Growth Patterns and Reproduction of Hampala Barb (*Hampala macrolepidota*) Kuhl and Van Hasselt 1823 in Jatigede Reservoir, West Java Indonesia

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Abstract

The indigenous species of the Cimanuk River that can adapt to the stagnant waters of the Jatigede Reservoir is the hampala barb. This fish grows and breeds well; it has an ecological function as a predatory fish from the cyprinidae family. Its economic function is that it can be traded in the Jatigede Reservoir. However, its growth pattern, condition, and reproduction factors have yet to be widely known. The research was conducted for six months (September - December 2017 and January - February 2018). The research aimed to find the growth pattern, condition factors, and reproductive characteristics of the hampala barb. Field survey research method, composite fish sampling from five research stations, data calculated using fisheries biology methods. The results showed that the growth was negative allometric. b value of male fish was 2.429; female fish was 2.717; good condition factor K value of male fish was 1.17 to 1.47, and female fish was 1.16 to 1.38. Reproduction is a partially spawn.

Keywords: Condition factor, Female, Negative allometric, Partial spawn.

1. Introduction

Jatigede Reservoir is a dam project located in Cijeungjing Village, Jatigede Subdistrict, Sumedang Regency, West Java Province. The inundation of the dam was inaugurated on 31 August 2015, and the inauguration of irrigation operations was on 7 April 2017. The construction of the Jatigede Reservoir submerged five sub-districts in Sumedang Regency with a total area of 3,035.84 Ha, including Jatigede Sub-district consisting of 5 villages, namely Jemah, Ciranggem, Mekarasih, Sukakersa, and Cijeungjing Village cover an area of 760.55 Ha. Cisitu subdistrict consists of 4 villages, Pejagan, Ciguntung, Cisitu, and Sarimekar Villages, with an area of 48.65 Ha. Darmaraja Subdistrict consists of 12 villages: Cipaku, Pakualam, Karangpakuan, Jatibungur, Sukamenak, Leuwihideung, Cibogo, Sukaratu, Tarunajaya, Ranggon, Neglasari and Darmaraja Villages with an area of 1,575.67 Ha. Wado Subdistrict consists of 4 villages, namely Wado, Padajaya, Cisurat, and Sukapura Villages, with an area of 459.23 Ha. Jatinunggal District consists of 2 villages, namely Sirnasari and Pawira Village, with an area of 239.89 Ha (Center for Research on Natural Resources and Environment Unpad, 1992). The main purpose of building this reservoir is to control floods downstream of the Cimanuk River as a source of water for irrigation, which can irrigate 90,000 hectares of agricultural land during the dry season, to provide clean water for Cirebon, Indramayu, and surrounding areas, as a source of water for hydroelectric power plant with an installed capacity of 110 MW, tourism and fisheries activities (Cimanuk-Cisanggarung River Basin Center, 2010). Fish native to the Cimanuk River that can adapt and grow well in the Jatigede Reservoir are the hampala barb.

The hampala barb in the Jatigede Reservoir is an indigenous species of the Cimanuk River, this fish usually lives in swift water flow, but these fish can adapt well to environments with stagnant waters such as reservoirs (Herawati et al., 2017). This fish is a carnivorous fish from the family Cyprinidae, which has ecological and economic functions in the community around the Jatigede Reservoir. This fish is classified as a protected wild animal, with the conservation status of Least Concern (Ahmad, 2019), found in several rivers in West Java (Herawati et al., 2019b). In Jatigede Reservoir, hampala barb was a fiscivorous fish, its main feed was fish, with a preponderance index of 59%, but in the dry season, these fish could utilize plants as their food source (Herawati et al., 2019a).

2. Materials and Methods

Time and Places

The methodology used in fish sampling is survey, fish measurement is a fish biology method, and data analysis is based on quantitative. Fish were collected within 6 months (September - December 2017, January - February 2018), namely in the dry season, the transition from dry to rainy, and the rainy season (Herawati et al., 2019).

Methods

The hampala fish were sampled according to the guidelines for the use of living organisms. Fish in the Figure 1 were caught using monofilament gill nets measuring 80 m – 100 m long and 10 m wide, mesh size 3 – 5 inches, nets installed for 24 hours from 08.00 WIB to 08.00 WIB the next day.

Figure 1. Hampala barb

Fish sampling locations in Jatigede Reservoir are in five stations in the Figure 2. The fish caught are sent to the Water Resources Management Laboratory, The Faculty of Fisheries and Marine Science, Universitas Padjadjaran, to measure of fish length, weight, and reproductive system.

a. Station 1 at Wado, coordinate 6° 56'11" S and 108°5'30" W with inlet from DAS Cimanuk, Sub DAS Cialing and Sub DAS Cacaban.
b. Station 2 at Sukamenak, coordinate 6° 55'43" S and 108°5'27" W with inlet from DAS Cimanuk,
c. Station 3 at Cisitu, coordinat 6° 51'29" S and 108°5'27" W
d. Station 4 at Pasir Calung coordinat 6° 53'29" S and 108°5'38" W
e. Station 5 at Jatigede coordinat 6° 53'34" S and 108°6'56" W with inlet from Sub DAS Cinambo.
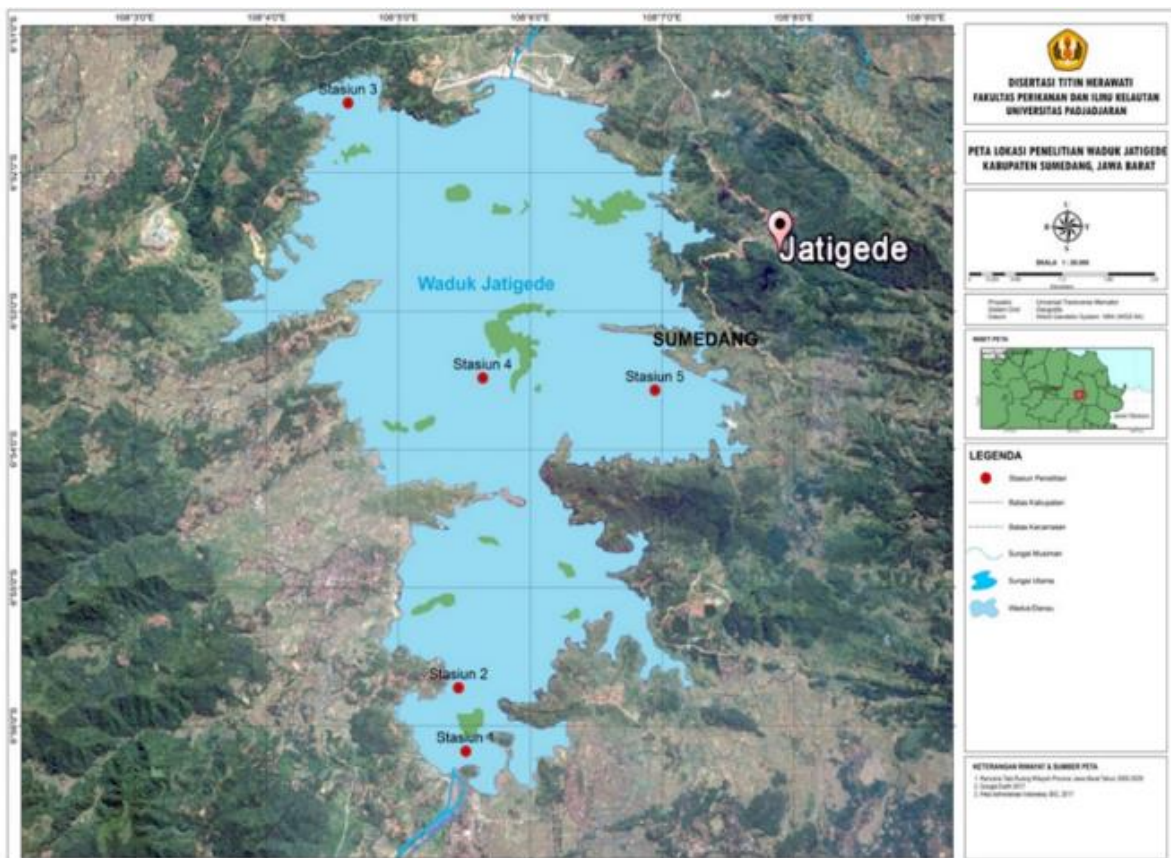
Figure 2. Map of hampala barb sampling stations

Data Analysis

Size Distribution

To find out the size distribution of the hampala fish, the fish size was grouped using a frequency distribution based on the sturges rule, in determining the number of classes with the following formula:

$$k = 1 + 3.3 \times \log (N) \qquad (1)$$

Explanation:
k = Number of classes
N   = Amount of data

Growth Pattern

The calculation of the growth pattern of fish is conducted by calculating the length and weight relationship which is described in the form of a equation as follows :

$$\text{Log } W = b \times \log L + \log a \qquad (2)$$

Explanation :
W   = Fish weight (g)
L   = Fish length (mm)
a,b = Constant

Testing the value of b with the decision-making criteria according to Ricker (1975), Effendi (1979), Herawati (2017).

If b = 3, Isometric growth pattern
If b ≠ 3, Allometric growth pattern.

The relationship between length and weight was analyzed using regression equations. To determine the effect of each variable by analyzing the coefficient of determination (R^2), and to determine the level of closeness of the relationship between variables by analyzing the correlation value (r).

Condition Factor

Calculation of condition factors or ponderal index using the metric system (K) which refers to calculations according to Effendi, (1979), Nasution et al. (2021):

$$FK = \frac{W}{\hat{W}} \qquad\qquad (3)$$

Explanation:
FK = Relative Condition factor
W   = Fish weight (g)
$\hat{W}$ = Expect weigth, estimated using lengt weight regression as following aL^b

3. Results and Discussion
Size Distribution

The hampala barb caught during the research has varied sizes. Based on the graphical analysis of the distribution of length and weight (Figures 3 and 4).
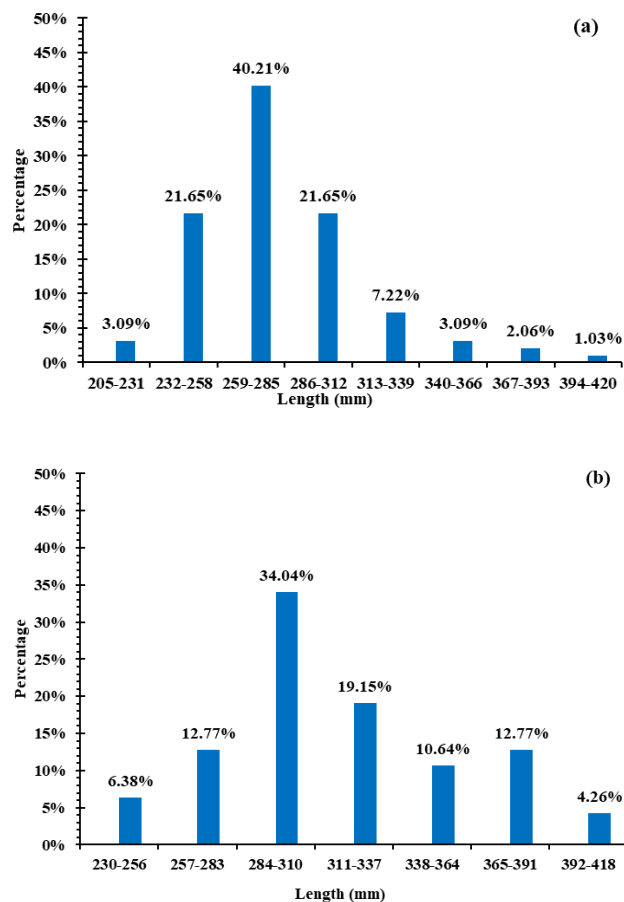

Figure 3. Length distribution (a) male and (b) female of catched hampala barb

The distribution of male hampala barb based on length consists of eight size classes. In comparison, the female hampala barb consists of seven size classes. The length of the male hampala barb ranges from 205 mm – 420 mm (Figure 3a), and the female hampala barb ranges from 230 mm – 397 mm (Figure 3b).

The smallest male hampala barb is 205 mm, and the female is 230 mm. The total length of hampala barb caught in the Jatigede reservoir is relatively longer than that of the Cirata reservoir fish. These results are different from the results of research by Sukimin (1990), which states that the length of the hampala barb at Cirata reservoir ranges from 135 mm - 320 mm; this indicates that the hampala barb that lives in the Jatigede Reservoir has a larger size. The longest male hampala barb is 415 mm, and the female is 392 mm. The most caught male fish were in the length group between 259 mm - 285 mm at 40.21%, while the female fish caught the most in the length group between 284 - 310 mm was 34.04%. The average length of male hampala fish is 281.13 mm, and female hampala fish is 314.84 mm.
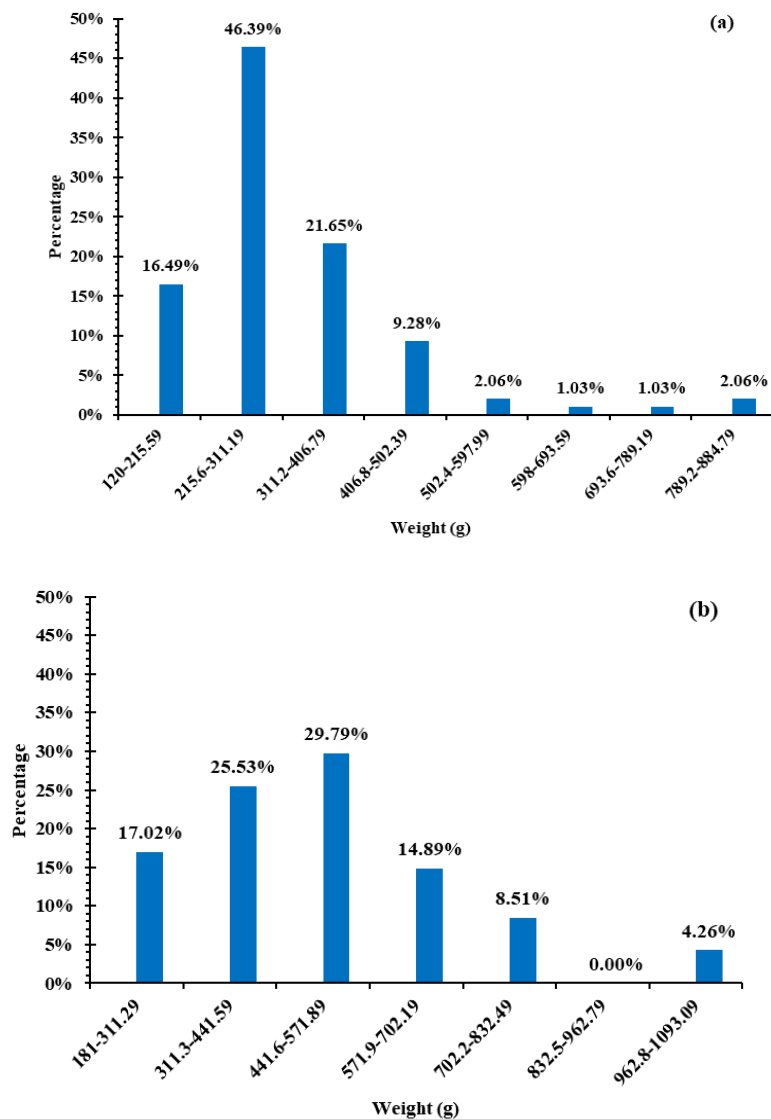

Figure 4. Weight distribution (a) male and (b) female of catched hampala barb.

The size distribution of male hampala fish caught based on weight consisted of eight size classes, and female hampala barb consisted of seven size classes. The weight of the male hampala barb ranged from 120 g – 888.79 g (Figure 4a), and the female hampala barb ranged from 181 – 1093.09 g (Figure 4b). The smallest male hampala barb weighs 120 g, and the female hampala

barb weighs 181 g. The biggest male hampala barb weighed 884.79 g, and the female hampala barb was 1093.09 g. The most caught male hampala barb in the weight class between 215.6 g – 311.19 g was 46.39%, and the female hampala barb in the size class between 441.6 g – 571.89 g was 29.79%. The average weight of a male hampala barb is 330.04 g, female hampala barb is 470.72 g.

Growth Pattern

Based on the results of the calculation of the value of b in the regression equation of the relationship between the length and weight of hampala barb (Figure 5), it shows that the growth pattern of hampala barb during the research is negative allometric (b < 3) growth in length is faster than growth in weight. The b value for male hampala fish is 2.429 with a regression value (R^2) = 0.7033 (which means 70.33% of length affects weight) (Figure 5a), female hampala fish is 2.7177 with a regression (R^2) = 0.789 (which means 78.90% length affects weight) (Figure 5b). The correlation value of the length and weight of the male hampala barb is 0.8386, female hampala fish is 0.8882, which shows a strong relationship. Effendie (2002) states that the relationship between length and weight shows relative growth, which means that it is possible to change according to time. If there is a change in the environment and food availability, it is estimated that the value of the length-weight relationship will also change.
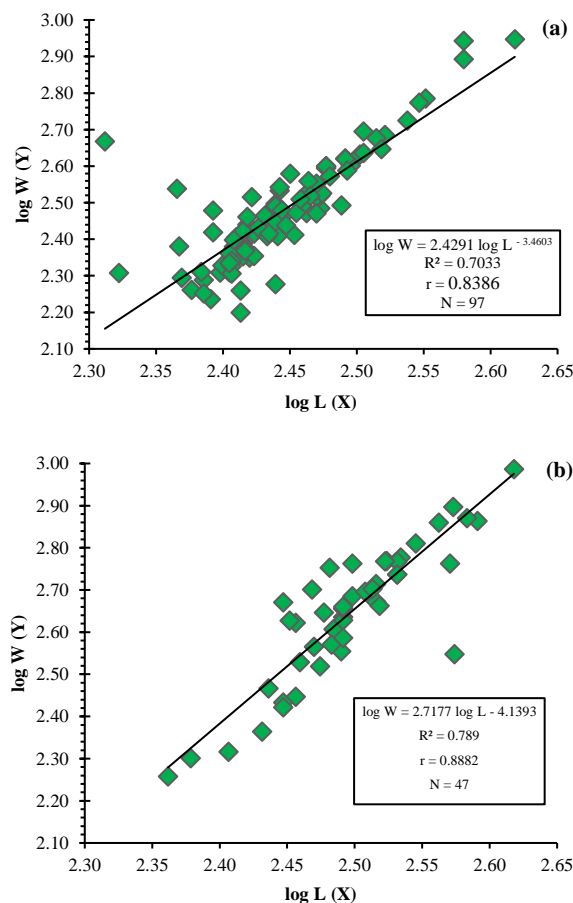

Figure 5. Regression of length-weight relationship (a) male and (b) female hampala barb caught in Jatigede Reservoir

Condition Factor

The condition factor (FK) of male hampala barb ranged from 1.17 to 1.47 (Figure 6a), female hampala barb ranged from 1.16 to 1.38 (Figure 6b). The condition factor of male fish is relatively larger than that of female fish.
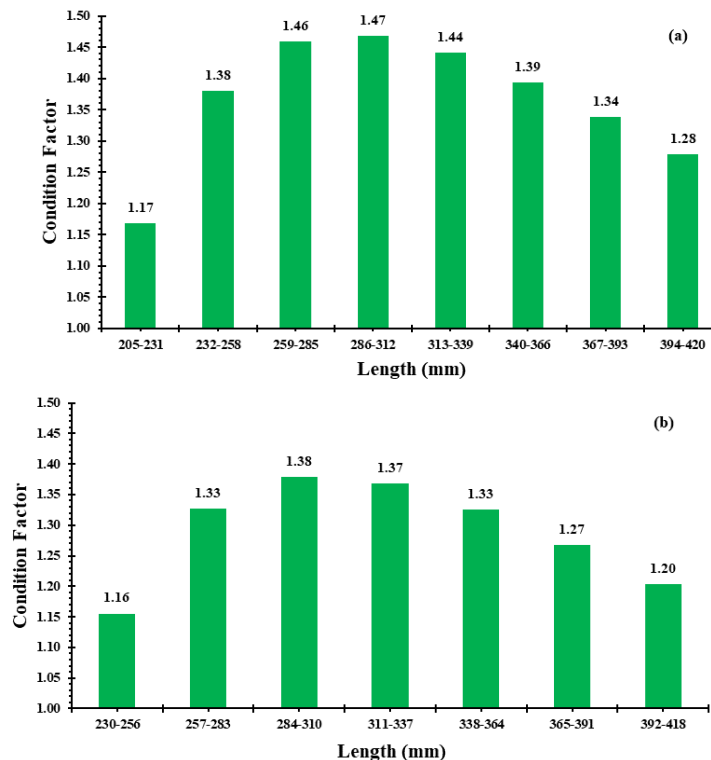

Figure 6. Condition factors (a) male and (b) female for the captured hampala barb in the Jatigede Reservoir

The maximum condition factor for the male hampala barb is found in long class intervals of 286 mm - 312 mm FK of 1.47, and female hampala barb of 284 mm - 310 mm FK of 1.38. Based on these results, the smaller the size of the fish, the higher the condition factor it has; this is in accordance with the opinion of Barus (2011) small fish have a high ponderal index, then decreases when the fish get bigger due to changes in fish food. According to Mustikawati (2017), the size of the hampala barb of more than 173 mm will experience a decrease in the value of the condition factor.

Reproduction

In the management of fish resources, the reproductive aspect is vital in relation to recruitment. The picture of hampala barb fish can be seen in Figure 7 (Oocyte development). Research results from September – December 2017 and January - February 2018 (for 6 months) representing the dry season, the dry to rainy transition season, and the rainy season Herawati, 2019; of 135 fish consisting of 97 male and 47 female fish showed that the hampala barb in the Jatigede Reservoir was a partial spawner as shown in the microscopic description of gonad development (Figure 7).
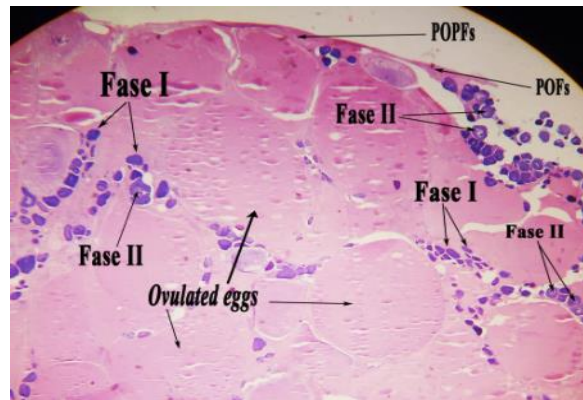
Figure 7. Oocyte development in hampala barb gonads at Gonadal Maturity Level IV

Based on the results of histological observations on the ovaries of hampala fish with gonadal maturity level IV, it was seen that there were many oocytes in phases I and II and the presence of *post ovulatory follicles* (POFs). This indicates that the hampala barb has *a partial spawner* or *multiple spawner* type, which means that the hampala barb has a spawning period several times a year. According to Harianti, (2013), the presence of groups of immature eggs indicates that the fish are partial spawners. Partial spawner spawning type is a type of spawning that lasts for a long time because fish spawn their eggs partially (Effendie, 2002). This is in accordance with the results of research conducted by Musrin (2013) which states that the hampala barb *(Hampala macrolepidota)* is one of the fish with gradual spawning type (partial spawner).

During the research (6 months), hampala barb is evidenced by the finding of female and male fish that have gonad development stages IV and V or are ready to spawn and have spawned. In November and December, the number of female fish with the gonadal maturity IV was highest (20.93 % and 16.28 %) and decreased in January – February (Table 1 and 2). In January – February found finger-size fish.

Table 1. Percentage of Gonad Maturity of Male (%) in Jatigede Reservoir in September – December 2017, January - February 2018

	Time						Total
GML[a]	Sep[b]	Oct[b]	Nov[b]	Dec[b]	Jan[c]	Feb[c]	
V	0.00	20.65	9.78	0.00	0.00	0.00	30.43
IV	0.00	7.61	4.35	5.43	2.17	5.43	25.00
III	3.26	0.00	2.17	5.43	5.43	13.04	29.35
II	4.35	0.00	2.17	2.17	0.00	5.43	14.13
1	0.00	0.00	0.00	1.09	0.00	0.00	1.09
Total	7.61	28.26	18.47	14.12	7.60	23.90	100.00

[a]Gonad Maturity Level
[b]2017
[c]2018

Table 2. Percentage of Gonad Maturity of Female (%) in Jatigede Reservoir in September 2017 to February 2018

	Time						Total
GML[a]	Sep[b]	Oct[b]	Nov[b]	Des[b]	Jan[c]	Feb[c]	
V	0.00	0.00	2.33	0.00	0.00	0.00	2.33
IV	0.00	2.33	20.93	16.28	11.63	2.33	53.49
III	6.98	2.33	4.65	0.00	2.33	6.98	23.26
II	6.98	0.00	2.33	000	0.00	9.30	18.60
I	0.00	0.00	0.00	0.00	2.33	0.00	2.33
Total	13.96	4.66	30.24	16.28	16.29	18.61	100.00

[a]Gonad Maturity Level, [b]2017, [c]2018

4. Conclusion

Based on the research results, it can be concluded: the growth pattern of male and female hampala barb in Jatigede Reservoir is negative allometric. The male hampala barb is relatively large compared to the female. In female fish, the peak condition factor is achieved in fish measuring total length between 284 mm to 310 mm, fish measuring more than 311 mm have decreased.

6. Acknowledgments

7. Declaration

The authors declare that there is no conflict of interest regarding the publication of this paper.

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