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MORPHOMETRY AND LENGTH/WIDTH-WEIGHT RELATIONSHIP OF *Psuedosesarma glabrum* INHABITING TROPICAL MANGROVES, SOUTH-WEST COAST OF INDIA

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ABSTRACT

In this study, the inter-relationship of width/weight-length by sex of *Psuedosesarma glabrum* population living in tropical mangrove ecosystem, South-West coast of India was examined. A total of 290 Samples coimprising 162 males and 128 females were examined during the period June 2019- November 2020. Morphometric characters *viz.,* carapace width (CW), carapace length (CL), frontal width (FW), sternum width (SW), abdomen width (AW), propodus length (PL), dactylus length (DL) and body weight (BW) were measured for each animal. Linear regression analysis was used to study the interrelationship between various morphometric characters and Analysis of Covariance (ANCOVA) was performed to test the difference between male and female. In this study, sample collected include the carapace size group of 10-15 mm with a mean value of 13.65±1.68 in males and 11-15 mm with a mean value of 13.16±1.61 in females during the sampling period. All the set of characters showed a positive significant correlation except propodus length in *P. glabrum* ($P < 0.05$). Correlation value between carapace width and propodus length (PL) are, $r = 0.834$ in males and $r = 0.768$ in females and the Coefficient of detrmination with carapace length (CL) are, $r = 0.816$ in males and $r = 0.779$ in females respectively. Student's-t test for length / width - weight relationship established allometric growth pattern in this species.

KEYWORDS: *Psuedosesarma glabrum;* Morphometric Measurements; Length/Width-Weight Relationship; Tropical Ecosystem, Linear Regression, Growth Pattern, Allometric Growth

In crustaceans, as growth progresses, certain dimensions of the animal's body may grow much more than others, resulting in the phenomenon known as relative growth (Hartnoll, 1974). Sexual difference observed in the growth of several body parts relative to carapace size have often been used to examine the relationship between morphometric and sexual activity in addition to morphometric difference among populations or species (Aikens and Waddy, 1989). Studies of relative growth in crustaceans allow to define the type of allometry in the growth of different body parts, such as chelae, locomotor appendages, abdomen and pleopods, and to relate them to their specific functions. One probable factor responsible for these changes in the allometric growth is the sexual maturity (Gonzalez-Gurriaran and Freire, 1994). In population studies, while morphometric analysis provide a powerful complement to genetic and environmental stock identification approaches (Cadrin, 2000) the length/width-weight relationship allow the conversion of growth in length equations to growth in weight for use in a stock assessment model (Moutopolos and Stergiou, 2002).

Relative growth in brachyuran crabs has been studied since the earlier decades of the centuary, but only in more recent work, these allometric pattern reviewed for the group (Hartnoll; 1974). However, apart from majids and portunids, which include a large number of commercially exploited species, the relative growth pattern at the family level are not well known. Available information on relative growth of grapsids is still inadequate to establish allometric trends in this heterogeneous family (Fransozo and Flores, 1999). With these research inputs, the aim of this study is to provide baseline data on length/width-weight relationship and morphometric analysis of *Psuedosesarma glabrum* (Ng *et al*., 2017) is a newly recorded semi-aquatic crab widely distributed in the intertidal mixed mangrove zones along the Vembanad ecosystem, in Kerala, India.

MATERIALS AND METHODS

Total crabs comprising 162 males and 128 females of *P. glabrum* collected from its natural habitat, mangrove swamps in the Northern Vembanad ecosystem (9°52′1.42″N, 76°18′54.97″E), South - West coast of India. They brought to the laboratory and all materials were analyzed in fresh condition. Individual carapace width (CW), carapace length (CL), frontal width (FW), sternum width (SW), abdomen width (AW), propodus length (PL), dactylus length (DL) were measured using a

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vernier caliper (0.1 mm accuracy) and individual weight was taken after removing all adhering water from the body. The length-weight and width-weight relationships were determined separately for males and females in *P. glabrum* by the method of least squares using the logarithamic forms of the exponential equation,

$W = a L^b$ (Rickter; 1973) …… (eq. 1)

Where W = weight (g) of crab, L = length (mm) of crab, 'a' is initial growth coefficient and 'b' is the growth coefficient. For this purpose, the length/width and weight of individual crabs were transferred in to logarithamic values and regression analysis was carried out to calculate the 'a' and 'b' values. The values of constant 'a' and 'b' were estimated after logarithemic transformation of eq. 1 using the least square linear regression as described by Zar (1984) to give,

$\log_{10}W=\log_{10}a + b \log_{10}L$ …… (eq.2)

The correlation coefficient (r) was determined to know the degree of association of the two variables involved. Growth pattern were tested using Student's t-test ($\alpha = 0.05$). If $b > 3$, then the dimension (Y) increase in size relatively more rapidly than the reference dimension (X) does and growth is said to be positively allometric. A condition of $b < 3$ indicates negative allometry, and $b = 3$ indicates a condition of isometry that means there is no change in the relative shape with increasing size. ANCOVA (Analysis of covariance) technique was conducted to test the significance between the regression coefficients (b) in male and female *P. glabrum* (Zar; 1999).

RESULTS AND DISCUSSION

Information about individual body weight, length/width relationships of an animal contributes a better understanding of many biological events that occur in their life cycle (Gould, 1996). Such knowledge also helps to establishing the taxonomy of that particular species. In this study, the length/width-weight relationships of *P. glabrum* were done. They are semi-terrestrial crabs inhabiting the intertidal mixed mangrove zones along the southern Vembanad lake system (Ng *et al*., 2017). An extensive sampling was carried out and a total of 290 Samples comprising 162 males and 128 females were examined during the period of June 2019 - November 2020. Morphometric characters *viz.,* carapace width (CW), carapace length (CL), frontal width (FW), sternum width (SW), abdomen width (AW), propodus length (PL), dactylus length (DL) and body weight (BW) were measured for each animal. The mean, maximum and minimum values of morphometric characters and body weight of *P. glabrum* is given in Table-1. From the observations, sample collected include the carapace size group of 10-15 mm with a mean value of 13.65±1.68 in males and 11-15 mm with a mean value of 13.16±1.61 in females during the sampling period. Knowledge about the range of carapace width and carapace length of a particular species are important because of they are the body dimensions which are mostly used as the independent variable in the analysis of relative growth of crabs (Castiglioni and Negreiros-Fransozo; 2004).

The results of linear regression analysis of length- width relationships are given in Table - 2 and their scatter diagrams from Figure 1 to Figure 4. Positive allometric growth is an indication of crabs heaviness with the implication that the crabs are heavier than their lengths (Sparre and Venema, 1992). From the observations, all the set of characters showed a positive significant correlation except propodus length in *P. glabrum* ($P < 0.05$). Propodus length (PL) is negatively correlated with carapace width (CW) and carapace length (CL) in male *P. glabrum* (Fig.1 – Fig.4). The change in growth coefficient (b) value depends primarily on the shape and fatness of the species, seasons or time of the year, temperature, salinity food (quantity, quality and size), sex and stage of maturity (Sparre and Venema, 1992). Coefficient of determination values (r^2) of the set of these characters in both sexes revealed that propodus length (PL) had the highest correlation value with carapace width (CW) and carapace length (CL). Correlation value between carapace width and propodus length (PL) are, $r = 0.834$ in males and $r = 0.768$ in females and the correlation value with carapace length (CL) are, $r = 0.816$ in males and $r = 0.779$ in females respectively.

The regression lines were tested using the Univariate Analysis of Variance in order to check whether there is any difference in the length/width-weight relationships between sexes. From the observations, these species showed a significant difference between sexes. A scatter diagrams each for male and female in respect to *P. glabrum* was obtained by plotting the length/ width against weight of individual crabs (Fig. 5) and their data given in the Table-3.

Student's-t test for length / width - weight relationship established allometric growth pattern (Table - 4). The results of the length / width – weight relationship analysis in *P. glabrum* indicate that, weight gain is not uniform, and morphologically males and females are similar in their size. These results are showed a common trend in *Portunus pelagicus* (sukumaran and Neelakandan,1997; Sukumaran,1997; Josileen, 2011), *Scylla serrata* (Khan and Mustaqeem, 2013), *Uca sp.*

(Rosenberg, 2002), *Potamon algeriense* (Fadlaoui *et al*., 2019), *Talamita crenata* (Susantho and Irnawati, 2014), *Ucides cordatus* (Araujo *et al,* 2012), *Grapsus albolineatus* (Khot and Jaiswar, 2018), *Neoepisesarma mederi* (Appukuttan *et al*., 2018), *Neoepisesarma brockii* (Khanna *et al*., 2018) *etc*. The allometric relationship among the various parts of the body is functionally important in the biology of organisms and particularly as a predictive tool for evolving specific conservation strategies.

With these research inputs, the aim of this study is to provide baseline data on length/width-weight relationship and morphometric analysis of *P. glabrum*, is a semi-aquatic crab widely distributed in the intertidal mixed mangrove zones along the Vembanad ecosystem, in Kerala, India. The results will be useful in comparing the different stocks of the same species at different geographical locations and they can be useful for further studies on their life history.

Table 1: Mean, Maximum and Minimum values of morphometric characters and body weight of *Psuedoesarma glabrum*

Sex		CW (mm)	CL (mm)	FW (mm)	SW (mm)	AW (mm)	PL (mm)	DL (mm)	BW (g)
Male	Mean±SD	13.65±1.68	12.50±1.66	8.13±0.63	9.04±1.13	7.89±0.59	10.31±1.73	5.58±1.17	1.29±0.54
	Max.	15.00	14.00	9.18	11.16	8.87	11.86	6.5	2.03
	Min.	10.25	9.25	7.15	7.41	6.53	7.25	3.25	0.51
Female	Mean±SD	13.16±1.61	11.81±1.72	8.17±0.73	10.01±1.41	8.16±1.08	7.89±1.08	4.1±0.61	0.97±0.38
	Max.	15.16	14.16	9.05	12.16	9.63	9.68	5.00	1.91
	Min.	11	9.44	6.25	8.50	6.00	6.73	3.22	0.54
CW=carapace width; CL=carapace length; FW=frontal width; SW=sternum width; AW=abdomen width; PL=propodus length; DL=dactylus length; BW=body weight; SD=standard deviation; Max.=maximum value; Min.=minimum value									

Table 2: Linear regression equation and correlation coefficient values (r) between different variables in male and female of *Psuedosesarma glabrum*

Independent variable (X)	Dependent variable (Y)	Male			Female		
		Y = a + bX		r^2	Y = a + bX		r^2
		a	b		a	b	
Carapace width	Frontal width	2.615	0.403*	0.557	3.842	0.334*	0.403
Carapace width	Sternum width	5.324	0.252*	0.107	1.446	0.661*	0.565
Carapace width	Abdomen width	2.825	0.367*	0.476	2.678	0.427*	0.491
Carapace width	Propodus length	-2.094	0.915*	0.695	0.389	0.577*	0.590
Carapace length	Frontal width	3.058	0.405	0.559	4.272	0.335*	0.431
Carapace length	Sternum width	6.007	0.222*	0.083	2.510	0.644*	0.571
Carapace length	Abdomen width	3.130	0.376*	0.500	3.254	0.426*	0.519
Carapace length	Propodus length	-0.784	0.896*	0.666	1.254	0.568*	0.608
Significantly different at P<0.05							

Table 3: Length / width - weight relationship in male and female of *Psuedosesarma glabrum*

Sex	Independent variable (X)	Dependent variable (Y)	Parabolic equation $W = a L^b$	r^2
Male	Carapace width	Body weight	$W = 0.081\ L^{0.187}$	0.511*
	Carapace length	Body weight	$W = 0.122\ L^{0.173}$	0.436*
Female	Carapace width	Body weight	$W = 0.092\ L^{0.167}$	0.607*
	Carapace length	Body weight	$W = 0.132\ L^{0.155}$	0.568*
Significantly different at P<0.05				

Table 4: t-values for the carapace length/width – weight relationship in male and female of *Psuedosesarma glabrum*

Sex	Independent variable (X)	Dependent variable (Y)	t- value |t|	b-value	Isometric/ Allometric growth
Male	Carapace width	Body weight	2.0507	2.596	Negative allometric growth
	Carapace length	Body weight	4.0773	2.209	Negative allometric growth
Female	Carapace width	Body weight	6.1476	2.084	Negative allometric growth
	Carapace length	Body weight	9.0218	1.764	Negative allometric growth
b>3 = positive allometry, b=3 isometry, b<3 = negative allometry					

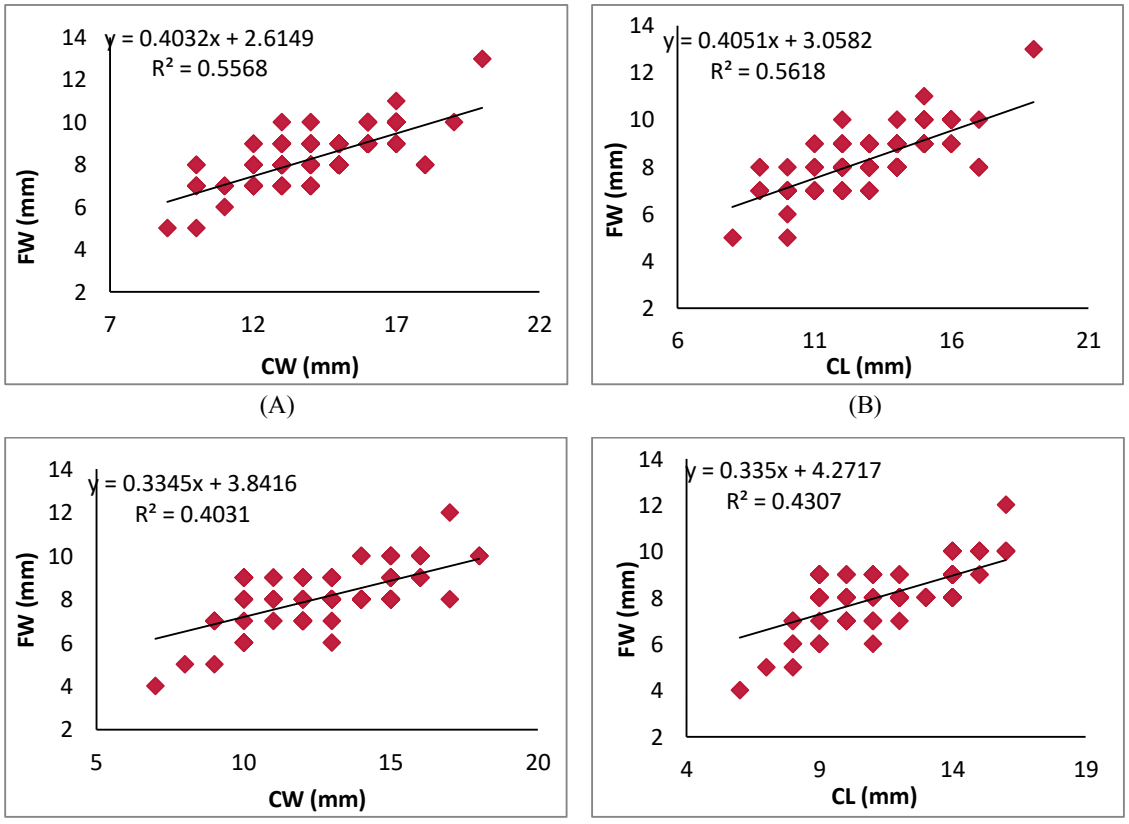
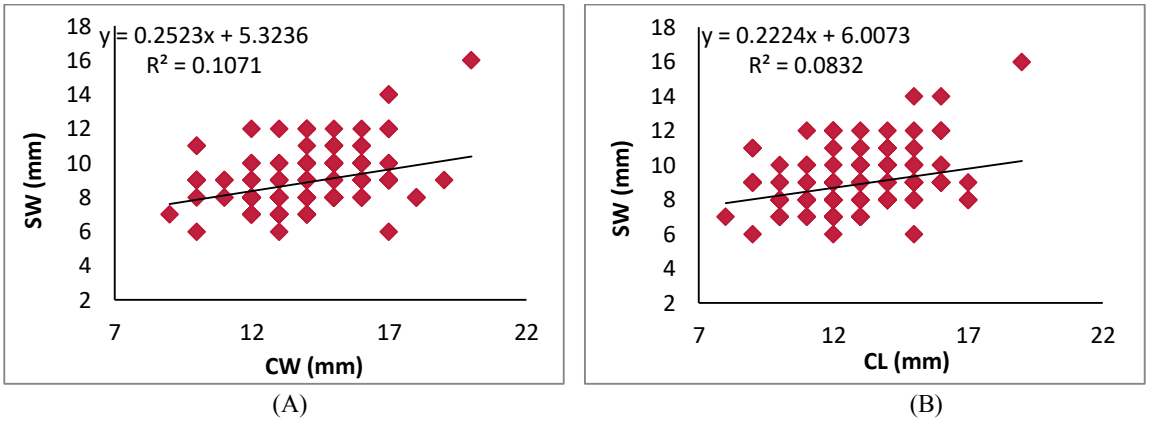
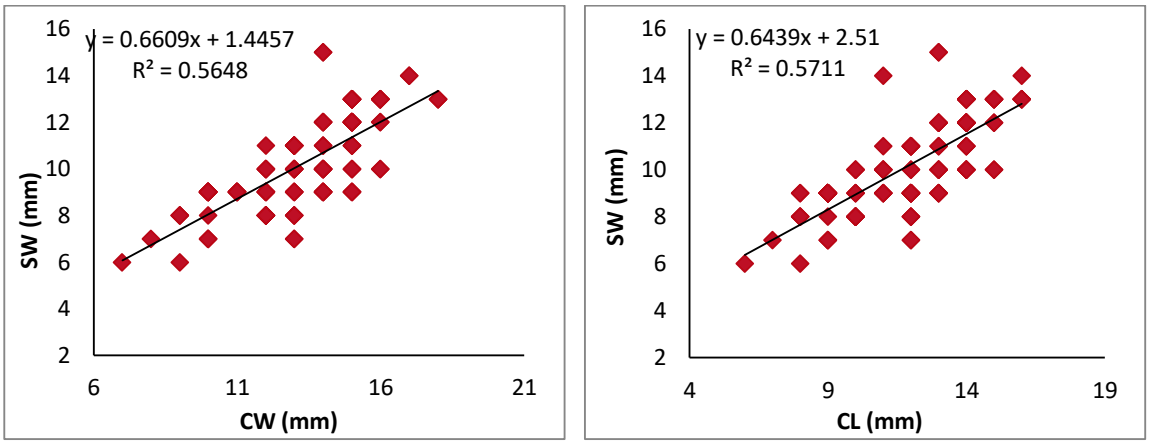


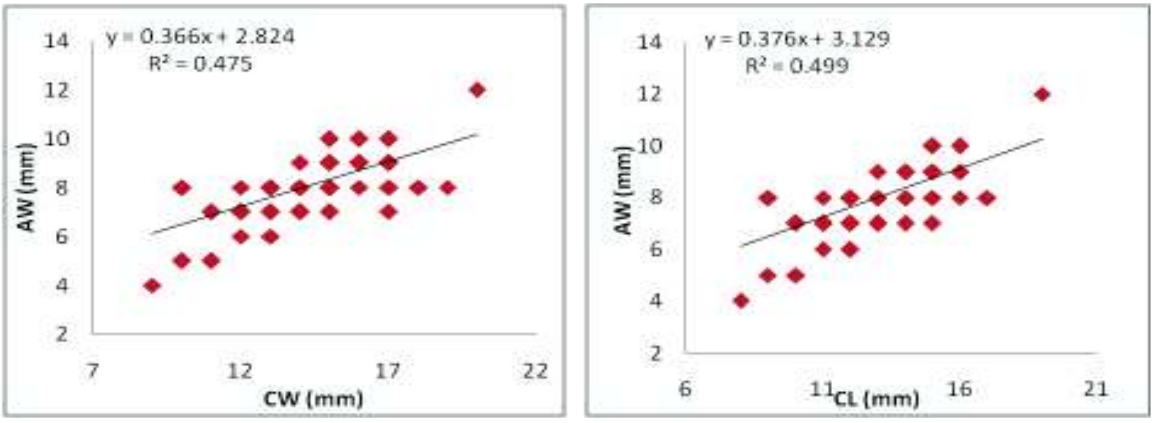
Figure 1: Linear relationship between frontal width with carapace width and carapace length in male (A and B) and female (C and D) *Psuedosesarma glabrum*



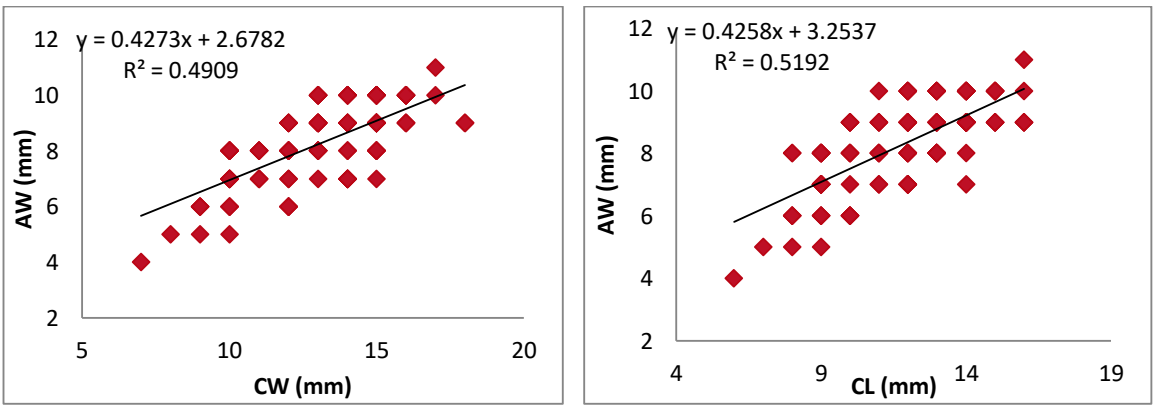


(C) (D)

Figure 2: Linear relationship between sternum width with carapace width and carapace length in male (A and B) and female (C and D) *Psuedosesarma glabrum*



(A) (B)



(C) (D)

Figure 3: Linear relationship between abdomen width with carapace width and carapace length in male (A and B) and female (C and D) *Psuedosesarma glabrum*

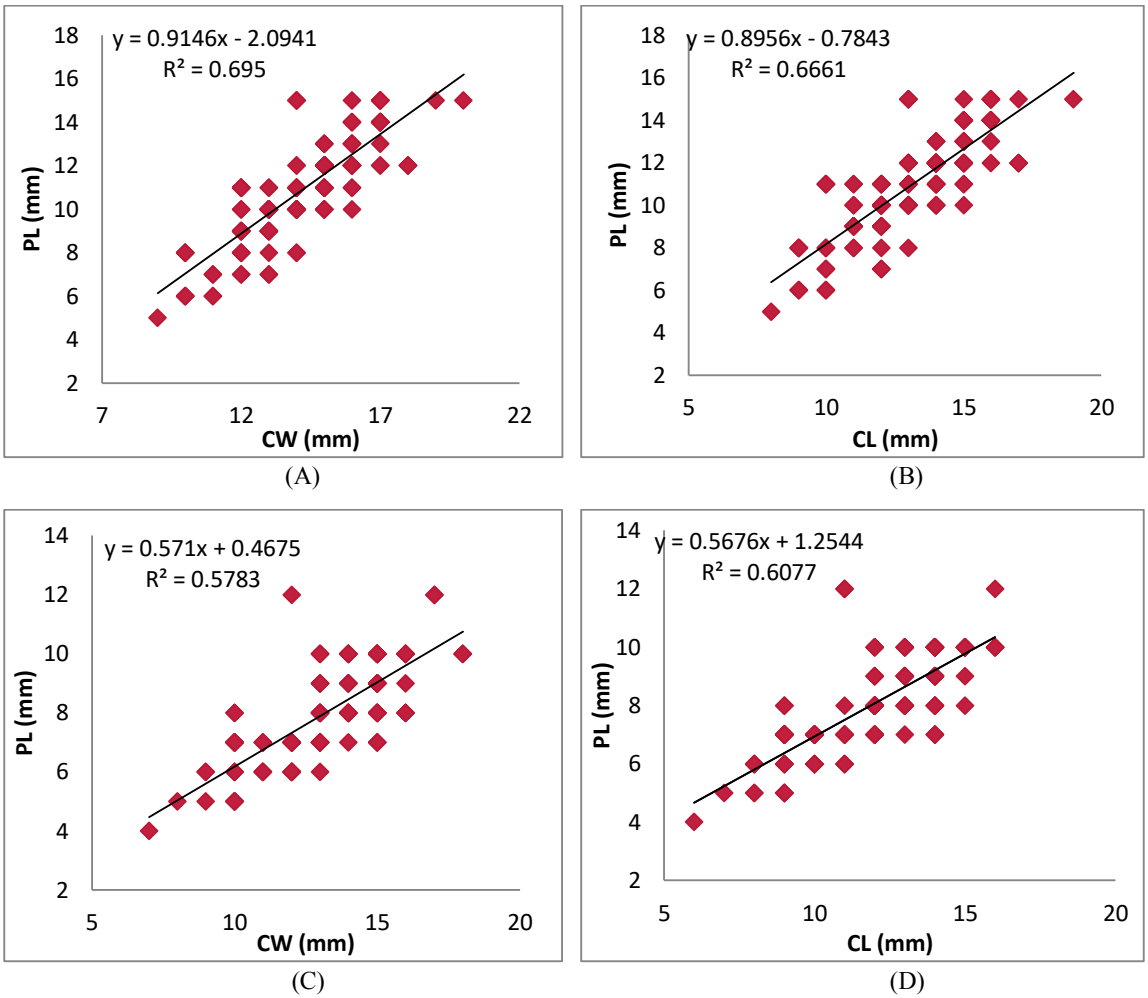
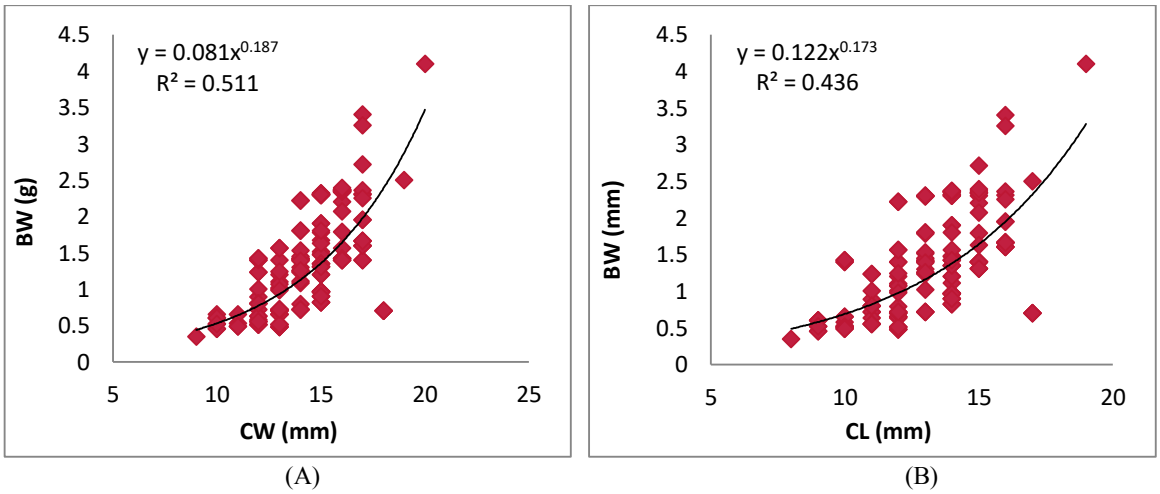
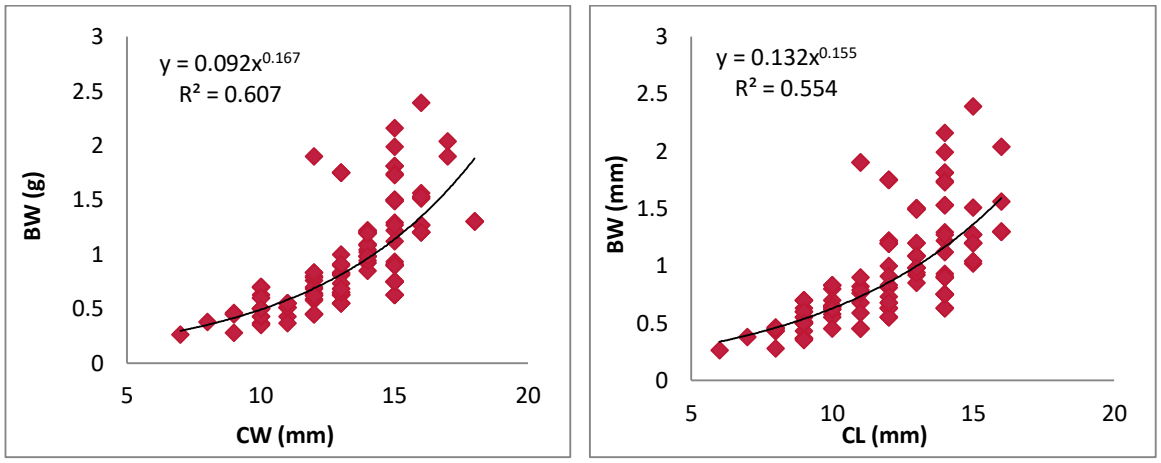


Figure 4: Linear relationship between propodus length with carapace width and carapace length in male (A and B) and female (C and D) *Psuedosesarma glabrum*





(C) (D)

Figure 5: Linear relationship between body weight with carapace width and carapace length in male (A and B) and female (C and D) *Psuedosesarma glabrum*

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