

Viscerosomatic, hepatosomatic indices and condition factor of *Barbonymus* and *Osteochilus* genus in the freshwater river of North Aceh, Indonesia

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Abstract. North Aceh is one of the regencies in the Aceh province that has extensive freshwater fisheries. Commonly freshwater species found in this area are *Barbonymus* and *Osteochilus* genus. This study was conducted to analyse the viscerosomatic, hepatosomatic index, and condition factor of these species. Specimens were caught using fishing nets, gill nets, and fish traps. The data collection took place in 10 villages, and sampling were collected from July to August 2024. The observed parameters during the study were the viscerosomatic index, hepatosomatic index, condition factor, and water quality parameters. All samples were measured for weight and length, and then dissected to measure the viscerosomatic and hepatosomatic indices. This study found 6 species of *Barbonymus* and 4 species of *Osteochilus* genus, totaling 123 and 96 specimens respectively. Length and weight of *Barbonymus* genus of six species were 10.20 – 15.50 cm and 14.47 – 51.83 g, respectively, while the *Osteochilus* genus showed a range of 12.70 – 17.30 cm and 22.99 - 70.21 g. The condition factor of the *Barbonymus* genus varied from 0.97 - 1.39, while in the *Osteochilus* genus was 1.10 – 1.36. The VSI of *Barbonymus* genus was 5.98 – 8.50%. whereas, the *Osteochilus* genus showed a range of 7.18 – 29.97%.

1 Introduction

Freshwater fishes are recognized for their significant role as a source of protein for community [1]. Among these, the Cyprinidae family is the largest, with over 2,000

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species spread across Asia and Southeast Asia [2]. Tawes (*Barbonymus*) and Nilem (*Osteochilus*) are included in the Cyprinidae family which are commercially important species found in the northern and southwestern regions of Aceh [3]. These two species typically inhabit rivers, lakes, and swamps. Additionally, they are also popular as ornamental fish due to their bright and attractive colors [3, 4].

Aceh, particularly in the northern region, is considerable potential for fisheries development, yet it remains underdeveloped. The area predominantly depends on traditional fishing methods, which contribute slowly to the growth of the fishing sector. Therefore, there is an immediate need to implement effective management strategies to boost production volume. In addition, the genetic resources of freshwater species are under serious threat because of human activities. Destructive fishing practices, which involve the use of materials, tools, or methods that damage aquatic resources and the environment, greatly contribute to these risks [5-7]. Hence, it is essential to implement effective and sustainable conservation efforts to guarantee food security for both current and future generations.

Furthermore, in fisheries studies, biometric measurements, weight-length analysis, and the condition factor are used to assess the well-being of species. Experiments on the condition factors have been conducted on various freshwater fish species [8-10]. Additionally, the health status of a fish can be evaluated through the hepato-somatic index. This index is a significant indicator of a fish's condition [11], including its metabolic health and estimated fish's energy reserves [12].

[13] mentioned that knowledge of some quantitative aspects such as the viscerosomatic and hepatosomatic indices in fish, is crucial for studying biological fundamentals. This is because measuring and analyzing these indices are vital for evaluating the food value of fish. Moreover, the examination of viscerosomatic and hepatosomatic indices plays a crucial role in understanding fish metabolism, particularly in relation to digestion, nutrient absorption, the synthesis and secretion of digestive enzymes. The viscerosomatic and hepatosomatic indices have also been explored in tilapia [14] and in *Cyprinus carpio* [15].

Thus, this study aims to provide information on both the viscerosomatic and hepatosomatic indices, as well as the condition factor of *Barbonymus* and *Osteochilus* genus in the freshwater river of North Aceh. The objective is to assess whether the fish are in good condition. The data generated will be crucial for the effective management of the fishery. The findings of this research are expected to support fish conservation efforts and provide a valuable database of fish species present in Aceh.

2 Materials and methods

2.1 Time and place

This study was carried out in the North Aceh, with sampling locations spread across 4 sub-districts in 10 stations: Sawang, Dewantara, Nisam, and Kuta Makmur (Fig. 1). The selection of sampling stations was based on a site survey and interviews with the fisheries officers and local community. Fish were captured using gill nets, fishing rods, and fish traps, depending on the river and water conditions. These locations were chosen due to the presence of a major river, as well as geographical features, distribution of wild fish, temperature, and water flow rate. Data collection took place

from July to September 2024, and identification of fish specimen was carried out in the Laboratory of the Aquaculture Department, Universitas Samudra.

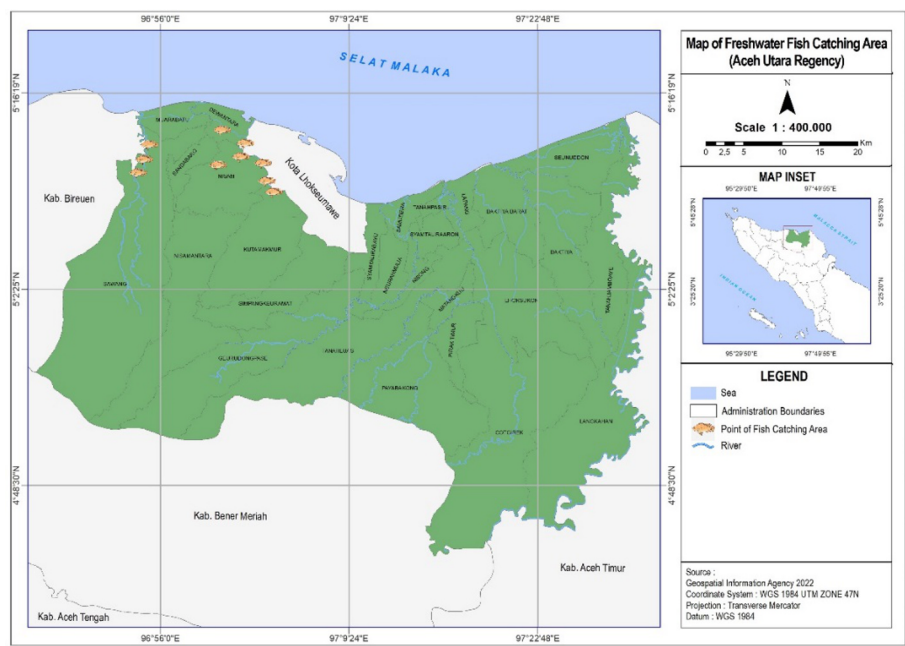


Fig. 1. Map of the study area in North Aceh, Indonesia.

2.2 Data collection

The fish species exploration in North Aceh was carried out using the roaming technique [16]. All species discovered at the research sites were gathered, and their local names, habitats, and morphological features were documented [17]. Species identification was carried out in the laboratory, following the guidelines from references [18-19]. The origin and habitat of each species were identified based on [20]. The distribution pattern of the fish was mapped using GPS coordinates and analyzed with a GPS program [21].

2.3 Fish biometric

The biometric parameter data are calculated using the formula provided by [3]. Morphometric Measurement: Body weight was measured using an electric balance and recorded in gram, whereas the total length was measured from the snout tip to the end of the caudal fin. Length measurements were taken using a meter rule and recorded in centimeters. The condition factor (CF) is a measure of body shape and weight increase percentage, indicating the fish's weight relative to its total length. It is used to assess the physical or biological condition of the fish.

$$\text{Condition factor (CF)} = \frac{\text{Weight of fish}}{\text{length of fish}} \times \dots\dots\dots (1)$$

Viscerosomatic index (VSI) and Hepatosomatic index (HSI) were examined by sacrificing experimental fish from each replication to weight the visceral. VSI and HSI was calculated using the formula described by [22].

$$\text{Viscerosomatic index (VSI)} = \frac{\text{weight of visceral}}{\text{weight of fish}} \times \dots\dots\dots (2)$$

$$\text{Hepatosomatic index (HSI)} = \frac{\text{weight of liver}}{\text{weight of fish}} \times \dots\dots\dots (3)$$

The hepatosomatic index (HSI) measures the relative weight of the liver, while the viscerosomatic index (VSI) gauges the weight of the fish's viscera

2.4 Data analysis

The average and standard error for body weight, total length, and condition factor were computed. The variation in the mean values of body weight and total length was examined for significant differences using Analysis of Variance (ANOVA) at the 0.05 significance level. Mean ranking was performed using the Duncan Multiple Range Test (DMRT) where significant differences were observed

3 Results and discussion

3.1 Measurement of fish size

The fish size is depicted in length and weight intervals as seen in Table 1. The results indicated that the length and weight of *Barbonymus* genus of six species were 10.20 – 15.50 cm and 14.47 – 51.83 g, respectively. Whereas the smallest is the Yellow tail tawes (10.20 cm and 14.47 g) and the biggest one is the Ponggol tawes (15.50 cm and 51.83 g). Meanwhile, the *Osteochilus* genus showed a range of 12.70 – 17.30 cm and 22.99 - 70.21 g. Whereas the Black spot Nilem showed the smallest size (12.70 cm and 22.99 g). The weighest is seen in Linea Nilem (17.30 cm and 70.21 g). In this study, it shown that the *Barbonymus* genus found in Aceh Tamiang is smaller than that caught in North Aceh. It is assumed due to different water condition and feed availability. Other studies also reported that *Barbonymus* sp caught in several different areas showed different size, for instance: by [23] (9.52 cm and 58.69 g), [24] (20.56 cm and 126.33 g), and [25] (19.84 cm and 124.82 g). In general, differences in body weight among organisms in a population are typically attributed to variations in body length.

3.2 Fish Condition Factor (CF)

The fish condition factor indicates the overall plumpness of the fish, derived from its length and weight measurements. The condition factor results are shown in Table 1.

The CF of the *Barbonymus* genus varied from 0.97 - 1.39, while in the *Osteochilus* genus was 1.10 – 1.36. Knowing the CF value is necessary as biological data to understand fish population dynamics, such as growth, adaptation to environmental changes, or the impact of human activities. The condition factor of fish species is known to fluctuate, typically decreasing during periods of low temperatures, limited food availability, and spawning season [26]. Fish condition factor are widely influenced by both internal and external factors, as stated by some researchers [27-29] mentioned that condition factors in fish can be affected by factors such as sex, gonadal maturity, and climate. Moreover, the condition factor values provide insights into the biological condition of the fish, and reflect their overall welfare including the quantity and quality of fish meat.

Table 1. Data on condition factor of *Barbonymus* and *Osteochilus* genus.

No	Scientific Name	Local Name	TL (cm)	BW (g)	CF
1	<i>Barbonymus gonionotus</i>	Yellow tail Tawes	10.20	14.47	1.36
2	<i>Barbonymus sp</i>	Ponggol Tawes	15.50	51.83	1.39
3	<i>Barbonymus sp</i>	Golden scales Tawes	14.20	33.61	1.17
4	<i>Barbonymus sp</i>	Silver Tawes	10.90	16.23	1.25
5	<i>Barbonymus sp</i>	Glow Tawes	12.90	20.91	0.97
6	<i>Barbonymus sp</i>	Red fin Tawes	13.10	30.64	1.36
7	<i>Osteochilus sp</i>	Chanos Nilem	14.10	30.77	1.10
8	<i>Osteochilus sp</i>	Linea Nilem	17.30	70.21	1.36
9	<i>Osteochilus sp</i>	Black spot Nilem	12.70	22.99	1.12
10	<i>Osteochilus sp</i>	Bueng Nilem	13.40	28.56	1.19

Note: TL= total length; BW= body weight; CF= condition factor

3.3 Viscerosomatic index (VSI) and Hepatosomatic index (HSI)

Understanding certain quantitative aspects such as the viscerosomatic and hepatosomatic indices of fish is essential for studying biological fundamentals. Measuring and analyzing these indices are crucial for evaluating the nutritional value of fish [11]. The Viscerosomatic index (VSI) and Hepatosomatic index (HSI) results as seen in Table 2. The results indicated that the VSI of the *Barbonymus* genus (Tawes) was 5.98 – 8.50%. Whereas the lowest is seen in Golden scales Tawes and the highest VSI is in Silver Tawes. Meanwhile, the *Osteochilus* genus (Nilem) showed the range of 7.18 – 29.97%. Whereas the Chanos Nilem showed the lowest VSI and the highest is seen in Black spot Nilem. This present study found that the percentage VSI of the *Osteochilus* genus is higher than the *Barbonymus* genus. The Viscerosomatic Index is a significant biological indicator, as its measurement is

essential for evaluating the nutritional value of fish. It represents the ratio of the visceral mass to the carcass mass and is expressed as a percentage. Similar to other vertebrates, there is a relationship between a fish’s diet and the length of its gut or intestine [30]. In this study, the intestine length of the *Barbonymus* genus varied from 10.40 to 26.10 cm, with the shortest found in Glow Tawes and the longest noticed in Red fin Tawes. Meanwhile the intestine length of the *Osteochilus* genus was observed from 74.10 to 151.60 cm. This present study reported that the intestine of the *Osteochilus* genus is longer than that of the *Barbonymus* genus. The viscerosomatic index analysis in this study showed that the fish had more flesh compared to its visceral organs. This finding is similar to the study of [15] in *C. carpio*; [11] in *O. niloticus*, and [30] in the Clariidae family.

The general health condition of a fish can be assessed by determining the Hepatosomatic Index (HSI). In poor environmental conditions, fish typically have less energy stored in their liver [31]. The HSI index of the *Barbonymus* genus and the *Osteochilus* genus varied from 0.39 to 0.81% and 0.39 to 0.61%, respectively. The HSI variation in this study is lower than *B. bayad* 1.77 - 4.13% [31]; *O. niloticus* 0.74 - 1.63% [32]; *P. senegalensis* [33], and *P. obscura*: 0.55 - 0.64% [34].

Table 2. Viscerosomatic index (VSI) and Hepatosomatic index (HSI) of *Barbonymus* and *Osteochilus* genus.

Local Name	LW _(g)	VW _(g)	IL (cm)	HSI (%)	VSI (%)
Yellow tail Tawes	0.10	1.21	18.90	0.69	8.36
Ponggol Tawes	0.42	3.78	11.40	0.81	7.29
Golden scales Tawes	0.13	2.01	15.70	0.39	5.98
Silver Tawes	0.07	1.38	17.90	0.43	8.50
Glow Tawes	0.10	1.67	10.40	0.48	7.99
Red fin Tawes	0.20	2.24	26.10	0.65	7.31
Chanos Nilem	0.16	2.21	74.10	0.52	7.18
Linea Nilem	0.39	7.50	149.20	0.56	10.68
Black spot Nilem	0.14	6.89	78.30	0.61	29.97
Bueng Nilem	0.11	5.41	151.60	0.39	23.91

Note: LW= liver weight;VW= visceral weight; IL= intestine length; HIS= hepatosomatic index; VSI= viscerosomatic index.

3.4 Water quality parameter

In this study, pH levels were recorded at each site, showing optimal water quality within the range of 5.5 to 7.1, which is conducive to supporting aquatic life. Temperature and dissolved oxygen levels across the locations were recorded between

24.5 – 32.2°C and 4.5 to 6.5 ppm, respectively, which were found to be suitable for organisms in Aceh [35]. Data on water quality is provided in Table 3.

Table 3. Water quality parameter.

Parameter	Water Quality
pH	5.5 – 7.1
DO	4.5 – 6.5 ppm
Temperatur	24.5°C – 32.2°C
Brightness	0.8 – 1.5 m
Water current	15 – 35 cm/s

Dissolved oxygen concentrations that are too low or too high can impair fish health and leading to slower growth [36]. DO is needed by all living organisms for respiration, metabolic processes, or substance exchange, which in turn produce energy for growth and reproduction [37].

4 Conclusion

Based on the results, it can be concluded that the water conditions in North Aceh are very suitable for fish habitat and can support the growth of *Barbonymus* and *Osteochilus* populations. The condition factor value also shows that the fish get enough nutrition. Through visceral examination, found that the intestine of the *Osteochilus* genus is longer than that of the *Barbonymus* genus. It also reported that VSI of the *Osteochilus* genus is higher than the *Barbonymus* genus. Knowing the viscerosomatic, hepatosomatic index, and Condition factors are crucial for fisheries management and research on fish populations and habitats. Moreover, they provide a foundation for future efforts in the domestication of freshwater fish.

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