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Length-Weight Relationship and Condition Factor of the Giant River Prawn *Macrobrachium rosenbergii* from Poovar, Kerala, India

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Abstract: The giant river prawn, *Macrobrachium rosenbergii*, is an important freshwater aquaculture species. Understanding its growth patterns and body condition is crucial for effective fisheries management and optimizing aquaculture production. This study investigated the length-weight relationship and condition factor of *M. rosenbergii* from Poovar Estuary, Kerala, India. A total of 250 specimens were collected between June and July 2022, and 193 individuals were analyzed. The length-weight relationship was described by the equation: $W = 1.1367 * L^{1.57166}$, where W is the weight in grams and L is the total length in centimeters. The allometric coefficient ($b = 1.57166$) indicated a strong positive allometric growth pattern, with weight increasing more rapidly than length. The coefficient of determination ($R^2 = 0.5763$) suggested that 57.63% of the variation in weight could be explained by length. The mean condition factor was 102.78 (range: 60.11-209.69), indicating a generally healthy population but with considerable individual variation. The results provide valuable information for the management and selective breeding of *M. rosenbergii* in aquaculture systems. Periodic monitoring of the length-weight relationship and condition factor is recommended to account for potential changes in environmental and biological factors over time.

Keywords: Length-weight relationship, Condition factor, *Macrobrachium rosenbergii*, Allometric growth, Poovar Estuary

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Introduction

The giant river prawn, *Macrobrachium rosenbergii*, is a commercially and ecologically important freshwater prawn species widely distributed across the Indo-Pacific region. It is a highly valued aquaculture species, contributing significantly to

global freshwater prawn production (FAO, 2020). Understanding the growth patterns and overall well-being of *M. rosenbergii* populations is crucial for effective fisheries management, stock assessment, and aquaculture production

optimization.

The length-weight relationship (LWR) is a fundamental tool for evaluating the growth patterns, biomass estimation, and life history traits of fish and crustacean populations (Froese, 2006). It describes the functional relationship between the length and weight of individuals, providing insights into their growth patterns and body condition. The condition factor (K), derived from the LWR, serves as an indicator of the robustness or well-being of individuals within a population (Houde and Schekter, 1981; Froese, 2006).

In this study, we examined the length-weight relationship and condition factor of *M. rosenbergii* from Poovar, Kerala, India. Our objectives were to (1) determine the LWR parameters and evaluate the growth pattern, (2) assess the condition factor and its variation within the population, and (3) compare our findings with previous studies on *M. rosenbergii* from other regions. Understanding these aspects is crucial for effective management and sustainable utilization of this valuable aquatic resource in Poovar, Kerala, India.

Materials and Methods

Study Site and Sample Collection:

The study was conducted in Poovar Estuary (8°19'05" N, 77°04'34" E), located in the Thiruvananthapuram district of Kerala, India. A total of 250 specimens of *M. rosenbergii* were collected between June and July 2022 using baited traps set overnight. After collection, the specimens were immediately preserved in ice and transported to the laboratory.

Morphometric Measurements:

In the laboratory, the total length (TL) of each specimen was measured to the nearest 0.1 cm using a fish measuring board. The body weight (W) was recorded to the nearest 0.01 g using a digital balance after blotting the specimens with paper towels to remove excess water. A total of 193 individuals were analyzed for the length-

weight relationship and condition factor calculations.

Length-Weight Relationship and Condition Factor Calculations:

To calculate the length-weight relationship, the total length (TL) and total weight (TW) data were log-transformed:

$$\log(\text{TL}) = \log \text{ of each total length value}$$

$$\log(\text{TW}) = \log \text{ of each total weight value}$$

A linear regression analysis was then performed, with $\log(\text{TW})$ as the dependent variable and $\log(\text{TL})$ as the independent variable:

$$\log(\text{TW}) = a + b * \log(\text{TL})$$

The regression estimated the values of the parameters a (intercept) and b (slope). The length-weight relationship was described by the equation:

$$W = a * L^b$$

Where, W = Weight (g) L = Total length (mm) a = exponential form of the regression intercept (e^a), b = the regression slope

The condition factor (K) of the shrimp was calculated using the following formula (Fulton, 1904):

$$K = (W / (a * L^b)) * 100$$

Where, a and b are the parameters from the length-weight relationship.

Statistical Analyses:

All statistical analyses were performed using R studio version 4.2.1 (Core Team, 2023). The length-weight relationship was fitted using the $\text{lm}()$ function for linear regression. The regression equation used was $\log(\text{TW}) = a + b * \log(\text{TL})$, where TW is total weight and TL is total length. The significance of the regression was tested using ANOVA. The 95% confidence intervals for the parameters a and b were calculated. Additionally, the coefficient of determination (R^2) was computed to evaluate the degree of association between length and weight.

Table 1: Summary statistics for total length (TL) and total weight (TW) of *M. rosenbergii*

Statistic	Total Length (TL, cm)	Total Weight (TW, g)
Mean	6.404	22.001
Standard Deviation	1.030	8.338

Table 2: Summary statistics for the condition factor (K) of *Macrobrachium rosenbergii*

Statistic	Value
Minimum	60.11
1st Quartile	83.25
Median	104.24
Mean	102.78
3rd Quartile	121.65
Maximum	209.69

Results

The summary statistics for the total length (TL) and total weight (TW) of the *Macrobrachium rosenbergii* specimens are presented in Table 1.

The mean total length of the *M. rosenbergii* specimens was 6.404 cm, with a standard deviation of 1.030 cm. The mean total weight was 22.001 g, with a standard deviation of 8.338 g. These results provide a summary of the size distribution and weight variation within the studied population of *M. rosenbergii* from Poovar, Kerala, India.

Length-Weight Relationship:

The length-weight relationship is a vital tool for understanding the growth patterns, biomass estimation, and overall well-being of fish and crustacean populations (Froese, 2006). In this study, we examined the length-weight relationship and condition factor of the giant river prawn, *Macrobrachium rosenbergii*, an economically and ecologically important species.

The length-weight relationship for *Macrobrachium rosenbergii* was described by the equation: $W = 1.1367 * L^{1.57166}$.

Where, W is the weight in g, and L is the total length in cm.

The parameters $a = 1.1367$ and $b = 1.57166$

were estimated from the linear regression model fitted to the log-transformed data ($\log(W) = 0.12818 + 1.57166 * \log(L)$). The slope coefficient ($b = 1.57166$) was highly significant ($p\text{-value} < 2e-16$), indicating a strong positive allometric growth pattern, where weight increases more rapidly than length (Froese, 2006). The coefficient of determination ($R^2 = 0.5763$) suggests that approximately 57.63% of the variation in weight can be explained by the variation in length.

Condition Factor:

The condition factor (K) provides a measure of the robustness or well-being of individuals within a population (Froese, 2006). The condition factor (K), calculated as $K = (W / (a * L^b)) * 100$, provides a measure of the robustness or well-being of the individuals. Fulton's condition factor (K), is widely used in aquaculture and fisheries studies to determine the degree of robustness of fish and crustaceans. $K=1$ is the baseline between slender and robust condition of the organism and $K>1$ indicates the fish or crustacea is in a better condition of robustness of the organism (Hartnoll, 1982; Araneda *et al.*, 2008). The summary statistics for the condition factor are presented in Table 2.

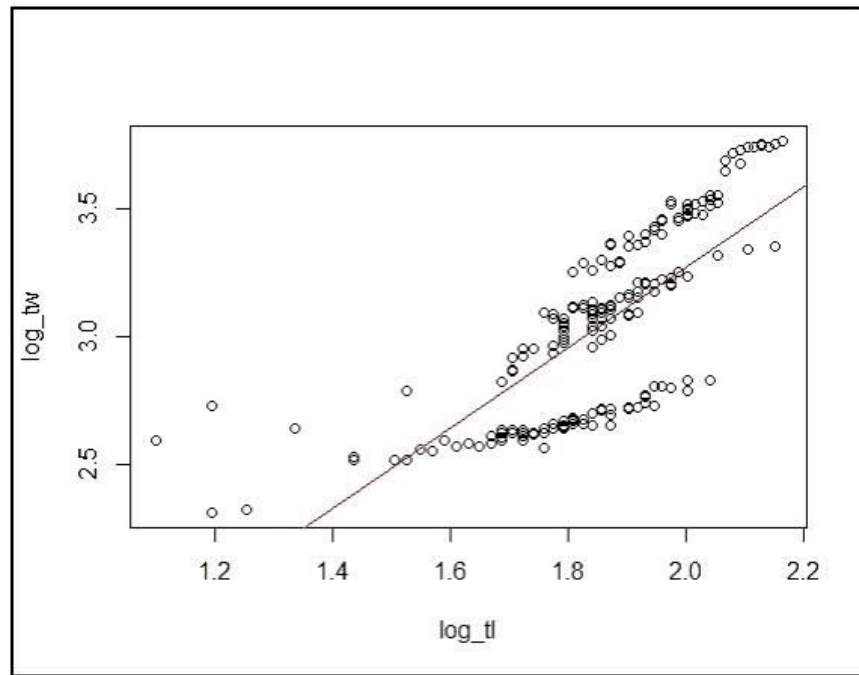


Fig.1: Length-weight relationship of *M. rosenbergii*.

In our study, the mean condition factor was 102.78, with a median of 104.24, indicating a slightly skewed distribution. The condition factor ranged from 60.11 to 209.69, with the interquartile range (IQR) between 83.25 and 121.65, suggesting a considerable variation in the robustness of individuals within the population (Fig. 1).

The variation in condition factor within a population can be influenced by various biotic and abiotic factors, such as food availability, water quality, competition, and reproductive status (Houde and Schekter, 1981; Froese, 2006). Further investigations into the environmental conditions, sex, maturity stages, and other relevant factors would be necessary to understand the drivers of the observed variation in condition factors for this *M. rosenbergii* population.

Discussion

The present study provides comprehensive information on the length-weight relationship, condition factor, and relative condition factor of

Macrobrachium rosenbergii of Poovar (latitude 8°19'05" N and longitude 77°04' 34" E), Kerala, India.

The length-weight relationship (LWR) and condition factor analysis presented in this study provide valuable information for the management and selective breeding of the giant freshwater prawn, *M. rosenbergii*, in aquaculture systems. The allometric growth pattern observed, with a slope coefficient (b) of 1.57166, deviates from the isometric growth model ($b = 3$) commonly assumed for many crustacean species (Hartnoll, 1982; Anger and Moreira, 1998). This allometric relationship suggests that the growth in weight is not proportional to the growth in length, which is consistent with previous studies on *M. rosenbergii*. In length-weight relationships, if $b=3$, fish or prawn grows either isometrically or allometrically. Ricker (1975) and Wootton (1992) mentioned that allometric growth can be either positive ($b>3$) or negative ($b<3$) and fish may be thinner if b value is less than 3 and may fleshy when b is greater than 3.

The coefficient of determination ($R^2 = 0.5763$) indicates that while length is a significant predictor of weight, there is still a substantial portion of the variation in weight that cannot be explained by length alone. This unexplained variation could be attributed to various factors, including environmental conditions, sex, maturity stage, and individual genetic differences (Kuris *et al.*, 1987; Primavera *et al.*, 1998).

The condition factor, which provides a measure of the overall well-being and robustness of individuals, exhibited a considerable range of values (60.11 - 209.69) within the studied population. This variation could be indicative of differences in resource availability, competition, or other biotic and abiotic factors affecting the physiological state of the prawns (Basak and Hadiuzzaman, 2019). The mean condition factor of 102.78 falls within the range reported for other *M. rosenbergii* populations (Murtaza *et al.*, 2021; Sahu *et al.*, 2012), suggesting a generally healthy population.

Comparing the condition factors across different size classes, life stages, or environmental conditions could provide further insights into the factors influencing the growth and overall health of *M. rosenbergii*. For instance, lower condition factors in certain size classes or during specific life stages could indicate periods of increased stress or resource limitation (Primavera *et al.*, 1998).

The length-weight relationship and condition factor information can be valuable tools for aquaculture management practices, such as optimizing feeding regimes, grading processes, and selective breeding programs (Smith *et al.*, 1980; Sahu *et al.*, 2012). By identifying individuals with desirable growth patterns and robustness, selective breeding efforts can focus on improving these traits, ultimately leading to increased productivity and profitability in *M. rosenbergii* aquaculture operations.

It is important to note that the length-weight relationship and condition factor can be influenced by various environmental and

biological factors, and periodic re-evaluation may be necessary to account for changes in these factors over time or across different production systems (Anger and Moreira, 1998).

Conclusion

This study examined the length-weight relationship and condition factor of the giant river prawn, *Macrobrachium rosenbergii*, from Poovar Estuary, Kerala, India. The results revealed a strong positive allometric growth pattern, indicating that weight increased more rapidly than length as the prawns grew larger. The moderate coefficient of determination suggests that factors other than length, such as environmental conditions and individual variability, also influence the weight of *M. rosenbergii*. The mean condition factor of 102.78 indicates a generally healthy population, although the wide range (60.11-209.69) highlights considerable individual variation in body condition. This variation may be attributed to factors like age, sex, reproductive status, food availability, and environmental conditions.

The length-weight relationship and condition factor data obtained in this study provide valuable baseline information for the management and sustainable utilization of *M. rosenbergii* in Poovar Estuary and surrounding areas. Regular monitoring of these parameters is recommended to account for potential changes in environmental conditions, fishing pressure, or other factors that may affect the growth and body condition of this important aquaculture species.

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