International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(Research Article)

Sexual dimorphism, length-weight relationship, and condition factor of *Hampala ampalong* (Bleeker, 1852) from Kalong Floodplain, Ogan Komering Ilir Regency

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International Journal of Science and Research Archive, 2023, 10(01), 666–674

Publication history: Received on 23 August 2023; revised on 03 October 2023; accepted on 06 October 2023

Article DOI: https://doi.org/10.30574/ijsra.2023.10.1.0800

Abstract

Sumatra hampala or kebarau fish, *Hampala ampalong* (Bleeker, 1852) is one of the fish species found in Kalong Floodplain in the Ogan Komering Ilir Regency, South Sumatra, Indonesia. This study aimed to determine sexual dimorphism, length-weight relationship and condition factor of *H. ampalong*. The study method used was direct observation with purposive sampling technique. The total fish obtained consisted of 12 male and 12 female. The results showed that almost all morphometric characters of female were longer than male except for head length which determined that male longer than female. The head length of male was 2.28 ± 1.04 while the head length of female was 2.27 ± 0.85 it could be assumed that the sexual dimorphism seen from the difference in head length. While the meristic characteristics there was no difference between male and female; dorsal fin spine and rays (I. 7-8), ventral fin rays (6-8), pectoral fin rays (13), anal fin rays (6-9) and caudal fin rays (18). The length-weight relationship of male obtained a linear regression equation $y = 0.0092x^{3.0418}$ with $R^2 = 89.45\%$, the value of b obtained was 3.0418 which means that the growth pattern of male was isometric (b=3), while the linear model regression equation of female fish $y = 0.0238x^{2.6975}$ with $R^2 = 76.74\%$, the value of b obtained was 2.6975 which indicates that the growth pattern of female includes negative allometric (b<3). The value of the relative condition factor of male and female were K>1 which means the value of fish condition were in good.

Keywords: Floodplain; Growth pattern; *H. ampalong;* Sexual dimorphism

1. Introduction

Floodplains are widely used by the people of South Sumatera to describe seasonally inundated waters. Floodplains are part of freshwater public waters consisting of swamps, lebungs, and rivers that naturally provide fish breeding during the high tide and paddy field planting during the low tide season (Muslim, 2012). The area of floodplain in Ogan Komering Ilir Regency is estimated to reach 146.279 ha, or 58.96% of the total floodplain area in South Sumatera (Rosana, 2021). Kalong floodplain, located in Ogan Komering Ilir Regency, South Sumatera Province, Indonesia, has an important role in the lives of local people and also as a habitat for flora and fauna. Its existence plays an essential role in the ecological and economic aspects of the community; ecologically, it functions as a freshwater reservoir and fish habitat, while economically, it plays a role in horticulture, water transportation, fish farming, and fishing activities (Muthmainnah *et al.,* 2012).

Sumatra hampala (*H. ampalong)* is one of the native species in the floodplains of South Sumatera. Generally, this fish has other names in several places in Indonesia, namely: kebarau, barau, sebarau, and barau-barau. *H. ampalong,* belonging to the Cyprinidae family, has an elongated and flat body shape, is scaly and silvery in color on the back and abdomen, and the tail fin is reddish with black longitudinal lines (Kottelat *et al.,* 1993; Samuel and Suryati, 2014). This

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fish is an economically valuable species that is quite commonly found in the open waters of Ogan Komering Ilir Regency. This species is caught by fishermen using traditional fishing gear such as bubu (fish traps), sengirai (fish traps), nets, and kemilar (fish traps). For the processing of this fish to maintain quality and a longer storage time, fishermen generally process it into salted fish or preserve it by fermentation, which local people know as pekasem. *H. ampalong* is one of Indonesia's native species with potential for cultivation (Muslim *et al*., 2020).

Sexual dimorphism is a biological study in morphology and reproduction that's used as a basic reference to differentiate males and females. Some aspects of observation that could be a basic source of information for knowledge of differences between males and females include morphometric characters, meristics, length-weight relationships, and condition factors to determine fish age. Research related to sexual dimorphism has been widely reported in freshwater and marine fish species (Timahakim *et al.,* 2019; Putra *et al.,* 2023; Garcia and Zuanon, 2019; Sukmaningrum *et al.,* 2019; Abduh *et al.,* 2020; Mainero *et al.,* 2023).

Length-weight relationships and condition factors have an important role in fisheries science studies due to their ability to provide essential knowledge on fish growth, fish welfare conditions, and other data on fish biology (Sajid Khan *et al.,* 2020; Narzary and Khangembam, 2022). The assessment of length-weight relationships is also important for the sustainability of fisheries conservation in aquatic systems (Lawson, 2011) and quite essential in formulating recommendations for aquatic resource management (Ergüden, 2021; Sonowal *et al.,* 2019). Research related to the length-weight relationship and condition factors of *H. ampalong* has been reported by several researchers, such as Zakaria *et al.* (2000) in Kenyir Lake, Malaysia; Hamid *et al.* (2015) in Temengor reservoir; Herawati *et al.* (2022) in Jatigede reservoir, West Java; Makmur *et al.* (2014) in Lake Ranau, Indonesia; Soetignya *et al.* (2016) in Betung Kerihun National Park, West Kalimantan Province, Indonesia; Tessssier *et al.* (2019) in a subtropical reservoir (Lao PDR).

Studies on length-weight relationships and condition factors have been reported by several researchers previously. However, information on sexual dimorphism, length-weight relationship, and condition factor of *H. ampalong* in the Kalong floodplain is not available. This study is important to conduct so that it becomes a source of initial information for the development process of fisheries resource management to maintain species sustainability. The purpose of this research was to obtain accurate fisheries biology data from morphometric analysis, meristics, length-weight relationships, and condition factors of *H. ampalong*. With this research, it is expected to be a reference in the management of sustainable fisheries resources in the Kalong floodplain waters of Ogan Komering Ilir Regency.

2. Material and methods

2.1. Site and Time

This research was conducted from June to July 2023 in the Kalong floodplain in Ogan Komering Ilir Regency. Determination of sampling points using the purposive sampling technique based on the catch area of local fishermen. Sampling was carried out at three stations: Station 1 (-3º16´33˝,104º49´10˝), Station 2 (-3º16´1˝,104º48´55˝), and Station 3 (-3º15´39˝,104º48´47˝) (Figure 1). Biometric measurements of fish samples were conducted at the Fisheries Laboratory, Faculty of Fisheries, Universitas Islam Ogan Komering Ilir Kayuagung.

2.2. Samples Collection

Samples of *H. ampalong* were caught using traditional fishing gear used by local fishermen, namely bubu (fish traps), sengirai (fish traps), kemilar (fish traps), and gillnets. A total of 24 specimen were obtained, consisting of 12 females and 12 males. Fish samples that have been obtained are put into plastic, then put into a cool box filled with broken ice blocks. Fish samples were transported to the laboratory for measure length, weight, morphometric characters, and the calculation of meristic characters. Measurement of the length of the sample fish using a caliper (with an accuracy of 0.05 cm) and the weight of the sample fish using digital scales (with an accuracy of 0.01 g).

2.3. Measurement of Morphometric Characters

Measurement of morphometric characters using a caliper with an accuracy of 0.05 mm. A total of 14 morphometric characters were measured, namely TL = total length; SL = standard length; HL = head length; HH = head height; ED = eye diameter; M-DF = mouth to dorsal fin distance; M-PF = mouth to pectoral fin distance; PFL = pectoral fin length; BD = body depth; VFL = ventral fin length; DFL = dorsal fin length; V-AF = ventral to anal fin distance; WBC = width base caudal; CFL = caudal fin length (Figure 2).

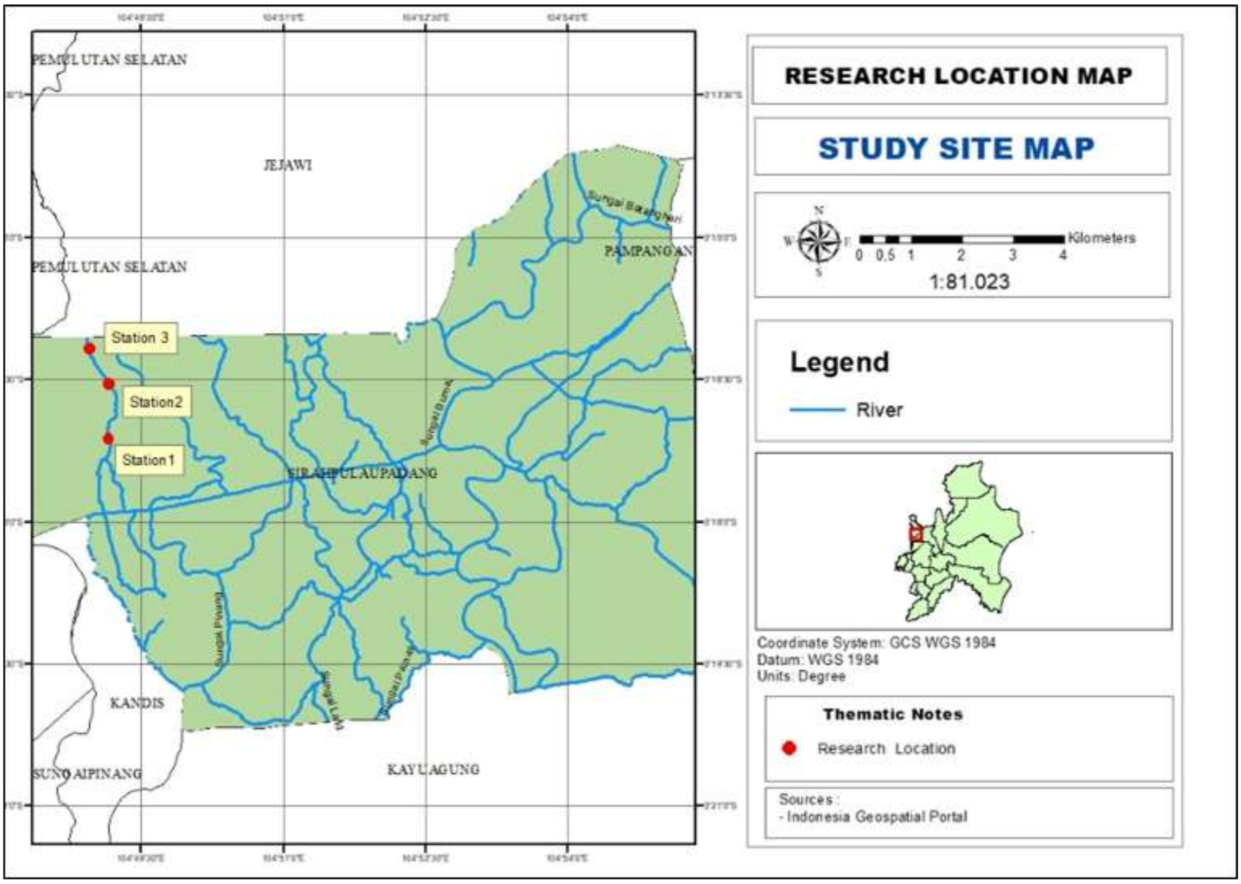

Figure 1 Sampling site of Hampala (*Hampala ampalong*, Bleeker 1852) in the Kalong Floodplain, Ogan Komering Ilir Regency, South Sumatra, Indonesia

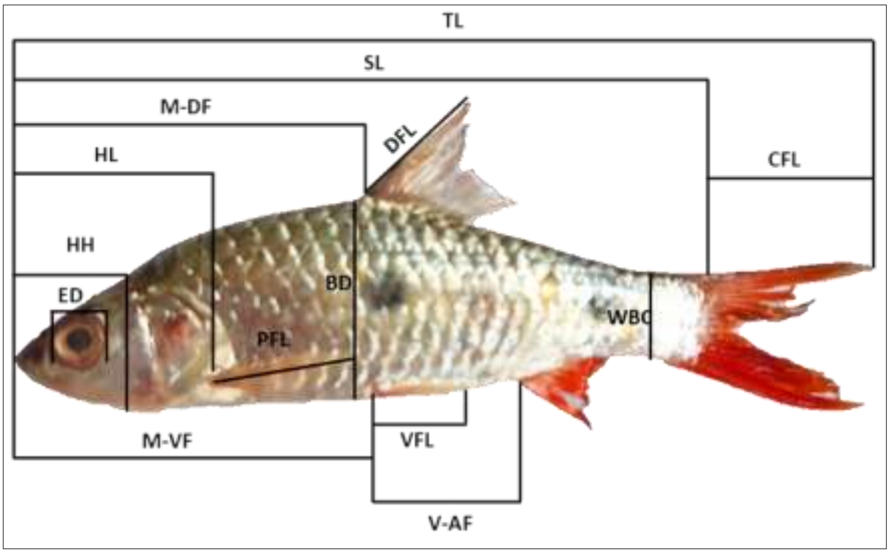

Figure 2 Morphometric characters measurement of *Hampala ampalong* (Bleeker, 1852). TL = total length; SL = standard length; HL = head length; HH = head height; ED = eye diameter; M-DF = mouth to dorsal fin distance; M-VF = mouth to ventral fin distance; PFL = pectoral fin length; BD = body depth; VFL = ventral fin length; DFL = dorsal fin length; V-AF = ventral to anal fin distance; WBC = width base caudal; CFL = caudal fin length

2.4. Calculation of Character Meristic

The meristic characters of *H. ampalong* calculated in this study include the number of spines and rays on the dorsal fin (D), ventral fin (V), pectoral fin (P), anal fin (A), and caudal fin (C).

2.5. Length-Weight Relationship

Length-weight relationships was calculated using the equation; W=aL^b (Pathak *et al.,* 2022), where W is weight of samples (g), L is total length of samples (cm), a and b are constant values. When b=3, it indicates isometric growth; b<3 indicates negative allometric growth, and when b>3, growth is positive allometric. The parameters 'a', 'b' and coefficient of determination (R^2) were estimated at 95% confidence level. All the data of length and weight were log transformed for ensuing least square linear regression with the weight as dependent variable and the parameters 'a' and 'b' were estimated by the linear regression on the transformed equation; Log W=Log a + b Log L.

$$\text{Log a} = \frac{\sum \log W \; x \; \sum(\log L^2) - \sum \log L \; x \; \sum(\log L \; x \; Log \; W)}{n \; x \; \sum(Log \; L^2) - (\sum \log L)^2}$$

$$\text{b} = \frac{\sum \log W - (n \; x \; \text{Log a})}{\sum \log \text{L}}$$

2.6. Relative Condition Factor

The relative condition factor (Kr) is defined for each fish by the ratio between its observed mass and its calculated theoretical mass: Kr = W / a L^b (Ouahb *et al*., 2021). For each fish, the Kr value places it on the length-weight curve established for the sample. If Kr > 1, the fish has a mass superior to the average mass of individuals of its size. If Kr <1, its mass is smaller than the average mass. Kn ≥1 refers to the good growth condition and well-being of the fish compared to an average individual of the same length (Pathak *et al*., 2022).

2.7. Statistical Analysis

The data documentation and all statistical analyses presented in the study were performed using Microsoft Excel 2013 software under the Windows operating system. The coefficient of determination (R^2) determined during regression is a measure of linear regression's prediction quality, and a value close to 1 indicates a better model.

3. Results and discussion

3.1. Morphometric characteristics

The results of this study have successfully measured 14 morphometric characters of *H. ampalong*. The results of morphometric character measurements are presented in Table 1.

The study of sexual dimorphism of *H. ampalong* in the Kalong Floodplain is not yet available, and this study could provide the latest information on the determination of sexual dimorphism of *H. ampalong*. Sexual dimorphism is particularly important in biodiversity assessment, fisheries biology, fish biometry knowledge, and sex determination (Bahuguna *et al*., 2010). Morphologically there are almost no morphometric and meristic differences between males and females.; both have a silvery color on the body; the dorsal, ventral, and pectoral have a light silvery color; the anal tail is reddish; and the tail has a bright reddish color. The most attractive part of this fish is that there is a fairly wide black spot in the middle of the body and near the base of the tail. The similarity of black spots on the part of the body of *H. ampalong is* also found in other species of *Hampala* sp., as reported by Herawati *et al.* (2023) from Jatigede Reservoir, Sumedang, West Java, Indonesia. On the other hand, the sexual differences in morphological dimorphism listed in Table 1 showed that nearly all morphometric characters of females are longer than males except for head length. Hence, sexual dimorphism in *H. ampalong* can be recognized in head length. These results illustrate that, morphologically, males are smaller than females. The associated research that stated the sexual dimorphism of males was smaller than females has been reported by Bahuguna *et al*. (2010) in the cyprinidae fish *Puntius ticto* (Hamilton-Buchanan) from Kumaun Himalaya and Pramono *et al.* (2019) in *Mystus singaringan* from Klawing River in Central Java, Indonesia.

Table 1 Morphometric characteristics of *H. ampalong* (Bleeker, 1852) from Kalong Floodplain, Ogan Komering Ilir, South Sumatra, Indonesia

Morfometric characters	Male		Character/TL (%)	Female		Character/TL (%)
	Range (cm)	AVG±SD		Range (cm)	AVG±SD	
TL	10.6-17.5	13.52±2.26	-	10.6-23	16.18±3.61	-
SL	8.4-14	10.98±1.75	79.63	8-18	12.78±2.82	79.06
HL	1.2-4.2	2.28±1.04	16.18	1.5-4.5	2.27±0.85	14.32
HH	2.4-3.7	2.92±0.45	21.50	2.1-5.6	3.60±1.05	22.23
ED	0.5-0.9	0.73±0.11	5.42	0.6-1.1	0.84±0.15	5.30
BD	0.5-3.6	2.48±1.05	17.58	0.3-4.7	2.93±1.34	17.49
PFL	1.5-2.2	1.80±0.22	13.14	1.5-3.3	2.15±0.52	13.34
CFL	2.2-3.8	3.03±0.47	21.96	2.4-5.6	3.59±1.00	22.09
WBC	1.1-1.8	1.41±0.20	10.25	1.1-2.7	1.67±0.45	10.30
DFL	1.6-2.5	2.08±0.32	15.45	1.3-3.5	2.52±0.61	15.71
VFL	1.4-2.4	1.96±0.31	14.31	1.6-3.00	2.29±0.41	14.36
V-AF	1.8-3.4	2.57±0.48	18.61	1.6-4.00	2.93±0.69	18.06
M-PF	4.3-7.2	5.72±0.84	41.51	4.2-9.4	6.68±1.52	41.31
M-DF	4.5-7.5	5.80±0.81	42.22	4.4-8.6	6.70±1.28	41.76

3.2. Meristic Characteristics

The results of meristic observations and calculations including the number of spines and rays on the dorsal fin (D), ventral fin (V), pectoral fin (P), anal fin (A), and caudal fin (C) are shown in Table 2.

Table 2 showed that all the fin rays of males and females have the same number, so it can be concluded that the body length of males and females does not affect the number of fin rays. The results of the calculation of meristic characters can be concluded to show that there are no differences in sexual dimorphism observed from the meristic aspects.

Table 2 Meristic characters of H. ampalong (Bleeker, 1852) from Kalong floodplain, Ogan Komering Ilir, South Sumatra, Indonesia

Meristic characters	Male	Female
Number of spine and ray of the dorsal fin (D)	D. I. 7-8	D. I. 7-8
Number of rays of the ventral fin (V)	V. 6-8	V. 6-8
Number of rays of the pectoral fin (P)	P. 13	P. 13
Number of rays of the anal fin (A)	A. 6-9	A. 6-9
Number of rays of the caudal fin (C)	C. 18	C. 18

3.3. Length-weight relationship

Analysis of the length-weight relationship of males obtained a linear model regression with the equation $y = 0.0092x^{3.0418}$, while the linear model regression equation of females was $y = 0.0238x^{2.6975}$. Based on the coefficient of determination (R^2), the relationship between length and weight of males shows a high correlation, assuming that 89.45% of weight growth is influenced by length growth, while in females the relationship between length and weight shows a high correlation of 76.74%, which means that the addition of fish weight is also influenced by the addition of fish length. Meanwhile, the results of the growth pattern analysis of males show an isometric growth pattern, which is the same length growth pattern as the weight growth pattern. While the results of the analysis of the growth pattern of females have a negative allometric growth pattern, which is faster length growth than weight growth (Figure 3).

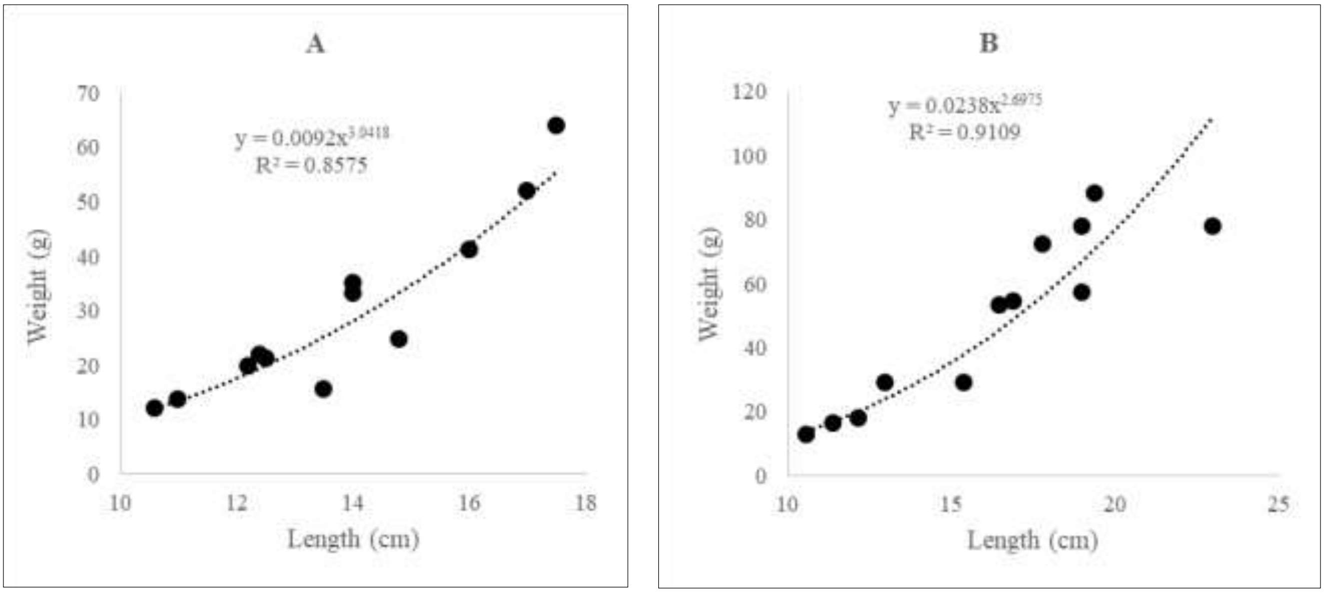

Figure 3 Length-weight relationship of *Hampala ampalong* (Bleeker, 1852) from Kalong Floodplain, Ogan Komering Ilir (A = male, B = female)

Information related to the length-weight relationship of *H. ampalong* is still limited, so this research could be a baseline reference in fisheries management or further research. Length-weight relationship analysis is needed in fisheries management to determine the size of fish in a population as well as conservation efforts, describe the physiological conditions of fish such as body shape, and determine growth patterns (Muslim *et al.,* 2022). The results of the regression analysis in Figure 3 indicate that there are differences in growth patterns between male and female. Male have a coefficient value of b = 3.041 which means that the growth pattern of male fish has an isometric pattern (b = 3) so that it can be interpreted that length growth is equal to weight growth. These results have been reported by Samuel and Nuryati (2014), who explained that the growth pattern of barau fish (*Hampala macrolepidota* Kuhl & van Hasselt 192) in Lake Kerinci Jambi is isometric. While the value of the coefficient b in female fish is 2.697, which means that the growth pattern of female fish has a negative allometric pattern (b3), Similar results have also been reported by Zakaria *et al. (2000),* who showed the growth pattern of sebarau fish (*H. macrolepidota*) in Lake Kenyir, Malaysia, is negative allometric with a coefficient b of 2.8. Risdawati *et al.* (2020) reported that the growth pattern of *Hampala macrolepidota* in Lake Singkarak, West Sumatra, Indonesia, is negative allometric and found in both males and females. Several factors that influence the difference include fish age, size, food availability, competitors, and aquatic environmental factors (Muslim *et al.,* 2022).

3.4. Relative condition factor

The condition factor describes the status of fish, which is expressed in numeric terms based on length and weight data. Condition factors for males and females are displayed in Table 3.

Table 3 Relative condition factors of H. ampalong (Bleeker, 1852) from Kalong Floodplain, Ogan Komering Ilir, South Sumatra, Indonesia

Sex	Relative condition factor (Kr)	
	Range	Mean
Male	0.617 – 1.241	1.015
Female	0.768 – 1.377	1.075

The results showed that, on average, the relative condition factor value of male and female fish was > 1. Fish development is categorized as good if the K> 1, so it can be concluded that the development of male and female fish in the waters is still in good condition. The condition factor value was obtained from the length-weight relationship of fish and has a relationship with growth patterns. The negative allometric growth pattern explains that the fattiness of the fish is not too large; this is related to the fact that the value of the female condition factor is higher than the value of the male condition factor; these results indicate that females are fatter than males (Timahakim *et al.,* 2019). There are several factors that influence, among others, the condition of the aquatic environment. The availability of food and competitors in obtaining food in the population also affect the level of fattiness and condition factors of fish (Manik, 2009; Bhatt *et al.,* 2021; Jisr *et al.,* 2018).

4. Conclusion

Sexual dimorphism of *H. ampalong* could be viewed from morphometric characters of head length; males longer than females. The growth pattern of males has an isometric growth pattern (b = 3), while females have a negative allometric growth pattern (b = 3). The relative condition factor of male and female fish has a K > 1, which implies that the development of fish in the water is in good condition.

Compliance with ethical standards

Acknowledgments

We would like to express our gratitude to the local fishermen who helped collect specimens in the field and the students who helped with laboratory work and data tabulation.

Disclosure of conflict of interest

The authors declared that there is no any conflict of interest for publishing this article.

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