25 cm)
1.	Fish swimming patterns	Fish start to actively swim or occasionally remain still	Fish start to actively swim or occasionally remain still	Fish actively swim and never stay still
2.	Fish position	Fish are on the surface of the water	Fish are occasionally on the surface of the water	Fish are at the bottom of the waters
3.	Response to current	Fish approaching the current	Fish approaching the current	Fish approaching the current
4.	Fish response when fed	Fish eat occasionally and the food given is not finished	Fish eat occasionally and the food given is left over	Fish are actively eating and the food is completely eaten
5.	Fish response when schooling	Fish are actively in schools	Fish are actively in schools	Fish are actively in schools

2. Growth

a. Absolute weight

The results of the calculation of the absolute weight of Batak fish can be seen as follows:



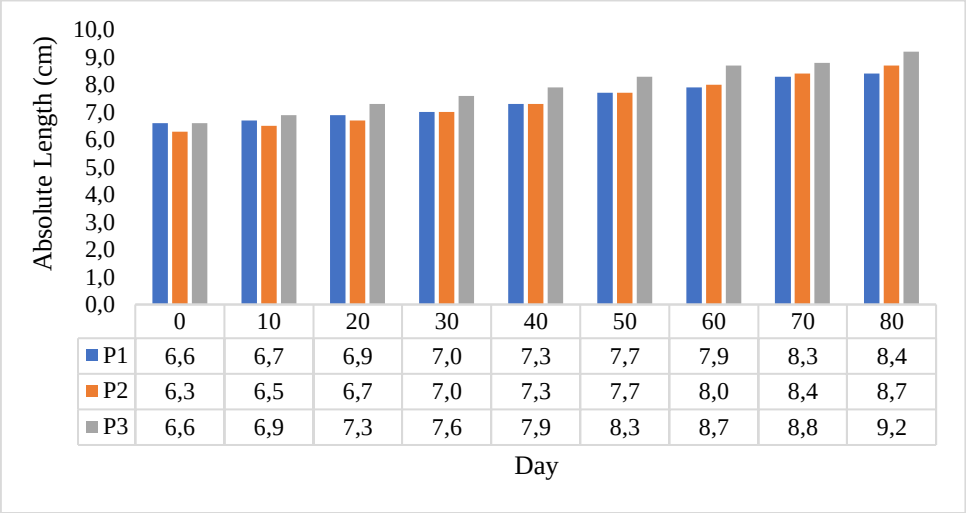
	0	10	20	30	40	50	60	70	80
P1	2,7	2,9	3,2	3,5	3,7	4,1	4,5	4,7	5,1
P2	2,6	3,0	3,2	3,5	3,9	4,4	5,0	5,1	5,3
P3	2,5	3,0	3,4	3,8	4,3	5,0	5,7	5,8	6,0

Figure 1. Graph of the Average Absolute Weight Growth of Batak Fish (*Neolissochilus thienemanni*)

Treatment P3 (25 cm) gave the highest average absolute weight growth rate for each treatment. In other words, the average absolute weight growth of Batak fish P3 was different from P1 and P2.

b. Absolute length

The results of the calculation of the absolute length of Batak fish can be seen as follows:



	0	10	20	30	40	50	60	70	80
P1	6,6	6,7	6,9	7,0	7,3	7,7	7,9	8,3	8,4
P2	6,3	6,5	6,7	7,0	7,3	7,7	8,0	8,4	8,7
P3	6,6	6,9	7,3	7,6	7,9	8,3	8,7	8,8	9,2

Figure 2. Graph of the Average Absolute Length Growth of Batak Fish (*Neolissochilus thienemanni*)

Treatment P3 (25 cm) gave the highest average absolute length growth rate value for each treatment. In other words, the average absolute length growth of Batak fish P3 was different from P1 and P2.

3. Water quality

Water quality data is presented in the following table:

Table 2. Water Quality Data of Batak Fish (*Neolissochilus thienemanni*) During the Study

Parameter	P1	P2	P3
Temperature (^{0} C)	28.3 – 28.7	28.5 – 28.7	28.4 – 28.5
pH	7.2 – 7.5	7.3 – 7.5	7.2 – 7.5
DO (mg/l)	4.2 – 6.5	4.2 – 6.5	4.3 – 6.5

DISCUSSION

1. Fish Response and Behavior

During the study, fish behavior was observed as an indicator of fish health and activity in the pond environment. Fish behavior can provide important clues regarding responses to the physical environment, including water quality and water level. Several aspects of Batak fish behavior observed during the study:

a. Fish swimming patterns

Fish swimming patterns can be used as a direct indicator to determine environmental conditions. Healthy and non-stressed fish tend to swim in a stable and directed pattern. Meanwhile, fish that are stressed or affected by poor water quality show zigzag swimming or tend to swim in one place without a clear direction (Yanuhar & Caesar, 2021).

b. Fish position

Water level and environmental quality can affect the vertical position of fish in the pond, where fish will look for the most comfortable zone. Fish that are often on the surface indicate that the fish are looking for oxygen because the dissolved oxygen levels in the water column are lower. Meanwhile, fish that tend to gather at the bottom indicate that the fish feel safer or more comfortable in a quieter area and are less exposed to direct light (Tamimi et al., 2023).

c. Response to current

Water current can be a stress factor for fish if it is too strong, but healthy fish are able to adjust to normal currents. Healthy and active fish are able to swim against the current, which indicates good physical condition. Meanwhile, fish that often let themselves be carried away by the current are marked by physical weakness or environmental stress (Arif Mustofa, 2020).

d. Fish response when fed

Feeding can be used as a direct indicator of fish health and shows whether the environment supports optimal growth in fish. Fish that move quickly and actively search for food indicate optimal conditions. Meanwhile, fish that are slow or reluctant to respond to food usually indicate health problems or less supportive environmental conditions (Kallau, 2018).

e. Fish response when schooling

Schooling behavior can provide an overview of the comfort of fish in their environment, as well as their physical health. Healthy fish usually school well, showing strong coordination in moving together. Meanwhile, fish that swim alone or are uncoordinated in groups, which indicates that the fish are stressed or in an uncomfortable condition (Zainuri, 2019).

The water level of the cultivation medium affects the total volume of water and movement space for Batak fish in a cultivation container of the same size. This causes competition in competing for movement space, oxygen and food. The water quality in the fish maintenance container must be maintained in good condition. One way to maintain good water conditions is to increase the water level in the maintenance container.

According to Yuliansyah et al. (2021), the low amount of oxygen in the water causes fish to have to work hard to pump large amounts of water into the respiratory tract to take oxygen. The adaptation of fish that is often done is seen by swimming to the surface to take oxygen. Lack of oxygen in the water causes fish activity to decrease, appetite to decrease, immunity to decrease and susceptibility to diseases that cause death in fish.

The availability of dissolved oxygen in water is very important for fish life. Dissolved oxygen in water is obtained through diffusion from air into water. Meanwhile, dissolved oxygen in water can decrease due to respiration and decay of organic matter at the bottom of the water (Yuliansyah et al., 2021).

Hypoxia is a phenomenon that occurs in the aquatic environment due to a decrease in dissolved oxygen concentration to a level that can be detrimental to the lives of aquatic organisms living in it.

2. Growth

Growth is an increase in the size or number of cells in an organism as measured by parameters such as weight and length. One of the factors that affects fish growth is the environment (water quality and water level). Water level in the cultivation system has a significant effect on the weight and length growth of Batak fish (*Tor soro*). Variations in water level can affect several environmental factors, such as oxygen distribution, temperature, and fish movement space, which ultimately affect the growth rate of fish.

a. Weight

Weight growth is the increase in body mass of fish, which occurs through the addition of muscle tissue, fat, and other organs during the study (Febri et al., 2020). Weight growth is the result of the conversion of consumed feed into energy and body tissue. Fish weight growth is measured by weighing the fish periodically using an accurate digital scale. Batak fish weight measurements were carried out every 10 days during the study period. Weight gain reflects the efficiency of fish in converting feed into body tissue (feed efficiency). One of the factors that affects fish weight growth is water level. Variations in water level can affect oxygen distribution and fish movement space, which contributes to weight gain.

The level of competition that occurs in space competition, oxygen competition and food competition is quite high, causing various negative impacts on the Batak fish population. Fish that lack space will experience increased stress, which can reduce immunity so that it can inhibit optimal growth because the fish cannot swim freely. Lack of oxygen can also inhibit fish metabolism, which has an impact on growth. If oxygen levels are very low, mass mortality will occur. On the other hand, more dominant fish get more food, while smaller or weaker ones are left behind. Fish that lose in food competition can experience malnutrition, which affects health. So that high food competition can cause fish stress, so that feed efficiency decreases.

b. Length

Length growth is an increase in the linear dimensions of fish, such as body length from head to tail. Length growth is often influenced by nutritional quality, environmental conditions, and fish genetics. Fish length growth is measured using a ruler, measured from the tip of the mouth to the base of the tail. Similar to weight measurement, fish length is measured periodically every 10 days. One factor that affects fish length growth is environmental quality. Temperatures that are too high or too low and poor water quality can cause fish to focus more on survival than growth.

According to Yuliansya et al. (2021). When fish are kept in narrow containers, various challenges arise due to limited space. Activities such as free swimming and natural interactions will be disrupted, which has a negative impact on the calmness of the fish. In extreme conditions, larger or dominant fish can disturb or prey on smaller fish in response to high competition and stress.

3. Water Quality

Nurhaliza (2019), stated that the temperature of a body of water greatly affects the existence of fish. Water temperatures that are too high or too low can cause fish to not be able to grow and develop properly. Temperatures that are too high can cause fish metabolism to increase excessively, resulting in increased oxygen requirements. This can cause stress, reduce appetite, reduce feed efficiency, and even increase susceptibility to disease. At very high temperatures, fish can die. Optimal temperature can cause fish metabolism to run optimally. Fish will be more active, have a good appetite, and grow well. Optimal temperature supports efficient conversion of feed into body weight. While low temperatures can slow down fish metabolism, reduce activity and appetite (Adi et al., 2024). Fish growth will slow down because more energy is used for survival than for growth. Very low temperatures can cause fish to experience stress and even death (Saputri & Mulyana, 2021).

According to Siburian et al. (2017), DO is the amount of oxygen dissolved in water, which is available for use by aquatic life such as fish, shrimp, plankton, and microorganisms. DO is one of the main indicators of water quality, because oxygen is needed for the respiration process and various biochemical reactions in aquatic ecosystems. Oxygen levels that are too high usually do not occur naturally, but in this condition, it can cause oxygen supersaturation, which can cause gas embolism in fish tissue (Maulianawati & Lembang, 2022). This is rare, but if it does, it can cause fish death. At optimal oxygen levels, fish respiration occurs normally, supporting efficient metabolism. Fish are active, grow well, have a high appetite, and show normal swimming patterns. Meanwhile, low oxygen levels cause fish to lack oxygen which causes fish to experience hypoxia (lack of oxygen). Fish will swim closer to the surface of the water to try to get more oxygen, appetite decreases, growth slows, and fish become lethargic. If oxygen levels drop below 3 mg/L, the risk of death increases significantly because fish cannot breathe well enough to survive. Maintaining adequate DO levels is essential to prevent stress, promote growth, and ensure the health of fish and other organisms in culture. The use of aeration devices and regular monitoring of water quality are important steps in healthy water management.

According to Siburian et al. (2017), pH is a measure used to indicate the level of acidity or alkalinity of a solution. pH is measured on a scale of 0 to 14, where pH 7 is neutral, pH <7 is acidic and pH> 7 is alkaline. Extreme pH (too acidic or too alkaline) can damage cells and biochemical processes in fish organisms. Barus (2004), said that water pH also affects fish life, the ideal water pH for fish life ranges from 6.5 - 7.5. Water pH less than 6 or more than 8.5 needs to be watched out for because there may be pollution, this can also cause metabolic and respiratory disorders in fish. Water with a pH that is too high (alkaline) can irritate fish gills and disrupt physiological balance. Fish can have difficulty in the respiration process, cause stress, and increase susceptibility to infection. At very high pH, fish death can occur due to alkalosis. pH in the optimal range supports normal physiological functions in Batak fish. The metabolic process runs efficiently, and fish can grow well without experiencing disruption to the respiratory and osmoregulatory systems. Meanwhile, pH that is too low (acidic) can cause damage to the gills, increase heavy metal toxicity, and interfere with the ability of fish to regulate ion balance in the body. This causes stress, reduces immunity, and can trigger death if it continues (Rasyid & Rustan, 2023).

CONCLUSION

Based on the results of research on the effect of water level on the response, behavior and growth of Batak fish (*Neolissochilus thienemanni*), where the ideal water level and good environmental quality greatly affect the response and behavior of Batak fish. Optimal water level provides enough space for fish to swim freely, behave in groups, and respond well to currents. Optimal environmental quality, including adequate dissolved oxygen, stable pH supports healthy and active fish behavior, and increases growth. Optimal water level helps fish get good oxygen distribution, maintains a stable temperature, reduces stress, and supports swimming and foraging activities. Conversely, water levels that are too low or too high can cause various environmental problems that inhibit growth.

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