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Biometric Characteristic Study of Green Lipped Mussel, *Perna viridis* (Linnaeus, 1758) From Malad Creek, Mumbai, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Biometric Studies are essential to understand the growth rate of the species which helps understand the growth patterns, reproduction rate and population distribution of the species. Growth patterns of molluscs help in evaluating their production potential and energy flows through populations and their distribution. *Perna viridis* (Linnaeus, 1758) commonly known as the green-lipped mussel or the Asian green mussel belongs to the family Mytilidae. It is distributed along the Indo-Pacific region. They are attached to the rocky substratum along the coast, in the intertidal region. The Biometric Analysis and Length-Weight Relationship study was carried out on *Perna*

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viridis (Linnaeus, 1758) to understand their growth rate and population distribution through the Coast of Mumbai. A total of 100 samples were used in this study. The correlation between the Total Weight of the Shell with the organism (WSO) to the Shell Length (SL), Shell Width (SW) and Shell Height (SH) and the correlation between the Soft Tissue Weight of the Organism (WO) to the Shell Length (SL), Shell Width (SW) and Shell Height (SH) gave an idea about the growth factors. The Relative Condition Factor was determined by equation $W = aL^b$. The b values of each correlation showed negative allometric growth with p value to be p<.001 with same significance in Pearson Correlation test. The Relative Condition Factor of WSO-SW and WSO-SL was observed to be above 1 indicating good growth conditions. Thus, biometric studies are a useful tool in study of *Perna viridis* (Linnaeus 1758) biology, physiology, ecology, growth potential, stock assessment, genetics and breeding of *Perna viridis* (Linnaeus, 1758).

Keywords: Biometric study; Perna viridis (Linnaeus, 1758); length-weight relationship; condition factor.

1. INTRODUCTION

Shellfish form a good and cheap source of animal protein and have been highly esteemed as delicious seafood with high nutrition owing to its content of Omega-3 fatty acids [1]. This study was carried out on *P. viridis* (Linnaeus, 1758) from Malad Creek, Mumbai. *P. viridis* (Linnaeus, 1758) is most abundantly found in Kozhikode – Kannur area extending upto Kasargod which is also known as the mussel zone of India [2]. Whereas on the east coast of India, it covers a wide spread from Chilka Lake (Odisha), Vishakhapatnam (Andhra Pradesh), Chennai (Tamil Nadu), and Cuddalore (Pondicherry). It is also found along West Coast of India in regions like Mangalore, Karwar, Goa, and Ratnagiri, and all the way up to Gulf of Kutch, with their presence seen on the Coasts of Andamans and Nicobar Islands [3].

Perna viridis (Linnaeus, 1758) commonly referred as the Green Lipped Mussel, belonging to the family Mytilidae and are economically and ecologically important species. The mussel species is a major fouling organism, causing economic impacts on industries, shipping and maritime as well as it also serves as a valuable food source all over Asia. It is majorly found along the Coasts of Mumbai in the intertidal region attached to the rocky substratum using byssus threads. It serves as a major food source for the people of Mumbai.

Growth patterns of molluscs are very helping when evaluating their production potential and energy flow through populations and ecosystems [4]. Growth patterns help understand their growth in the habitat they are present in. It helps in understanding the favourable and non-favourable conditions for optimum growth of the shellfish. This assessment of understanding the growth patterns helps in establishing culturing sites for aquaculture as *P. viridis* (Linnaeus, 1758) is an ideal species for aquaculture in coastal regions [5].

Perna viridis (Linnaeus, 1758) shell can grow up to 8cm to 10cm long in length [6]. They act as indicators of organochlorides and heavy metals pollution. They have a salinity tolerance of 80 PSU [7,8]. Various factors influence the growth of mussel i.e. Temperature, Salinity and Climate change. Understanding the growth pattern helps in understanding the effects of fluctuations of these factors on the growth of the mussel which further helps us establishing sites for aquaculture with favourable conditions and optimum yield as it is consumed by locals populace. Biometric analysis helps estimate the growth patterns of these molluscs and is used to provide information about the growth of length and weight of the bivalve and also understand their relationship.

2. MATERIALS AND METHODS

In the present study, 100 samples of *Perna viridis* (Linnaeus, 1758) were collected from Malad Creek, Mumbai in February, 2024, irrespective of their sexes. The collected bivalves were carried to the Zoology Department Research Centre in Sterile containers. They were thoroughly cleaned with water and the biometric values were noted for further calculations. The Shell Length (SL), Shell Width (SW) and Shell Height (SH) were taken using Vernier Calliper to the nearest millimetre and the Weight of the Shell with Organism (WSO) and the Weight of the Soft Tissue of the organism (WO) were measured by a digital balance of 0.01g accuracy.

Fig. 1. Sample collection site, Malad Creek, Mumbai, Maharashtra, India
(Source: http://www.google.com/maps)

The relationship of WSO to SH, WSO to SW, WSO to SL, WO to SH, WO to SW and WO to SL was done by Scatter plot graphs with equation, plotted for each correlation in Microsoft Excel of both the data and log10 values of the data. The Relative Condition Factor was determined by equation known as Cube's Law, $W = aL^b$ given by Le Cren, [9], where 'a' is the intercept that is initial growth coefficient & 'b' value indicates exponent or the slope also known as growth coefficient. The allometry coefficient is expressed by the exponent b of the linear regression equation [10,11]. The t-test, Pearson Correlation test and Normal Frequency Distribution Curve was conducted using IBM's SPSS software.

3. RESULTS AND DISCUSSION

3.1 Sample Structure

The *Perna viridis* (Linnaeus, 1758) collected from Malad Creek, had a Shell Length (SL) ranging from 5.4cm to 7.8cm whereas the Shell Width (SW) ranged from 2.6cm to 3.5cm and the Shell Height ranged from 1.7cm to 2.8cm. Total Weight of the Shell with the organism (WSO) was observed to be in the range from 10.11g to 32.65g whereas, Soft tissue weight of organism (WO) showed a range from 2.29g to 10.2g.

3.2 T-test

The t-test were performed using the SPSS software. The test showed correlation values for WSO-SH, WSO-SW, WSO-SL, WO-SH, WO-SW and WO-SL were 0.55, 0.67, 0.827, 0.441, 0.604 and 0.581 respectively, with P value observed as P <.001, stating the data to be statistically significant.

3.3 Pearson Correlation Test and Normal Frequency Distribution Curve

The Table 1. shows correlation between WSO-SH, WSO-SW and WSO-SL indicating a statistically significant strong positive correlation r(100)= .55, p = [<.001], r(100)= .67, p = [<.001] and r(100)= .827, p = [<.001] respectively. Similarly a similar correlation was observed

between WO-SH, WO-SW and WO-SL giving results r(100)= .441, p = [<.001], r(100)= .604, p = [<.001] and r(100)= .581, p = [<.001] having strong positive correlation respectively.

The Figs. 2,3,4,5 and 6 show the Frequency Distribution Curve of WSO, WO, SH, SW and SL respectively showing normally distributed curve of the sample data of this study.

3.4 Growth Coefficient

Correlation between WSO to SH, WSO to SW, WSO to SL, WO to SH, WO to SW and WO to SL gave b values (growth coefficient) as 1.4527, 2.0221, 2.2034, 1.5292, 2.4609 and 2.0509 respectively indicating Negative Allometric growth (Figs. 7,8,9,10,11 and 12).

This interprets that the SH, SW and SL show faster growth than WSO and WO. *P. viridis* (Linnaeus, 1758) spawns twice a year between March-April and October-November. As February falls just before the spawning period, it can be considered the preparatory month. This would also implicate that the mussel increasing its length faster, as to create space for the gamete maturation for reproduction in the upcoming month. As the Condition Factor for WSO-SH and WSO-SL were significantly higher suggesting of the same.

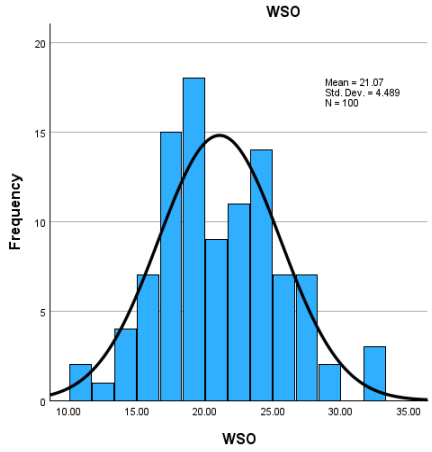

Fig. 2. Shows the Frequency Distribution Curve of WSO

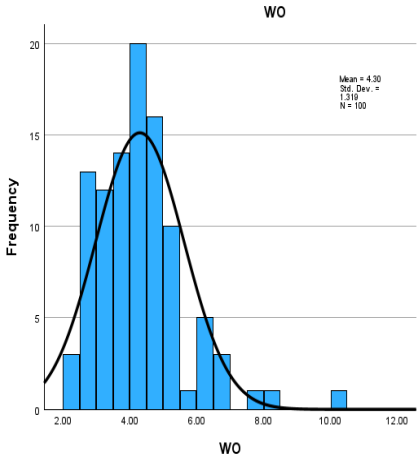

Fig. 3. Shows the Frequency Distribution Curve of WO

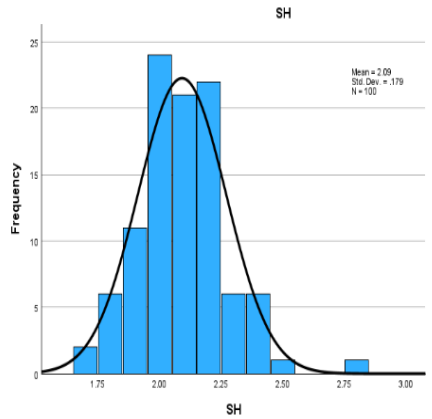

Fig. 4. Showing Frequency Distribution Curve of SH

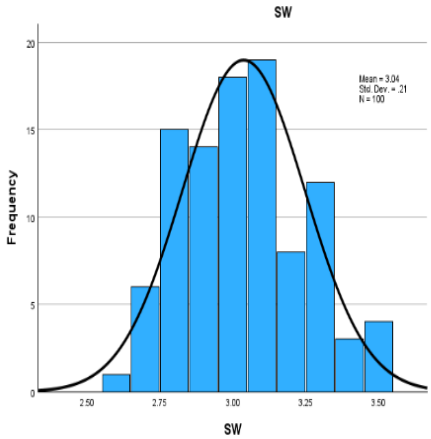

Fig. 5. Shows Frequency Distribution Curve of SW

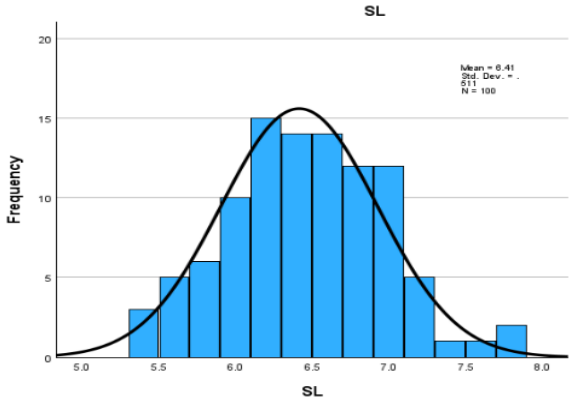

Fig. 6. Shows Frequency Distribution Curve of SL

Table 1. Showing Pearson Correlation test with strong positive significance at 0.01 level

Coefficient Correlations				
		SH	**SW**	**SL**
WSO	Pearson Correlation	0.550**	0.670**	0.827**
	Sig. (2-tailed)	<.001	<.001	<.001
	N	100	100	100
WO	Pearson Correlation	0.441**	0.604**	0.581**
	Sig. (2-tailed)	<.001	<.001	<.001
	N	100	100	100
** Correlation is significant at the 0.01 level (2-tailed)				

3.5 Relative Condition Factor

The values obtained from the relative condition factor are above 1 in WSO-SW and WSO-SL relationships indicating good growth conditions whereas WSO-SH, WO-SH, WO-SW and WO-SL relationships are in poor growth conditions as the values are found to be below 1 (Table 2). This takes into account the weight observed to that of the ideal calculated weight for the same length [12].

3.6 Discussions

Meher et al. [13] observed similar results, and stated that the growth of soft tissue of the organism was the lowest in the month of February. It was also seen that all the correlations showed negative allometric growth with the shell length increasing rapidly compared to that of shell width and shell height. Similar results were observed by Ashwin et al. [14] showing negative allometric growth with steady rise in b value from February to December. Serpil et al. [15], observed that in *Unio crassus* showed negative allometric growth throughout the year and that the largest shell length and shell height was observed in February with the highest weight. S. Takar et al. [16] found negative allometric growth in bivalve, *Donax cuneatus* and *Meretrix casta* throughout the year with the highest condition factor values in February, meaning that the best observed growth conditions were in the month of February, that corroborates with the present findings with *P. viridis.*

Table 2. Showing relative condition factor for each relationship of weight and length

Relationships	Relative condition factor
WSO - SH	0.7768
WSO - SW	1.0186
WSO - SL	1.0165
WO - SH	0.7322
WO - SW	0.7319
WO - SL	0.7315

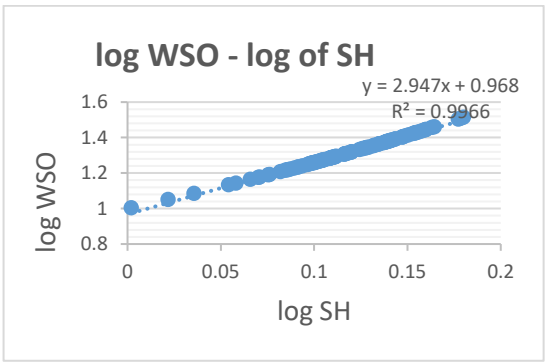

Fig. 7. Graph of log WSO - log SH

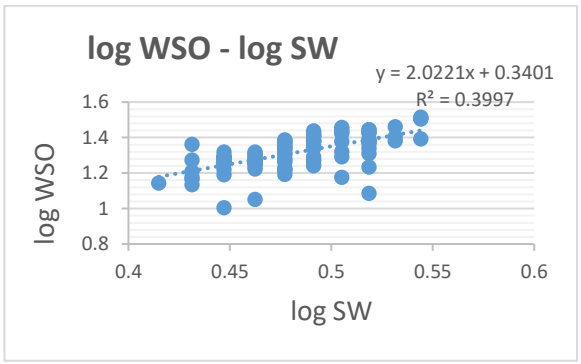

Fig. 8. Graph of log WSO – log SW

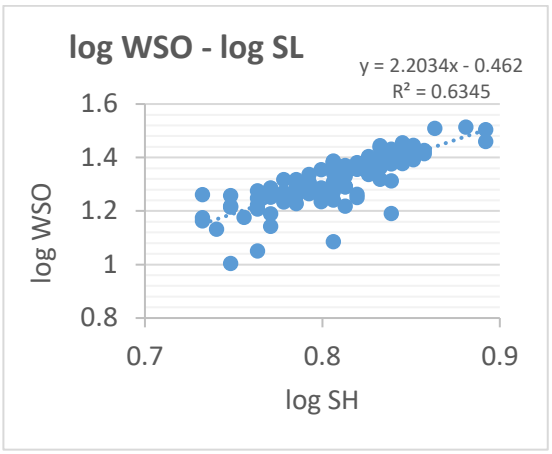

Fig. 9. Graph of log WSO – log SL

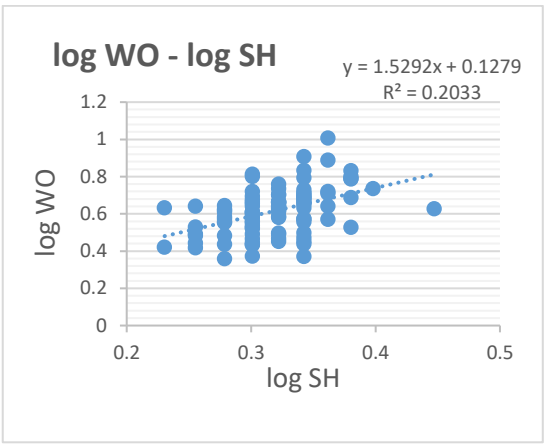

Fig. 10. Graph of log WO – log SH

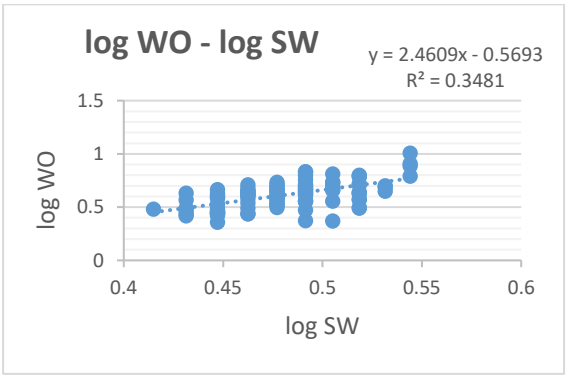

Fig. 11. Graph of log WO – log SW

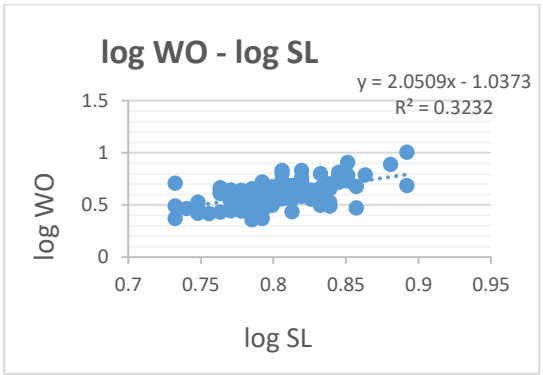

Fig. 12. Graph of log WO – log SL

4. CONCLUSION

The samples of *Perna viridis* (Linnaeus, 1758) from Malad Creek, Mumbai in February that is non-breeding season, showed Negative Allometric Growth indicating higher growth of SH, SW and SL than WSO and WO. This indicates that the lengths are fast growing than the weight of the organism. The Condition Factor indicated that the relationships WSO-SW and WSO-SL were in good growth conditions whereas it was observed that the relationships WSO-SH, WO-SH, WO-SW and WO-SL were found with poor growth conditions during the month of February, 2024. The t-test and Pearson Correlation Test indicated p value to be <.001 proving to be statistically significant. The Frequency Distribution Curve showed normal distribution in the sample data.

CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented and published in the conference: An International Conference on Coastal and Marine Conservation CMC-2024 dated from 1st and 2nd March, 2024 in Mumbai, India. Web Link of the proceeding:https://mithibai.ac.in/wp-content/uploads/2024/02/CMC2024-CONFERENCE-brochure..pdf

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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