JIPK. Volume 15 No 2. November 2023
Sinta 1 (Decree No: 158/E/KPT/2021)
e-ISSN:2528-0759; p-ISSN:2085-5842
Available online at https://e-journal.unair.ac.id/JIPK

JIPK
(JURNAL ILMIAH PERIKANAN DAN KELAUTAN)
Scientific Journal of Fisheries and Marine

Research Article

# Length-weight Relationship and Condition Factors of Endemic Fish, *Lagusia micracanthus* Bleeker, 1860 (Pisces: Terapontidae) in Gilireng River, Wajo Regency, Indonesia

**Neneng Rahayu Ningsih[1], Sharifuddin Bin Andy Omar[2*], Abdul Haris[3], Muhammad Nur[4], and Rakhma Fitria Larasati[5]**

[1]Master Program of Fisheries Science, Departement of Fisheries, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar, 90245. Indonesia
[2]Department of Fisheries, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar, 90245. Indonesia
[3]Department of Marine Science, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar, 90245. Indonesia
[4]Department of Aquaculture, Faculty of Animal Husbandry and Fisheries, University of West Sulawesi Barat, Majene, 91214. Indonesia
[5]Department of Capture Fisheries, Marine and Fisheries Polytechnic, Pengambengan, Negara, Jembrana, 82218. Indonesia

OPEN ACCESS

**ARTICLE INFO**

Received: November 26, 2022
Accepted: January 20, 2023
Published: February 23, 2023
Available online: August 15, 2023

*) Corresponding author:
E-mail: sb.andyomar@gmail.com

**Keywords:**
Endemic Fish
Gilireng River
Growth
Lagusia micracanthus
Pirik Fish



## Abstract

*Lagusia micracanthus* or locally known as pirik fish and is the only endemic freshwater fish from the family Terapontidae. To date, published information related to biological aspects of this species in the Gilireng River, Arajang Village, Wajo Regency, is unavailable. This study aims to determine the length−weight relationship and condition factors of *L. micracanthus* fish populations in the Gilireng River. Fish sampling was performed once a month January 2022 to June 2022.The fish collected from Gilireng River comprised 69 male and 66 females during the study period. Pirik (*L. micracanthus*) in the Gilireng River demonstrated nearly an isometric growth pattern. Condition factor values ranged from 0.6455 to 4.3239, and the average condition factor values for female fish were smaller than male fish. The result of this study has contributed to the knowledge of the endemic pirik fish population in the Gilireng River that could assist fishery management scientists in conducting studies on the management of these fish.

Cite this as: Ningsih, N. R., Andy Omar, S., Haris, A., Nur, M., & Larasati, R. F. (2023). Length-weight Relationship and Condition Factors of Endemic Fish, *Lagusia micracanthus* Bleeker, 1860 (Pisces: Terapontidae) in Gilireng River, Wajo Regency, Indonesia. *Jurnal Ilmiah Perikanan dan Kelautan*, 15(2):290–302. http://doi.org/10.20473/jipk.v15i2.40950

## 1. Introduction

In ecology, endemism is an important concept in biogeography and plays a role in conservation biology. Endemism describes taxa in certain areas which is absent in other places (Andy Omar, 2012; Tedesco *et al*., 2012). Endemic species have always attracted attention, as they reflect the role of speciation, extinction and dispersal which are ultimately responsible for limited geographic distributions, which is responsible for distribution-limited geographies (Rosindell and Phillimore, 2011).

The freshwater environment of Sulawesi Island is a place for some endemic animals, including freshwater fish (Miesen *et al*., 2016). The island has 56 endemic freshwater fish species. Species of endemic freshwater fish from the Gobiidae family are represented by 10 species, including the genera *Mugilogobius, Glossogobius,* and *Redigobius*; Eleotridae and Terapontidae are respectively represented by one species from the genus *Bostrychus*, and *Lagusia* (Parenti, 2011). Hadiaty (2018) reported that 68 species of endemic fish in the freshwater of Sulawesi Island have legal status.

*Lagusia micracanthus* Bleeker, 1860, also known as pirik fish (Andy Omar, 2012), is the only species of freshwater endemic fish from Terapontidae. The habitat of *L. micracanthus* is a stream with a rocks and sandy substrate with a heavy water flow. This fish swims quickly among stones (Vari and Hadiaty, 2012). Therefore, the types of *L. micracanthus* are found in the river flow in the Maros and in the Walannae Cenrana areas due to the abundance of flowing river on these areas (Nur *et al*., 2020). In addition to the two locations, pirik fish is also found in the Gilireng River, Wajo Regency. However, information on *L. micracanthus* in this river has not yet been found.

Research on the length−weight relationship of pirik fish has been conducted in the Pattunuang River, Maros Regency (Amir, 2015), Sanrego River, Bone Regency (Adnan, 2015), and several other rivers, including rivers in the Maros and Walannae Cenranae watersheds (Nur *et al*., 2022). Nevertheless, research on the length-weight relationship and condition factors for pirik fish in the Gilireng River, Arajang Village, Wajo Regency, has not been conducted yet.

The length−weight relationship is a standard method that produces important biological information in fishery evaluations (Kuriakose, 2017). Nehemia *et al*. (2012), Ujjania *et al*. (2012), Safi *et al*. (2014), Asrial *et al*. (2021), and Hamid *et al*. (2015) have used this relationship to predict fish weight based on fish length. Fish weight can be calculated on the basis their length, and vice versa. The length−weight relationship can be developed to estimate fish conditions, based on the assumption that fish with heavy weight on a certain length shows better conditions (Hamid *et al*., 2015). The length−weight relationship can also be used in morphometric comparisons of interspecies and intrapopulation (Safi *et al*., 2014). Condition factors in fisheries are used to compare the fatness, or welfare of a fish species (Dirican and Cilek, 2012). The value of high condition factors shows the effects of the biotic and abiotic factors including stress, sex, climate, food availability, and water quality (Nehemia *et al*., 2012; Ujjania *et al*., 2012). Information related to the length−weight relationship and the condition factors of *L. micracanthus* in South Sulawesi is still limited.

Therefore, this research is the first reference on the length−weight relationship and condition factors of endemic pirik fish in the aforementioned river. The results of this study can be used as a source of initial information or management of pirik fish (*L. micracanthus*) in the Gilireng River.

## 2. Material and Methods

### 2.1 Location and Research Period

The research was conducted in the Gilireng River, Arajang Village, Gilireng District, Wajo Regency (Figure 1). The river current is rather swift, with substrate consisting of stone, gravel, and sand. On the banks of the river are riparian plants. Fish sampling was conducted by a fisherman once a month using net with a mesh size of 0.3 cm and was done against the river current. Sample fish were caught with a net with a width of 5 m, a height of 1.5 m, and a mesh size of 0.3 cm. The nets were set up from morning (10.00) until evening (16.00) during each fishing period. Analysis of fish samples was carried out at Fisheries Biology Laboratory Department of Fisheries, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar. Overall, the obtained amount of fish sample during the research was 135. The fish samples were packaged in a Styrofoam box measuring 32.5 (length, cm) x 24 (width, cm) x 25 (height, cm) and filled with ice cubes to keep the fish fresh during transportation from the field to the laboratory. In the laboratory, each fish sample is measured for length and weighed. The total body length (L) is the length of a fish measured from the tip of the snout to the tip of the longer lobe of the caudal fin using a digital caliper. Total body weight (W) was then measured (Rinandha *et al*., 2020) using digital balance. The equipment used to measure fish total length is a digital caliper (Dotziro, accuracy 0.01

mm) and a digital balance (Fujitsu, accuracy 0.01 g) is used to measure fish body weight. After measuring and weighing, fish sample was dissected, the gonads were removed and observed for morphological sex determination (Andy Omar, 2013).

### 2.2 Data Collection

Data collection was carried out by measuring the body length and body weight of the fish samples. The total body length (L) is the length of a fish measured from the tip of the snout to the tip of the longer lobe of the caudal fin using a digital caliper. Total body weight (W) was then measured (Rinandha *et al*., 2020) using digital balance. The equipment used to measure fish total length is a digital caliper (Dotziro, accuracy 0.01 mm) and a digital balance (Fujitsu, accuracy 0.01 g) is used to measure fish body weight. After that, each fish sample was dissected, the gonads were removed and observed for morphological sex determination (Andy Omar, 2013).

### 2.3 Data Analysis

#### 2.3.1 Length–weight relationship

The relationship between length and weight can be used to determine fish growth patterns (Ofor and Pepple, 2012). The length-weight relationship was analyzed overall by sex. The length-weight relationship was determined by linear regression analysis through the following equation:

$$W = aL^b \qquad \text{........ Eq (1)}$$

where:
W = body weight (g)
L = total length (mm)
a = intercept
b = regression coefficient.

The values "*a*" and "*b*" were calculated by using least squares regression method or logarithmic transformation data by Andy Omar *et al*. (2020):

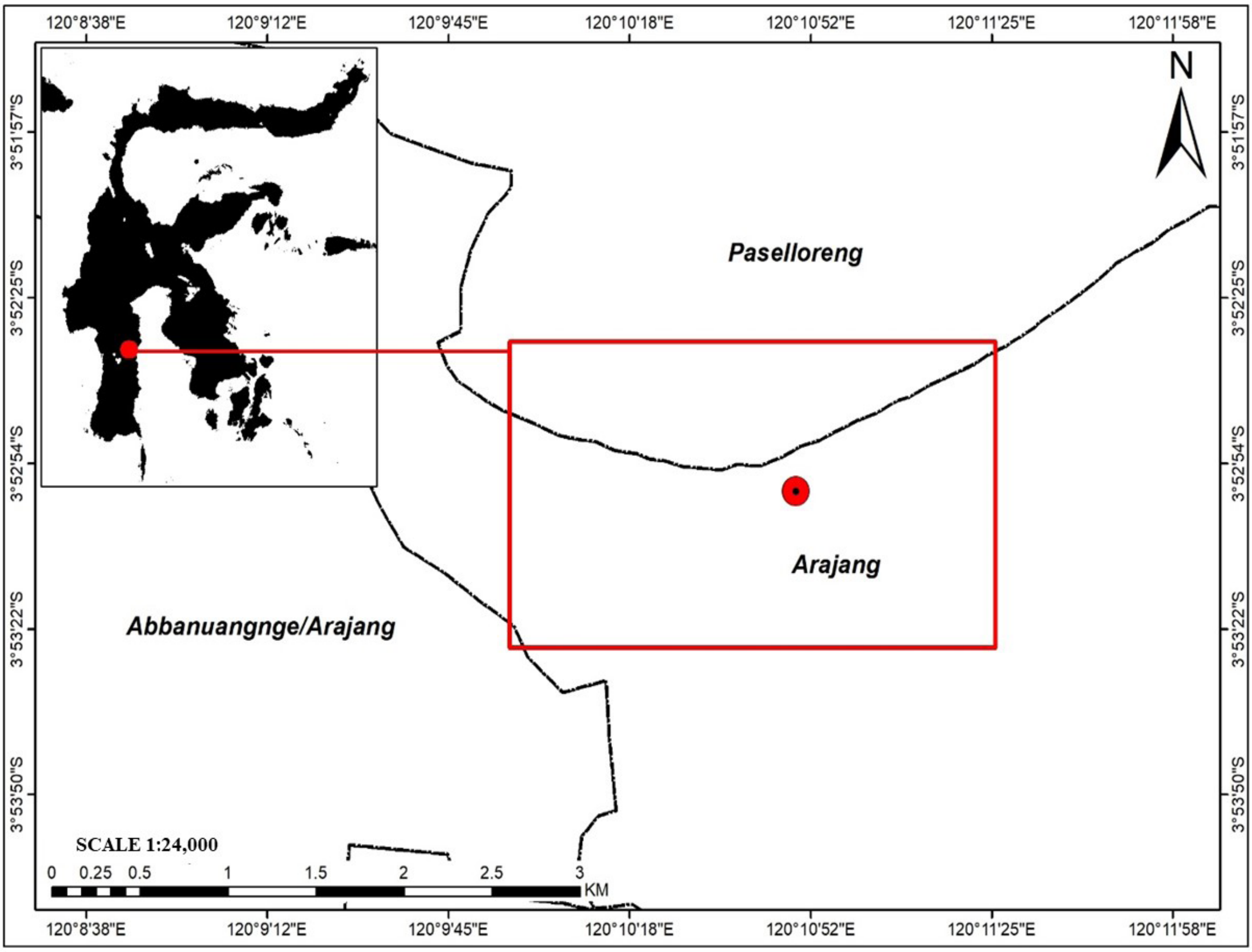


**Figure 1.** Map of research location at Gilireng River, Wajo Regency, South Sulawesi. The red dot is sampling location on the Gilireng River.

$$\log W = \log a + b \log L \quad \ldots \text{Eq (2)}$$

T-test against value "b" was then conducted by using the following equality to determine whether the obtained "b" value is equal to a value of 3 or not:

$$T_{val} = |(b-3)/S_b| \quad \ldots \text{Eq (3)}$$

where:
$t_{val}$ = t-value
"$b$" = regression coefficient
$S_b$ = standard error of "$b$"

If $t_{val}$ value is larger than $t_{tab}$ value at a probability level of 95%, then "b" is different from 3; if $t_{val}$ value is smaller than $t_{tab}$, then "b" is equal to 3 (Andy Omar, 2013).

The obtained value "b" can be used to determine the fish growth type. This value can be divided into the following three forms: isometric ($b = 3$), negative or minor allometric or hypo-allometric ($b < 3$), and positive or major allometric or hyper-allometric ($b > 3$) (Froese *et al*., 2011; Kumar *et al*., 2017; Asrial *et al*., 2021).

T-test was also used to compare regression coefficient "b" between male and female fish using following equation (Fowler *et al*., 1998):

$$t_{val} = (b_1 - b_2) / SE_{(b1 - b2)} \quad \ldots \text{Eq (4)}$$

where:
$t_{val}$ = t-value
$b_1$ = regression coefficient of male fish
$b_2$ = regression coefficient of female fish
SE = standard error

If $t_{val}$ is smaller than $t_{tab}$ at a probability level of 95%, then regression coefficient "b" between male and female fish was not significantly different. Therefore, male, and female fish data can be combined, creating a combined length−weight relationship equation. On the contrary, if $t_{val}$ value is larger than $t_{tab}$ value at a probability level of 95%, then regression coefficient "b" between male and female fish is really different (Andy Omar *et al*., 2020).

*2.3.2 Condition factors*

The condition factors (K) were analyzed on the basis of growth pattern obtained from the length−weight relationship (Abowei, 2010; Ahmed *et al*., 2011; Nakul *et al*., 2016). These factors were distinguished accordance to their sex. To compare the condition factor values between male and female fish, the t-test was used (Andy Omar, 2013):

$$K = 10^5 W / L^3 \quad \ldots \text{Eq (5)}$$

where:
K = condition factor
W = mean body weight (g) of the fish in a given size class
L = mean total length (mm) of the fish in the same size class

If fish growth follows an allometric pattern (hypo-allometric or hyper-allometric), then the condition factor formula used follows the relative condition factor formula by Andy Omar *et al*. (2020):

$$Kn = W / W^* \quad \ldots \text{Eq (6)}$$

where:
Kn = relative condition factor
W = observed mass (g) of an individual
W* = predicted mass, which is obtained from the linear regression of the length-weight relationship of the respective population sample ($aL^b$)

## 3. Results and Discussion

### *3.1 Size Distribution*

A total of 135 fish with 69 males and 66 females were caught during the study period. Most male fish were caught in the total length range of 73.6-81.8 mm (mid-class 77.7 mm) while female fish were caught in the size range of 98.5-106.7 mm (mid-class 102.6 mm). Based on body weight, both male and female fish were mostly caught in the size range of 8.00-12.78 g (mid-class 10.39 g). The average total length (TL) and body weight of female fish were larger than that of male *L. micracanthus*, but the total length and body weight of male and female fish were not significantly different (P > 0.05). The average total length and body weight of female fish was larger than male fish, which is also found in pirik fish that live in the Pattunuang River (Amir, 2015) and the Sanrego River (Adnan, 2015). The male pirik fish caught in the Pattunuang River had a total length ranging from 35.81 mm to 90.54 mm (66.08 ± 0.68 mm TL) and body weight ranging from 0.882 g to 13.10 g (5.47 ± 0.25 g), while female fish had a total length ranging from 49.76 mm to 92.14 mm (67.80 ± 0.71 mm TL) and body weight ranging from to 1.52 g to 15.08 g (6.02 ± 0.23 g). In the Sanrego River, the caught male pirik fish has total length ranging from 37.27 mm to 107.28 mm (69.54 ± 1.90 mm) and body weight ranging from 1.19 g to 23.21 g (6.86 ± 0.56 g) while those of female fish ranged from 42.58 mm to 103.75 mm (73.49 ± 1.73 mm) and 1.79g to 20.03 g (8.34 ± 0.55 g), respectively. The above data reveal that pirik fish that lives in the Gilireng River has larger body size than that living in the Pattunuang and Sanrego

Rivers. This size difference is thought to be due to the differences in environmental conditions among the three rivers. Water temperature in Gilireng River ranged from 24.9-29.5°C, the pH ranged from 5.7-7.5, the dissolved oxygen ranged from 3.9-7.9 ppm, the turbidity values ranged from 5.2-6.1 NTU, current speed ranged from 0.01-1.14 m/s and water depth ranged from 9.8-115 cm.

More female fish than male fish was found in the total length class range which was larger than 94.3 mm (Figure 2). In addition, the number of female fishes were also more common in the range of body weight which was larger than 24.76 g. Female fish caught during sampling are thought to be in spawning period, so they have a larger body length and body weight compared to male fish.

### 3.2 Length−Weight Relationship

The total length (L) − body weight (W) relationship of male pirik fish was $W = 0.000023\ L^{2.9409}$, whereas that of female fish was $W = 0.000038\ L^{2.8284}$. T-test results revealed that the regression coefficient value "b" of either male or female fish has isometric growth type (b = 3) and the increase in body length is

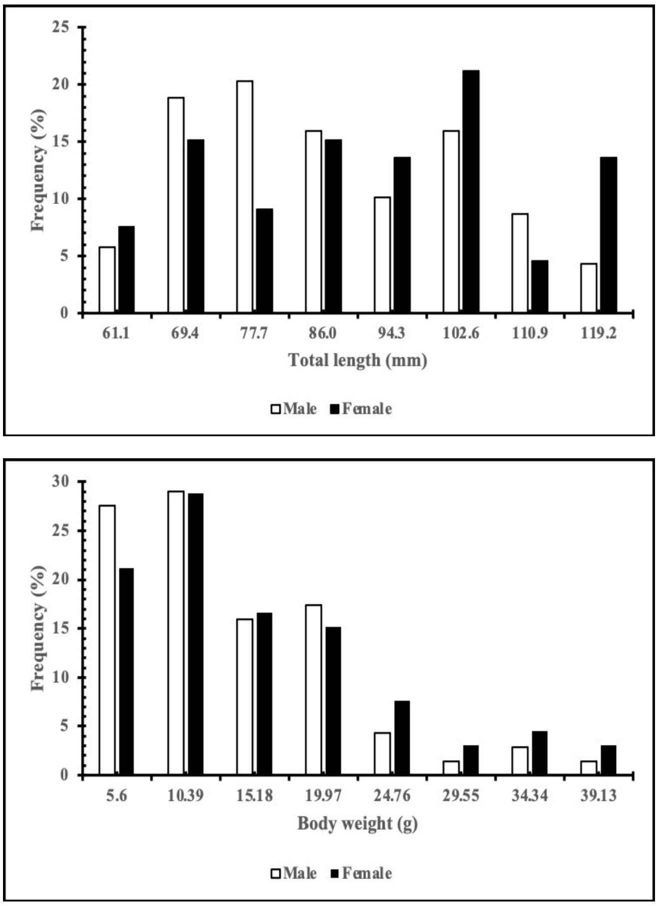


**Figure 2.** Total length (above) and body weight (below) frequency of *Lagusia micracanthus* in Gilireng River

as fast as that in weight. Further statistical analysis of the regression coefficients between male and female fish showed no significant difference ($p>0.05$), indicating that in general the body length and body weight gain of male and female pirik (*L. micracanthus*) does not differ. Therefore, the data for male and female fish were combined, resulting $W = 0.000032\ L^{2.8723}$, which shows an isometric growth type (Figure 3). Isometric growth demonstrated that all body parts grow at the same level, and this proportion does not vary significantly over an observable range of sizes (Andy Omar *et al.*, 2020).

Amir (2015) found that the male pirik fish caught in the new moon phase in the Pattunuang River has isometric growth type of ($W = 0.000034\ L^{3.3483}$; n = 86; r = 0.9235) whereas female pirik fish has hyper-allometric growth type of ($W = 0.000004\ L^{3.3483}$; n = 80; r = 0.9380). In the full moon, both male and female pirik fish had hyper-allometric growth type with the equation $W = 0.000005\ L^{3.3145}$ (n = 95; r = 0.9693) for male and $W = 0.000003\ L^{3.4419}$ (n = 56; r = 0.9511) for female. In the Sanrego River. Adnan (2015) obtained male pirik fish (*L. micracanthus*) at the new moon giving the equation of $W = 0.000025\ L^{2.9248}$ (n = 34; r = 0.9868) which indicate an isometric growth type while female fish have a growth type hypo-allometric with the equation of $W = 0{,}000044\ L^{2{,}8119}$ (n = 54; r = 0,9871). Pirik fish caught during full moon in the Sanrego River had an isometric growth type, both in male fish ($W = 0.000023\ L^{2.8554}$; n = 24; r = 0.9825) and in female fish ($W = 0.000036\ L^{2.8307}$; n = 87; r = 0.9872). Two growth types of endemic pirik fish (*L. micracanthus*) from several rivers in South Sulawesi were isometric and hypo-allometric. Isometric growth was found in the Ompo River and Sanrego River (Nur *et al.,* 2022) as well as in the Pattunuang River (Nur, 2015). By contrast, a hypo-allometric growth type was observed by Nur *et al.* (2022) in the Assanae River, Batu Puteh River, Camba River, whereas by Nur *et al.* (2020) in the Bantimurung River, Pattunuang River, Pucak River, and by Nur (2015) in Sanrego River (Table 1).

The hypo-allometric growth type of ($b<3$) is obtained if the increase in body weight is slower than the increase in length, whereas hyper-allometric growth ($b>3$) is obtained if the increase in weight is faster than the increase in body length. Fish that have hypo-allometric growth become relatively slender when they grow bigger and if they have hyper-allometric growth, the fish became fatter when they grow bigger (Andy Omar *et al.*, 2020). In this study, the growth type of endemic pirik fish (*L. micracanthus)* from Gilireng River was isometric. Regression coefficient value coefficient "b" showed variation either interlocation or from the same waters (Table 1). The regression coefficient can vary seasonally, daily, and in different

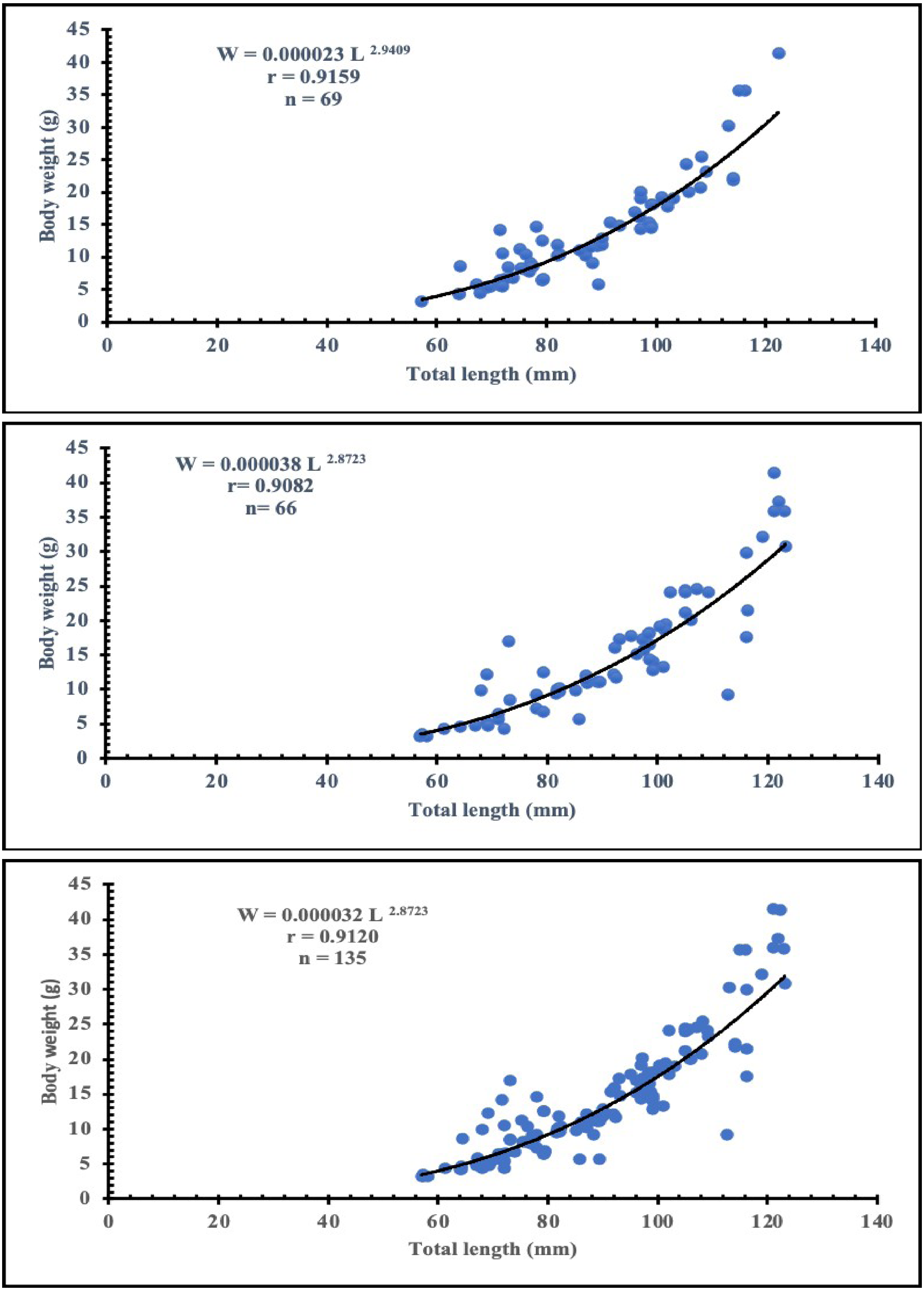


**Figure 3.** Length-weight curves and equations of *Lagusia micracanthus* in Gilireng River. Above: Males; Middle: Females; Below: All specimens (male + female)

**Table 1.** Regression coefficients and growth patterns of endemic fish *L. micracanthus* from several rivers in South Sulawesi, Indonesia

| River | Sex | n | Regression parameters | | | Growth type | References |
|---|---|---|---|---|---|---|---|
| | | | a | b | r | | |
| Assanae | Male | 64 | 0.00008 | 2.6301 | 0.93 | NA | Nur *et al.* (2022) |
| | Female | 58 | 0.00005 | 2.7378 | 0.95 | NA | |
| | Pooled | 122 | 0.00006 | 2.6984 | 0.94 | NA | |
| Bantimurung | Male | 217 | 0.0010 | 2.5190 | 0.96 | NA | Nur *et al.* (2020) |
| | Female | 206 | 0.0010 | 2.5225 | 0.93 | NA | |
| | Pooled | 423 | 0.0010 | 2.5237 | 0.94 | NA | |
| Batu Puteh | Male | 121 | 0.00006 | 2.7118 | 0.95 | NA | Nur *et al.* (2022) |
| | Female | 101 | 0.00006 | 2.6972 | 0.97 | NA | |
| | Pooled | 222 | 0.00005 | 2.7395 | 0.97 | NA | |
| Camba | Male | 116 | 0.00006 | 2.7269 | 0.96 | NA | Nur *et al.* (2022) |
| | Female | 105 | 0.00006 | 2.7003 | 0.97 | NA | |
| | Pooled | 221 | 0.00006 | 2.7230 | 0.96 | NA | |
| Ompo | Male | 75 | 0.00003 | 2.8379 | 0.96 | IS | Nur *et al.* (2022) |
| | Female | 71 | 0.00008 | 3.1818 | 0.96 | IS | |
| | Pooled | 146 | 0.00001 | 3.0488 | 0.96 | IS | |
| Pattunuang | Male | 307 | 0.00002 | 2.9489 | 0.89 | IS | Nur (2015) |
| | Female | 288 | 0.00001 | 3.0724 | 0.88 | IS | |
| | Pooled | 595 | 0.00002 | 3.0089 | 0.88 | IS | |
| | Male | 513 | 0.00001 | 2.5167 | 0.94 | NA | Nur *et al.* (2020) |
| | Female | 378 | 0.00005 | 2.7533 | 0.96 | NA | |
| | Pooled | 891 | 0.00009 | 2.6241 | 0.95 | NA | |
| Pucak | Male | 263 | 0.00009 | 2.0530 | 0.90 | NA | Nur *et al.* (2020) |
| | Female | 273 | 0.00008 | 2.6281 | 0.92 | NA | |
| | Pooled | 536 | 0.00010 | 2.4953 | 0.92 | NA | |
| Sanrego | Male | 72 | 0.00003 | 2.8719 | 0.97 | NA | Nur (2015) |
| | Female | 90 | 0.00003 | 2.8574 | 0.97 | NA | |
| | Pooled | 162 | 0.00003 | 2.8846 | 0.97 | NA | |
| | Male | 110 | 0.00010 | 3.0775 | 0.96 | IS | Nur *et al.* (2022) |
| | Female | 99 | 0.00005 | 2.8771 | 0.95 | IS | |
| | Pooled | 209 | 0.00020 | 3.0032 | 0.96 | IS | |
| Gilireng | Male | 69 | 0.000023 | 2.9409 | 0.92 | IS | This study |
| | Female | 66 | 0.000038 | 2.8284 | 0.91 | IS | |
| | Pooled | 135 | 0.000032 | 2.8723 | 0.91 | IS | |

Note: n = number of fish, a = intercept, b = slope, r = correlation coefficient, NA = negative allometric (hypoallometric), IS = isometric habitats (Andy Omar *et al*., 2020). Zubia *et al*. (2014) emphasized that coefficient "b" can vary differently based on the rate of interpopulation even when they are from the same species. The following factors can influence length-weight relationships in fish: water environment factors (temperature, salinity, and habitats); differentiation of sample account, geographic location, season, ontogenetic differentiation, age differentiation, growth phase, gonad maturity level, reproduction, sex, and food (quantity, quality and size); gastric fullness, parasites pressure, and preservative techniques (Alavi-Yeganeh *et al*., 2011; Hossain *et al*., 2012; Mir *et al*., 2012; Özdemir and Erkakan, 2012; Zaher *et al*., 2015; Milošević and Talevski, 2016; Azevedo *et al*., 2017; Moeslen and Daka, 2017; Hanif *et al*., 2020); health and fish condition (Hossain *et al*., 2012), food availability, overexploitation (Famoofo and Abdul, 2020); sample retrieval procedure (Jafari *et al*., 2017; Shalloof and El-Far, 2017; Olopade *et al*., 2018; Mitu *et al*., 2019). The size range used can also influence regression coefficient

**Table 2.** Condition factors of endemic fish *L. micracanthus* from several rivers in South Sulawesi, Indonesia

| River | Sex | n | Total length (mm) | Body weight (g) | Condition factor | | References |
|---|---|---|---|---|---|---|---|
| | | | | | Range | Mean±se | |
| Assanae | Male | 64 | 36.76-85.83 | 0.78-12.45 | 0.5538-1.5057 | 1.0008±0.1872 | Nur *et al*. (2022) |
| | Female | 58 | 24.07-99.04 | 0.44-14.95 | 0.6571-1.4365 | 1.0293±0.1637 | |
| Bantimurung | Male | 217 | 31.58-127.79 | 0.76-26.13 | 0.3066-4.1608 | 1.3489±0.3066 | Nur *et al*. (2022) |
| | Female | 206 | 35.19-119.40 | 1.32-25.33 | 0.3026-3.7318 | 1.3429±0.3026 | |
| Batu Puteh | Male | 121 | 24.45-99.87 | 0.20-15.67 | 0.3603-1.6655 | 0.9575±0.1678 | Nur *et al*. (2022) |
| | Female | 101 | 25.35-103.51 | 0.27-20.33 | 0.6289-1.4319 | 1.0567±0.1372 | |
| Camba | Male | 116 | 29.59-87.03 | 0.50-12.53 | 0.8057-1.6409 | 1.1674±0.1638 | Nur *et al*. (2022) |
| | Female | 105 | 25.65-92.27 | 0.39-13.36 | 0.7449-1.5208 | 1.0683±0.1335 | |
| Ompo | Male | 75 | 41.48-100.10 | 1.60-21.58 | 0.5423-1.0635 | 0.7057±0.1135 | Nur *et al*. (2022) |
| | Female | 71 | 46.90-106.64 | 1.87-30.43 | 0.7075-1.6834 | 1.0495±0.1842 | |
| Pattunuang | Male | 181 | 35.81-90.54 | 0.882-13.103 | 1.5655-4.0294 | 1.7877±0.2925 | Amir (2015) |
| | Female | 136 | 49.76-92.14 | 1.524-15.083 | 0.7716-1.9527 | 1.0110±0.0140 | |
| | Male | 513 | 37.70-106.55 | 0.96-22.31 | 0.250-2.408 | 1.417±0.250 | Nur *et al*. (2020) |
| | Female | 378 | 39.85-121.07 | 1.01-31.07 | 0.1659-1.6184 | 1.0541±0.1659 | |
| Pucak | Male | 263 | 37.59-95.80 | 1.45-12.67 | 0.5997-1.9876 | 1.0350±0.1760 | Nur *et al*. (2020) |
| | Female | 273 | 46.90-111.40 | 1.65-21.81 | 0.6773-1.8063 | 1.0588±0.1733 | |
| Sanrego | Male | 58 | 37.27-107.28 | 1,196-23.214 | 1.4565-2.3102 | 1.8239±0.0255 | Adnan (2015) |
| | Female | 68 | 42.58-103.75 | 1.798-20.035 | 0.7593-1.3075 | 1.0046±0.0118 | |
| | Male | 110 | 27.61-90.15 | 0.28-11.07 | 0.8671-2.1545 | 1.2443±0.2468 | Nur *et al*. (2022) |
| | Female | 99 | 29.81-88.13 | 0.46-11.14 | 0.3083-0.9473 | 0.5739±0.1166 | |
| Gilireng | Male | 69 | 57.3-122.3 | 3.21-41.32 | 0.8033-3.8686 | 1.8548±0.0565 | This study |
| | Female | 66 | 57.0-123.2 | 3.21-41.50 | 0.6455-4.3239 | 1.8197±0.0656 | |

Note: n = number of fishes

value "b" (Nazir and Khan, 2017; Blasina *et al.*, 2018). Furthermore, Nazir and Khan (2017) suggested not to use fish sample with a young or old age in calculating the length-weight regression. In addition to being a single factor, another factor is the differentiation of physico-chemical characteristics of habitats. Some of these factors were not observed during the fish sampling.

The correlation coefficient values ('r") acquired during the study are 0.9158 (male fish), 0.9082 (female fish), and 0.9120 (combination of female and male fish). The coefficient value is lower compared to a study from Amir (2015), wherein the Pattunuang River ranged from 0.9434 to 0.9441, and Adnan (2015), wherein the Sanrego River ranged from 0.9854 to 0.9862. Andy Omar (2013) revealed that the correlation coefficient value of 0.90 − 1.00 showed very strong correlation. This result indicated that the growth pattern in the length of pirik fish (*L. micracanthus*) is followed by an increase in body weight.

### *3.3 Condition Factors*

The results of male fish condition factors revealed that values obtained in the Gilireng River ranged from 0.8033 to 3.8686 (mean ± standard error, 1.8548 ± 0.0565) and those of female fish ranged from 0.6455 to 4.3239 (1.8197 ± 0.0656). The mean male fish condition factors are generally larger than those of female fish. However, no statistically significant differences ($P > 0.05$) were observed. The average value of the condition factor for male fish which is larger than female fish was also obtained by Amir (2015) pirik fish caught in the Pattunuang River and Adnan (2015) on pirik fish caught in the Sanrego River, both during the new moon phase and during full moon phase. Male pirik fish caught during the new moon in the Pattunuang River had condition factors ranging from 1.1943 − 4.0294 (1.8059 ± 0.0399) and female fish ranging from 0.7239 - 1.8705 (0.9645 ± 0.0179). In the full moon phase, the condition factor for male pirik fish ranged from 0.7951 to 1.4928 (1.0287 ± 0.0125) and female fish ranged from 0.7570 to 1.7357 (0.9504 ± 0.0200). In contrast, male pirik fish in the Sanrego River during the new moon phase had conditions ranging from 0.8169 to 1.2828 (0.9924 ± 0.0118). For the full moon phase, male fish condition factors ranged from 1.4565 to 2.3102 (1.8340 ± 0.0447) and female fish ranged from 1.5987 to 2.4054 (1.8087 ± 0.0566). It appears the average value of the condition factor for male pirik in the Gilireng River was larger than that of male pirik in the Assanae River (Nur *et al.*, 2022), Batu Puteh River (Nur *et al.*, 2022), Camba River (Nur *et al.*, 2022), Ompo River (Nur *et al.*, 2022), Pattunuang River (Nur *et al.*, 2020), Pucak River (Nur *et al.*, 2020), and Sanrego River (Adnan, 2015; Nur *et al.*, 2022). However, the condition factor for pirik fish in the Bantimurung River (Nur *et al.*, 2022) and the Pattunuang River (Amir, 2015) has higher average condition factor values compared to this study (Table 2). The same result was found for female pirik fish in the Gilireng River, which demonstrated an average condition factor value larger than that of several other rivers.

Condition factors can be used to evaluate the physiological status of fish type in its habitat based on the principle that individuals with a certain length have large body weight have a better "condition" (Awasthi *et al.*, 2015; Falaye *et al.*, 2015; Azevedo *et al.*, 2017). Condition factors can also be used to measure the health of individuals in a population or determine whether a population is healthier than other populations (Falaye *et al.*, 2015). Significant variations may be found in the value of the condition factor between members of one population due to body length differences despite sampling being conducted simultaneously (Parawansa *et al.*, 2020).

Fishes with a condition factor (K) larger than 1 indicate their superior condition to other fishes with condition factor values less than 1 in the same water (Awasthi *et al.*, 2015; Falaye *et al.*, 2015; Andy Omar *et al.*, 2020). Condition factor $K > 1$ and $K < 1$ show favorable and poor environmental conditions for fish growth, respectively (Ahmed *et al.*, 2017; Singh and Serajuddin, 2017). Fishes that have 1.00 condition factor generally had poor condition with long and thin bodies whereas those under good condition should have a condition factor of approximately 1.40 (Andy Omar *et al.*, 2020). Based on these criteria, 92.75% of male pirik fish and 87.88% of female fish had $K > 1.40$. This finding shows that the environmental conditions of Gilireng River are quite good for pirik fish to growth successfully and ensure population continuity.

Different values of fish condition factors are affected by many factors, including sex, season, environmental factors, stress, gonad development, food availability, and feeding activity (Emre *et al.*, 2010; Gupta *et al.*, 2011; Özdemir and Erkakan, 2012; Zargar *et al.*, 2012; Awasthi *et al.*, 2015). In addition, age (Falaye *et al.*, 2015), climate, and other water quality parameters (Olopade *et al.*, 2018) can affect the values of the condition factors.

## 4. Conclusion

Based on the results of this study it can be concluded that the endemic fish *L. micracanthus* caught in the Gilireng River generally has an isometric growth type, showing a growth in body length proportional to the increase in weight, both in male and female fish. The condition factors of male fish is greater than that of female fish. Therefore, environmental conditions in the Gilireng River must be considered because it is a suitable habitat for supporting the growth of *L. micracanthus*.

## Acknowledgment

This research activity started with the preparation of proposals for the publication of research results assisted by many parties. The author would like to thank the fisherman and all parties of the Paselloreng Dam, Wajo Regency, which has an assisted team for sampling. The author also thank Risnayanti who has assisted during the research.

## Authors' Contributions

The authors have made excellent contributions. SbAO; designed the research, conducted data analysis and together with AH, examined the final draft of the manuscript before it was sent to the journal management. NRN; designed and carried out field surveys, wrote research reports, conducted data analysis, and made manuscripts of scientific publication. MN and RFL; checked the reconstructed sentences and vocabularies and accomplished the publication text.

## Conflict of Interest

The authors declare that they have no conflict of interest.

## Funding Information

Research and publications are funded by authors.

## References

Abowei, J. F. N. (2010). The condition factor, length-weight relationship and abundance of *Ilisha africana* (Block, 1795) from Nkoro River Niger Delta, Nigeria. *Advance Journal of Food Science and Technology*, 2(1):6-11.

Ahmed, E. O., Ali, M. E., & Aziz, A. A. (2011). Length-weight relationships and condition factors of six fish spesies in Atrabara River and Khashm el-Girba reservoir, Sudan. *International Journal of Agricultural Science,* 3(1):65-70.

Ahmed, E. O., Ali, M. E., Aziz, A. A., & Rafi, E. M. K. (2017). Length-weight relationships and condition factors of five freshwater fish species in Roseires reservoir, Sudan. *European Journal of Physical and Agricultural Sciences*, 5(2):26-33.

Adnan, M. N. (2015). Hubungan panjang-bobot tubuh dan faktor kondisi ikan pirik (*Lagusia micracanthus* Bleeker, 1860) di Sungai Sanrego, Kabupaten Bone. Unpublished Thesis. Makassar: Universitas Hasanuddin.

Alavi-Yeganeh, M. S., Seifabadi, S. J., Keivany, Y., Kazemi, B., & Wallis, G. P. (2011). Comparison of length-weight relationships in different populations and sexes of Iranian thoothcarps. *Journal of Applied Ichthyology*, 27(6):1401-1403.

Amir, N. F. (2015). Panjang - bobot tubuh dan faktor kondisi ikan pirik (*Lagusia micracanthus* Bleeker, 1860) di Sungai Pattunuang, Desa Samangki, Kabupaten Maros. Unpublished Thesis. Makassar: Universitas Hasanuddin.

Andy Omar, S. Bin. (2012). Dunia ikan. Yogyakarta: Universitas Gadjah Mada Press.

Andy Omar, S. Bin. (2013). Biologi perikanan. Makassar: Universitas Hasanuddin.

Andy Omar, S. Bin., Kariyanti., Yanuarita, D., Umar, M. T., & Lawi, Y. S. A. (2020). Length-weight relationship and condition factor of the Celebes rainbowfish *Marosatherina ladigesi*, endemic to the Maros karst region. *AACL Bioflux*, 13(6):3384-3396.

Asrial, E., Arapat, Y., Hadi, U. K., Kalih, L. A. T. T. W. S., Liliyanti, M. A., Rosadi, E., Khasanah, R. I., & Rathnayake, I. N. (2021). The length-weight relationship and condition factors of bullet tuna landed at the Tanjung Luar fishing port, Indonesia. *Jurnal Ilmiah Perikanan dan Kelautan*, 13(1):1-10.

Awasthi, M., Kashyap, A., & Serajuddin, M. (2015). Length_weight relationship and condition factor of five sub_populations of *Trichogaster lalius* (Osphronemidae) of central and eastern regions of India. *Journal of Ichthyology*, 55(6):849-853.

Azevedo, J. W. J., Castro, A. C. L., & Silva, M. H. L. (2017). Length-weight relation, condition factor and gonadosomatic index of the whitemouth croaker, *Micropogonias furnieri* (Desmarest, 1823) (Actinopterygii: Sciaenidae), caught in Lençóis Bay, state of Maranhão, eastern Amazon, Brazil. *Brazilian Journal of Oceanography*, 65(1):1-8.

Blasina, G. E., Izzo, L., & Figueroa, D. (2018). Sexual dimorphism and length–weight relationship of the hairy conger eel *Bassanago albescens* (Anguilliformes: Congridae). *Journal of Ichthyology*, 58(3):396-400.

Dirican, S., & Cilek, S. (2012). Condition factors of seven Cyprinid fish species from Çamligöze dam lake on central Anatolia, Turkey. *African Journal of Agricultural Research*, 7(31):4460-4464.

Emre, Y., Balik, I., Sümer, Ç., Oskay, D. A., & Yeşilçimen, H. Ö. (2010). Age, growth, length-weight relationship and reproduction of the striped seabream (*Lithognathus mormyrus* L., 1758) (Sparidae) in the Beymelek Lagoon (Antalya, Turkey). *Turkish Journal of Zoology*, 34(1):93-100.

Falaye, A. E., Opadokun, I. O., & Ajani, E. K. (2015). Seasonal variation in the length – weight relationships and condition factor of *Gymnarchus niloticus* Cuvier, 1829 in Lekki lagoon, Lagos state, Nigeria. *International Journal of Fisheries and Aquatic Studies*, 2(6):159-162.

Famoofo, O. O & Abdul, W. O. (2020). Biometry, condition factors and length-weight relationships of sixteen fish species in Iwopin fresh-water ecotype of Lekki Lagoon, Ogun State, Southwest Nigeria. *Heliyon*, 6(1):1-6.

Fowler, J., Cohen, L., & Jarvis, P. (1998). Practical statistics for field biology (2nd ed.). Chichester: John Wiley & Sons Ltd.

Froese, R., Tsikliras, A. C., & Stergiou, K. I. (2011) Editorial note on weight–length relations of fishes. *Acta Ichthyologica et Piscatoria,* 41(4):261-263.

Gupta, B. K., Sarkar, U. K., Bhardwaj, S. K., & Pal, A. (2011). Condition factor, length-weight and length-length relationships of an endangered fish *Ompok pabda* (Hamilton 1822) (Siluriformes: Siluridae) from the River Gomti, a tributary of the River Ganga, India. *Journal of Applied Ichthyology*, 27(3):962-964.

Hadiaty, R. K. (2018). Taxonomical status of endemic freshwater ichthyofauna of Sulawesi. *Jurnal Iktiologi Indonesia*, 18(2):175-190.

Hamid, M. A., Mansor, M., & Nor, S. A. M. (2015). Length-weight relationship and condition factor of fish populations in Temengor Reservoir: Indication of environmental health. *Sains Malaysiana*, 44(1):61-66.

Hanif, M. A., Siddik, M. A. B., & Ali, M. M. (2020). Length-weight relationships of seven cyprinid fish species from the Kaptai Lake, Bangladesh. *Journal of Applied Ichthyology*, 2020;00:1-4.

Hossain, M. Y., Rahman, M. M., Fulanda, B., Jewel, M. A. S., Ahamed, F., & Ohtomi, J. (2012). Length-weight and length-length relationships of five threatened fish species from the Jamuna (Brahmaputra River tributary) River, northern Bangladesh. *Journal of Applied Ichthyology*, 28(2):275-277.

Jafari, O., Hedayati, A. A., & Keivany, Y. (2017). Length-weight relationships and condition factors of *Alburnus zagrosensis* Coad, 2009, from three rivers of Tigris basin in Iran (Teleostei: Cyprinidae). *Iranian Journal of Ichthyology*, 3(4):316-319.

Kumar, R., Abujam, S., Darshan, A., Kumari, A., & Das, D. N. (2017). Length-weight relationship of *Lepidocephalichthys guntea* (Hamilton, 1822) from Dikrong River, Arunachal Pradesh. *World Wide Journal of Multidisciplinary Research and Development*, 4(2):197-200.

Kuriakose, S. (2017). Statistical methods. In S. Kuriakose, K. G. Mini & T. V. Sathianandan (Ed.), Advanced methods for fish stock assessment and fisheries management. (pp. 82-96). Kochi: Central Marine Fisheries Research Institute.

Miesen, F. W., Droppelmann, F., Hüllen, S., Hadiaty, R. K., & Herder, F. (2016). An annotated checklist of the inland fishes of Sulawesi. *Boon Zoological Bulletin*, 64(2):77-106.

Milošević, D., & Talevski, T. (2016). Length-weight relationship of 11 fish species from three natural and two artificial lakes in the Former Yugoslav

Republic of Macedonia (FYROM). *Acta Zoologica Bulgarica*. 68(3):391-394.

Mir, J. I., Shabir, R., & Mir, F. A. (2012). Length-weight relationship and condition factor of *Schizopyge curvifrons* (Heckel, 1838) from River Jhelum, Kashmir, India. *World Journal of Fish and Marine Sciences*, 4(3):325-329.

Mitu, N. R., Alam, M. M., Hussain, M. A., Hasan, M. R., & Singha, A. C. (2019). Length-weight and length-length relationships, sex ratio and condition factors of the Asian striped dwarf catfish *Mystus tengara* (Hamilton, 1822) (Siluriformes: Bagridae) in the Ganges River, Northwestern Bangladesh. *Iranian Journal of Ichthyology*, 6(1):21-30.

Moeslen, M., & Daka, R. K. (2017). Length-weight relationship and condition factor of *Periopthalmu papilio* (Bloch & Schneider, 1801) obtained from a tidal creek in the Bonny Estuary, Nigeria. *Journal Aqua Fisheries Manager*, 1(1):1-4.

Nakul, B., Bhatt, N. A., Shwetanshumala, S. B. K., & Tarang, S. (2016). Length-weight relationship and condition factor of *Catla catla* in Lake Pichhola, Udaipur, Rajasthan. *International Journal of Fauna and Biological Studies*, 3(4):19-23.

Nazir, A., & Khan, M.A. (2017). Length-weight and length-length relationships of *Cirrhinus mrigala* (Cyprinidae) and *Xenentodon cancila* (Belonidae) from the River Ganga. *Journal of Ichthyology*, 57(5):787-790.

Nehemia, A., Maganira, J. D., & Rusmisha, C. (2012). Length-weight relationship and condition factor of *Tilapia* species grown in marine and fresh water ponds. *Agriculture and Biology Journal of North America*, 3(3):117-124.

Nur, M. (2015). Biologi reproduksi ikan endemik pirik (*Lagusia micracanthus* Bleeker, 1860) di Sulawesi Selatan. Makassar: Universitas Hasanuddin.

Nur, M., Rahardjo, M. F., Simanjuntak, C. P. H., Djumanto, D., & Krismono, K. (2020). Length-weight relationship and condition factor of an endemic *Lagusia micracanthus* Bleeker, 1860 in Rivers of the Maros Watershed. *Jurnal Iktiologi Indonesia*, *20*(3):263-270.

Nur, M., Rahardjo, M. F., Simanjuntak, C. P. H., Andy Omar, S. Bin., Tresnati, J., Krismono., Djumanto., & Wahana, S. (2022). Ikan endemik pirik, ekobiologi dan konservasi. Makassar: Nasmedia.

Ofor, C. O., & Pepple, P. C. G. (2012). Length-weight relationship and condition factor of *Heterobranchus longifilis* Valenciennes, 1840, reared in tanks and earthen ponds. *Asian Fisheries* Science, 25(2):124-132.

Olopade, O. A., Dienye, H. E. & Eyekpegha, A. (2018). Length frequency distribution, length-weight relationship and condition factor of cichlid fishes (Teleostei: Cichlidae) from the New Calabar River, Nigeria. *Iranian Journal of Ichthyology*, 5(1):74-80.

Özdemir, F., & Erkakan, F. (2012). Growth and reproductive properties of an endemic species, *Gobil hettitorum* Ladiges, 1960 in Yesildere stream, Karaman, Turkey. *Journal of Biology & Chemistry*, 40(4):457-468.

Parawansa, B. S., Andy Omar, S. Bin., Rappe, R. A., Nessa, M. N., & Umar, M. T. (2020). Length-weight relationship and condition factor of orange-spotted spine foot, *Siganus guttatus* (Bloch, 1787), in Takalar, South Sulawesi, Indonesia. *International Journal of Advanced Science and Technology*, 29(4):5259-5276.

Parenti, L. R. (2011). Endemism and conservation of the native freshwater fish fauna of Sulawesi, Indonesia. Paper presented at the Prosiding Seminar Nasional Ikan VI, Cibinong, Indonesia.

Rinandha, A., Andy Omar, S. Bin., Tresnati, J., Yanuarita, D., & Umar, M. T. (2020). Length-weight relationship and condition factors of Matano medaka (*Oryzias matanensis* Aurich, 1935) in Towuti Lake, South Sulawesi, Indonesia. *AACL Bioflux*, 13(4):1946-1954.

Rosindell, J., & Phillimore, A. B. (2011). A unified model of island biogeography sheds light on the zone of radiation. *Ecology Letters*, 14(6):552-560.

Safi, A., Khan, M. A., Hashmi, M. U. A., & Khan, M. Z. (2014). Length-weight relationship and condition factor of striped piggy fish, *Pomadasys stridens* (Forsskal, 1775) from Karachi coast, Pakistan. *Journal of Entomology and Zoology Studies,* 2(5):25-30.

Shalloof, K. A. Sh., & El-Far, A. M. (2017). Length-weight relationship and condition factor of some fishes from the River Nile in Egypt with special reference to four *Tilapia* species. *Egyptian Journal of Aquatic Biology & Fisheries*, 21(2):33-46.

Singh M., & Serajuddin M. (2017). Length-weight, length- length relationship and condition factor of *Channa punctatus* collected from three different rivers of India. *Journal of Entomology and Zoology Studies*, 5(1):191-197.

Tedesco, P. A., Leprieur, F., Hugueny, B., Brosse, S., Dürr, H. H., Beauchard, O., Busson, F., & Oberdorff, T. (2012). Patterns and processes of global riverine fish endemism. *Global Ecology and Biogeography*, 21(10):977-987.

Ujjania, N. C., Kohli, M. P. S., & Sharma, L. L. (2012). Length-weight relationship and condition factors of Indian major carps (*C. catla, L. rohita* and *C. mrigala*) in Mahi Bajaj Sagar, India. *Research Journal of Biology*, 02(01):30-36.

Vari, R. P., & Hadiaty, R. K. (2012). The endemic Sulawesi fish genus *Lagusia* (Teleostei: Terapontidae). *The Raffles Bulletin of Zoology*, 60(1):157-162.

Zaher, F. M., Rahman, B. M. S., Rahman, A., Alam, M, A., & Pramanik, M. H. (2015). Length-weight relationship and GSI of hilsa, *Tenualosa ilisha* (Hamilton, 1822) fishes in Meghna River, Bangladesh. *International Journal of Natural and Social Sciences*, 2(2015):82-88.

Zargar, U. R., Yousuf, A. R., Mustaq, B., & Jain, D. (2012). Length–weight relationship of the crucian carp, *Carassius carassius* in relation to water quality, sex and season in some lentic water bodies of Kashmir Himalayas. *Turkish Journal of Fisheries and Aquatic Sciences*, 12:683-689.

Zubia, M., Rehana, Y., Muhammad, S.H, & Omer, M.T. (2014). Length-weight relationship, condition and relative condition factor of four mugilid species (Family Mugilidae) from the Karachi Coast of Pakistan. *Journal of Coastal Development*, 17(385):1-5.