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LENGTH-WEIGHT RELATIONSHIP, GROWTH PATTERN AND CONDITION OF MIDAS CICHLID FISH (AMPHILOPHUS CITRINELLUS) IN LAKE BATUR, BANGLI REGENCY, BALI

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ABSTRACT

Midas cichlid fish (Amphilophus citrinellus) is often referred to as a pest fish because it is a fish that can only prey but does not produce sufficient economic value, because it reproduces very quickly. This research aims to determine the length-weight relationship, growth patterns and condition of Midas cichlid fish as well as the water conditions of Lake Batur. The research was carried out using quantitative descriptive methods, with a purposive sampling method for sampling. The sampling locations were at three stations. The fishing gear used is gill nets. The total number of fish caught during data collection was 287 individuals. Based on the results of the analysis of the length-weight relationship of midas cichlid fish (Amphilophus citrinellus) in Lake Batur, the equation W=0.0215L2.92 was obtained, where from this equation the value b = 2.92 was obtained. The t test was carried out and it was found that the b value was <3 so it could be concluded that the growth pattern was negative allometric. The relative condition (Kn) of male and female Midas cichlid fish in Lake Batur is in good condition (1.01), with a less flattened body shape (fusiform). The condition of the water parameters in Lake Batur during the research was classified as good and stable for the survival of aquatic biota, one of which was the Midas cichlid fish with a pH value of 7.1-7.5; DO 5.3-6.5 mg/L; Temperature 27.8-29.6°C and brightness 1.5-1.9 m.

Keywords: Lake Batur, Midas cichlid, water parameters, growth

INTRODUCTION

Lake Batur is the largest lake on the island of Bali, located in Kintamani District, Bangli Regency. Lake Batur has been designated as one of the 15 national priority lakes, in the Bali agreement on sustainable lake processing at the 2009 First Indonesian Lakes National Conference (Suwanto et al., 2011). Lakes in this

regulation are directed as an effort to save aquatic ecosystems, border ecosystems and water catchment area ecosystems (PERPRES, 2021).

Fish introduction activities through stocking are often carried out on Lake Batur, in general these activities aim to increase fisheries activities around Lake Batur. As a result of errors and lack of selective fish introduction activities in Lake Batur, the emergence of Midas cichlid fish (Amphilophus citrinellus) which dominates the waters of Lake Batur (Sentosa and Wijaya., 2012).

Midas cichlid fish originate from Central America, specifically Nicaragua and Costa Rica. Midas cichlid fish are often referred to as pest fish because they are fish that can only prey but do not produce sufficient economic value, and they reproduce very quickly (Fatma, 2017). The rapid growth of the midas cichlid population and its underutilization by local communities is predicted to make it a pest that can damage the Lake Batur ecosystem (Parawangsa and Tampubolon., 2022).

Based on this, it is necessary to make efforts to minimize the dominance of midas cichlid fish in the Lake Batur area. One of the efforts that can be made is to carry out basic research on growth aspects, namely the length-weight relationship, growth patterns and condition factors. It is hoped that the results of research conducted in Lake Batur regarding several aspects of growth will be able to provide basic information to reduce the population of midas cichlid fish and support saving the aquatic ecosystem of Lake Batur.

RESEARCH METHODS

This research was conducted using quantitative descriptive methods. Midas cichlid fish sampling determined with using the purposive sampling method at Lake Batur. Purposive sampling is a technique for determining research stations with certain considerations with the aim of making the data obtained more representative (Sugiyono, 2018).

Material

The ingredients used are midas cichlid fish (Amphilophus citrinellus), 95% alcohol and distilled water.

Tool

The tools used are gillnets, GPS, callipers, cool boxes, worksheets, stationery, pH meters, plastic bottles, trays, bottles, gloves, cameras, digital scales, secchidisks, DO meters and water thermometers.

Data analysis

a. Length-Weight (HPB) Relationship and Growth Patterns

The length-weight relationship (HPB) of fish is calculated using the equation according to Effendie (2002), which is as follows:

$$W = aL^b$$

Information:
W = fish body weight (g),
L = total length of fish (cm),
a and b = constant

The equation is then transformed into logarithmic form as a linear equation:

Log W = Log a + b Log L Testing of the b value is carried out with the t test, with the hypothesis:

1. H0: b = 3, indicating an increase in weight
   The fish is balanced by increasing in length so it is included in the isometric growth pattern.
2. H1: b ≠ 3, indicating an allometric growth pattern. If b < 3, then the increase in length is faster than the increase in weight (negative allometric). If b > 3, then the weight increase is faster compared increaselength (positive allometric).

b. Relative Condition Factor (Kn)

Relative Condition Factor (Kn) according to Rahardjo and Simanjuntak (2008), is calculated using the equation:

$$Kn = \frac{W}{W^*}$$

Information:
Kn = Relative condition factor of the fish W = Weight of the fish (g)
W* = Weight fish results estimation (Length-Weight Relationship)

RESULTS AND DISCUSSION

There were 287 Midas cichlid fish (Amphilophus citrinellus) caught during three months in Lake Batur, with 192 males and 95 females.

Length-Weight (HPB) Relationship and Growth Patterns

The results of the analysis of the combined length-weight relationship between male and female midas cichlid fish (Amphilophus citrinellus) for three consecutive months in Lake Batur, obtained the equations W=0.0215L2.92, $W=0.0212L^{2.92}$ and
$W=0.0243L^{2.89}$, with b values respectively 2.92; 2.92 and 2.89.

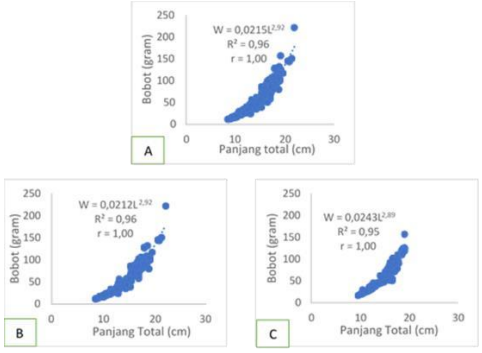

Figure 1. Combined Length-Weight Relationship of Midas Cichlid Fish (Amphilophus citrinellus), n=287 (A); Males, n=192 (B); Females, n=95 (C) in Lake Batur, January-March 2024.

The length and body weight of the fish will influence variations in the b value obtained (Romdoni et al, 2023). The b value of the combined midas cichlid (Amphilophus citrinellus) and the male in Lake Batur is 2.92, while the female is smaller, namely 2.89 (Figure 1). Based on this b value, it can be stated that the midas cichlid that inhabits Lake Batur has normal growth .

Variations in the b value parameter in the growth pattern of midas cichlid fish (Amphilophus citrinellus) are influenced by biological and physiological factors. Biological factors such as differences in age, gonad maturity, food availability, fishing activity, and parasite pressure have a significant influence (Pachla et al., 2020; Yonvitner et al., 2020). Meanwhile, physiological factors such as sex, pH, temperature, geographical location and habitat conditions also influence the b value in fish growth patterns (Muchlisin et al., 2012).

The t test is carried out on the b value, so that the growth pattern can be determined. The growth pattern of midas cichlids in Lake Batur is negative allometric (combined) and isometric (male and female). Negative allometric growth pattern, namely the increase in total length is faster than the increase in weight. The isometric growth pattern means that there is a balance between increasing the length and weight of the fish (Effendi, 2002).

Relative Condition Factor (Kn)

The relative condition factor of midas cichlid fish (Amphilophus citrinellus) in Lake Batur was calculated every month during the three months of research. The relative condition factors for male and female Midas cichlid fish during the three consecutive months of research ranged from (0.63-1.41 and 0.68-1.34) with both averages being 1.01.

The relative condition factor of male midas cichlid fish (Amphilophus citrinellus) in January ranged from 0.78-1.35 with a mean of 1.00, then in February it had a value range of 0.63-1.41 with a mean of 1.01 and in In March, male Midas cichlid fish had a relative condition factor value range of 0.69-1.33 with an average of 1.01. This shows that the condition of male midas cichlids (Amphilophus citrinellus) in Lake Batur has improved in February and March.

Female midas cichlids (Amphilophus citrinellus) in January had a relative condition factor value range of 0.88-1.16 with an average of 1.00. In February, female Midas cichlid fish had a relative condition factor value range of 0.83-1.24 with an average of 1.00. The relative condition factor value of female midas cichlids in March ranged from 0.68 to 1.34 with a mean of 1.01. This shows that the condition of female midas cichlid fish in Lake Batur has improved in March.

Table 1. Range and Mean Values of Relative Condition Factors for Midas Cichlid Fish (Amphilophus citrinellus) in Lake Batur for the period January-March 2024.

No	Month	Amount	Male		Amount	Female	
			Range	Average		Range	Average

1	January	52	0.78-1.35	1.00	22	0.88-1.16	1.00
2	February	94	0.63-1.41	1.01	49	0.83-1.24	1.00
3	March	46	0.69-1.33	1.01	24	0.68-1.34	1.01
	Total	192	0.63-1.41	1.01	95	0.68-1.34	1.01

The value of the relative condition factor can determine the suitability or suitability of the fish to its environment. The higher the value of the relative condition factor, the more suitable the fish is to that environment (Effendi, 2002). According to Ujjania et al (2012), if the relative condition factor value of the fish is greater than or equal to 1, it indicates that the condition of the fish is in good condition. This situation illustrates the existence of environmental balance and the availability of food sources (Ujjania et al., 2012). The relative condition factor value for fish can vary because it is influenced by a number of factors, including body size, age, sex, gonad maturity, behavior before and after spawning, the number of fish in the water, and water parameters such as temperature, pH and salinity. , as well as overall environmental conditions (Froese and Torres, 2006).

The characteristics of the fish's body, such as being flat (compressed) or less flat (fusiform), also influence the value of the condition factor, where fish with a compressed body have a value ranging between 3-4, while fish with a fusiform body have a value ranging between 1-3 (Effendie , 2002). Midas cichlid (Amphilophus citrinellus) in the waters of Lake Batur, with a less flat (fusiform) body shape, is included in the good condition category. Fish with a fusiform body have maximum body depth in the anterior part, and according to Lerman (1986), fish with a fusiform body shape tend to be able to move quickly, catch prey and avoid threats in the water. This indicates that the fusiform body shape facilitates the movement of midas cichlid fish (Amphilophus citrinellus) in the waters of Lake Batur.

Water Condition Parameters

The pH parameter in the waters of Lake Batur, especially the waters of Songan, Toya Bungkah and Kedisan, has a varying range of values. The range of pH values from the three locations respectively is 7.1-7.3; 7.2-7.5 and 7.3-7.5. Judging from the average value, the pH in the Songan waters area has the smallest value, namely 7.2, while the Toya Bungkah and Kedisan waters have the same value, namely 7.4. The results of the measurements carried out are compared with the quality standards of PP No. 22 of 2021 is still within the specified range.

The DO parameter in the Lake Batur waters, especially the Songan, Toya Bungkah and Kedisan waters, has a varying range of values. The range of DO values from the three locations respectively is 5.3-5.7 mg/L; 6.2-6.5 mg/L and 5.8-6.1 mg/L. Judging from the mean values, the values are 5.5 mg/L, 6.3 mg/L and 5.98 mg/L. The results of the measurements carried out are compared with the quality standards of PP No. 22 of 2021 is still within the specified range.

Temperature parameters in the Lake Batur water area, especially the Songan, Toya Bungkah and Kedisan waters, have a varying range of values. The range of temperature values from the three locations respectively is 27.8-28.5°C;

28.4-29.6°C and 28.8-29.5°C. Judging from the mean values, the values are 28.1°C, 28.85°C and 29.1°C. The results of the measurements carried out are compared with the quality standards of PP No. 22 of 2021 is still within the specified range. The range of brightness values from the three locations respectively is 2.4-2.6 m; 2.5-2.8 m and 2.5-2.7 m. Judging from the average values, the values are 2.5 m, 2.62 m and 2.55 m, respectively.

Table 2. Water quality in Lake Batur for the period January-March 2024.

No	Water Parameters	Mark	Station 1 (Songan)	Station 2 (Toya Mum)	Station 3 (Kedisan)	Quality Standards (PP Number 22 Year 2021)
1	pH	Range	7.1-7.3	7.2-7.5	7.3-7.5	6-9
		Average	7.2	7.4	7.4	
2	DO (mg/L)	Range	5.3-5.7	6.2-6.5	5.8-6.1	≥ 3
		Average	5.5	6.3	5.98	
3	Temperature (°C)	Range	27.8-28.5	28.4-29.6	28.8-29.5	26-30
		Average	28.1	28.85	29.1	
4	Brightness (m)	Range	2.4-2.6	2.5-2.8	2.5-2.7	2.5
		Average	2.5	2.62	2.55	

The pH parameters recorded in Lake Batur during the research were in accordance with quality standards (7.1-7.5). Similar study results were also found in previous research by Nirasari et al (2018), which recorded a range of pH values in Lake Batur between 7-8. This pH value range is considered good and stable for fish survival. Most aquatic biota are sensitive to changes in pH and tend to prefer a pH value of around 7-8.5 (Prakoso, 2014).

Dissolved oxygen (DO) in the waters of Lake Batur is in accordance with quality standards, namely ≥ 3 mg/L (5.3-6.5 mg/L). Fish generally require a minimum of 3 mg/L dissolved oxygen for growth and development, and growth will be more optimal if it is above 5 mg/L (Rahardjo et al., 2011).

The temperature parameters also show suitability in the waters of Lake Batur (27.8-29.6°C). The water temperature range that meets lake water quality standards is 26-32°C. Water brightness is important to determine the depth at which sunlight can still penetrate the water layers and is related to the photosynthesis process (Zulfia and Aisyah, 2013). The brightness range measured in Lake Batur is between 2.4-2.8 m. This finding shows that sunlight can still penetrate the waters of Lake Batur.

CONCLUSION

Based on the research that has been carried out, the conclusion that can be drawn is that the growth pattern of midas cichlids (Amphilophus citrinellus) in

Lake Batur is negative allometric (combined) and isometric (male and female). The condition factor for male and female midas cichlid fish (Amphilophus citrinellus) in Lake Batur is overall in good condition (1.01), with a less flat (fusiform) body shape. Water conditions in Lake Batur (pH, DO, temperature and brightness) during the research were classified as good and stable for the survival of midas cichlid fish in Lake Batur.

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