

MORPHOMETRY AND LENGTH / WIDTH - WEIGHT RELATIONSHIPS OF THE MANGROVE CRAB *Neopisesarma mederi* (H. MILNE EDWARDS, 1854) FROM A TROPICAL ESTUARY, SOUTH - WEST COAST OF INDIA

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ABSTRACT

The interrelationship between the morphometric characters as well as the growth pattern in male and female of the mangrove crab *Neopisesarma mederi* was studied. The samples were collected from Cochin estuary for a period of one year from June 2016 – May 2017. The total animals examined comprised of 376 males and 139 females. 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 male, propodus length had the highest coefficient of determination with carapace width ($r^2 = 0.4801$) and carapace length ($r^2 = 0.4912$). In female, carapace width showed highest coefficient of determination with sternum width ($r^2 = 0.4989$) while carapace length with propodus length ($r^2 = 0.4489$). Length / width - weight relationship was established ($W = aL^b$) for males and females separately and growth was found to be allometric. Analysis of Covariance showed that the growth was significantly different in male and female ($P < 0.05$).

KEYWORDS: *Neopisesarma mederi*; Morphometric Measurements; Length / width – Weight Relationships; Linear Regression Analysis; Allometric Growth.

Relative growth in brachyuran crabs has been studied since the earlier decades of the century, 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 (Flores *et al.*; 1999).

Brachyuran crabs comprise about 700 genera and 5000 – 10,000 species worldwide. *N. mederi* is a brachyuran crab (Family: Grapsidae) inhabiting along the south – west coast of India. Being a mangrove inhabitant and its ecological importance in mangrove ecosystem, there is an urgent need to understand the biology and related aspects of this species. The present study aimed to characterize the relative growth of the species based on allometric changes of some morphometric characters and also perceived to establish precise mathematical equations between the length / width – weight measurements, so that if one is measured, the other dimension could be computed.

MATERIALS AND METHODS

Crabs used in this study were monthly sampled from June 2016 to May 2017. The crabs were caught with

knots made of rachis of coconut leaflet, an indigenous method and simply by hand picking. Live samples were brought to the laboratory and it is then numbed by freezing and preserved in 10 % formaldehyde for further studies. The specimens were identified and sexed. A total of 515 individuals of *N. mederi* were analyzed, being 376 males and 139 females. Measurements were made for 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) separately for each sex. Vernier calipers with an accuracy of 0.1 mm were used for length measurements, and the total body weight of the crab was determined to the nearest gram using a digital balance (Keenan *et al.*; 1998).

Linear regression analysis was used to study the interrelationships between the set of morphometric characters separately in male and female. The length / width-weight relationship was established using the log form of the growth equation $W = aL^b$ (Ricker; 1973), where W = the weight, L = the length of the animal, 'a' and 'b' are constants using Excel, 2010. Student's t-test was applied to study whether the growth is isometric or allometric. The variation between the growth coefficient (b) in male and female studied using ANCOVA (Zar; 1999).

RESULTS AND DISCUSSION

Presence of *N. mederi* in the mangrove ecosystem in Aroor, adjacent to Cochin estuary was conformed in the study conducted by Devi *et.al.*, (2014). In the present study, samples collected include the size group of 6-26 mm and 6-22 mm for males and females, respectively. The number of small crabs (carapace width < 6 mm) obtained during sampling was comparatively less and this is mainly due to the difficulty in trapping them due to their small size and their active movement. Carapace width is the body dimension which is mostly used as the independent variable in the analysis of relative growth of crabs, because it fully represents the physiological changes that occur throughout their life history (Castiglioni and Negreiros-Fransozo; 2004).

The results of linear regression analysis of all the set of length / width - weight characters were given as T-1 and T-2. In the study, all the characters showed positive significant correlation between the set of characters ($P < 0.05$). Coefficient of determination values (r^2) of the set of morphometric characters in male crabs revealed that both carapace width and carapace length had the highest correlation value with propodus length i.e., $r^2 = 0.4801$ and $r^2 = 0.4912$, respectively. In female, carapace width had the highest correlation value with sternum width ($r^2 = 0.4989$) while carapace length had highest correlation ($r^2 = 0.4489$) with propodus length. The observations in the present study are in agreement with the studies in *Portunus pelagicus* (Josileen; 2011), who reported that the allometric relationships between the characters are positive and highly significant. In *Sesarma rectum*, a grapsid crab, abdomen width was positively allometric in the beginning of development and, after the puberty molt, it become slightly positive, practically isometric. Males and females showed positive allometry between carapace width and abdomen width (Ribeiro *et al.*; 2013).

The regression lines were tested using the Analysis of Covariance in order to check whether there is any difference in the width / length - weight relationships between sexes. In this study, significant differences were observed between sexes. Therefore the regression was set separately for male and female and the exponential form was changed to linear form by considering the logarithm. Scatter diagram were plotted for male and female separately by plotting body weight against carapace width (CW), carapace length (CL), sternum width (SW) and abdomen width (AW). Student's-t test for length / width - weight relationship established allometric growth pattern (T - 3). Carapace width has high correlation with body weight, i.e., carapace width was increased with increasing body weight. Analysis of Covariance indicated that, there is a significant difference between sexes with respect to the carapace width-weight relationship. These observations are in agreement with Hajje (2016) in *Portunus segnis* and Akin - Oriola *et al.*, (2005) in *Cardiosoma armatum* and *Callinectes pallidus*, showed a positive allometric growth.

The results of the length / width - weight relationship analysis in *N. mederi* indicate that, weight gain is not uniform, and morphologically also males are larger than females. The tendency of males to be heavier than females in *N. mederi* is in accordance with the observations in portunid crabs as reported by Josileen (2011).

The study on the morphometry of a species is very much important for determining their general well-being and variations in growth with size of maturity and also useful in comparing the different stocks of the same species at different geographical locations. Mangrove crabs are considered to be the key stone species in the mangrove ecosystem; has a significant role in detritus formation, nutrient and carbon recycling.

Table 1: Linear regression equation showing morphometric relationships in male and female of *Neopisesarma mederi*

Independent variable (X)	Dependent variable (Y)	Male			Female		
		Y= a+ b X		r ²	Y= a+ b X		r ²
		a	b		a	b	
Carapace width	Abdomen width	5.9238	0.1865*	0.1694	7.1505	0.1413*	0.1285
Carapace width	Sternum width	5.490	0.3745*	0.1818	2.2586	0.6597*	0.4989
Carapace width	Propodus length	-1.161	0.8703*	0.4801	0.617	0.4951*	0.4878
Carapace length	Abdomen width	6.3532	0.1820*	0.1682	7.6485	0.1263*	0.101
Carapace length	Sternum width	6.0322	0.3852*	0.2006	3.7054	0.6782*	0.5185
Carapace length	Propodus length	0.6356	0.8621*	0.4912	1.867	0.4789*	0.4489

*Significantly different at P < 0.05

Table 2: Linear regression equation and correlation coefficient (r²) values between different width / length- weight relations in male and female of *Neopisesarma mederi*

Independent variable, X (log L)	Dependent variable, Y (log W)	Male			Female		
		log W = log a + b log L		r ²	log W = log a + b log L		r ²
		log a	b		log a	b	
Carapace width	Body weight	-1.017	1.1469*	0.7965	-1.0775	1.1798*	0.807
Carapace length	Body weight	-0.684	0.9182*	0.7219	-0.7098	0.9206*	0.7159
Sternum width	Body weight	-0.029	0.416*	0.1577	-0.6441	0.8784*	0.4709
Abdomen width	Body weight	-0.159	0.601*	0.1234	-0.4519	0.8032*	0.1399

*Significantly different at P < 0.05

Table 3: Student's t- test for length/ width- weight relationship of *Neopisesarma mederi*

Independent variable (X)	Dependent variable (Y)	t- value		Isometric/ Allometric
		Male	Female	
Carapace width	Body weight	37.79	23.93	Allometric
Carapace length	Body weight	30.78	18.58	Allometric
Sternum width	Body weight	08.26	11.04	Allometric
Abdomen width	Body weight	07.16	04.71	Allometric

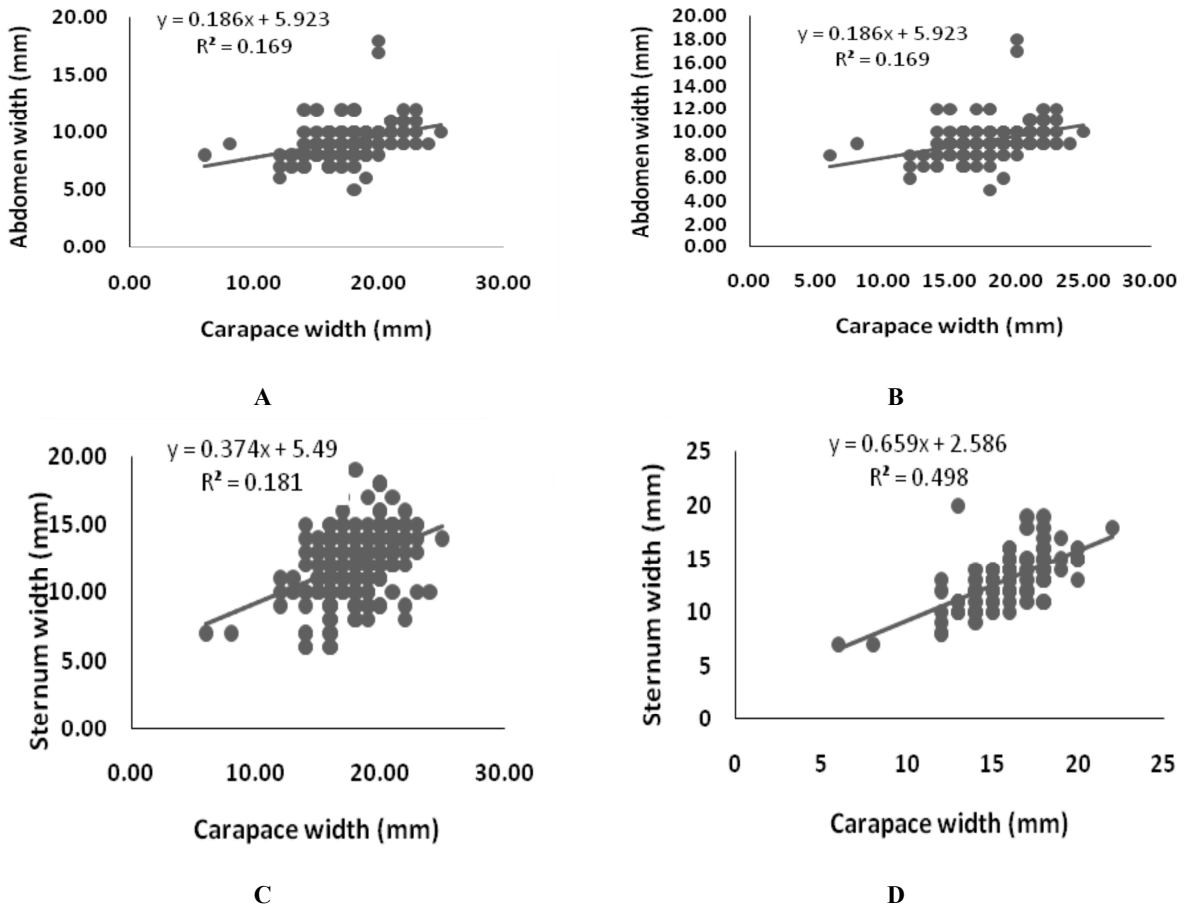


Figure 1: Linear relationship between carapace width and abdomen width (A -in male, B- in female), carapace width and sternum width (C-in male, D- in female)

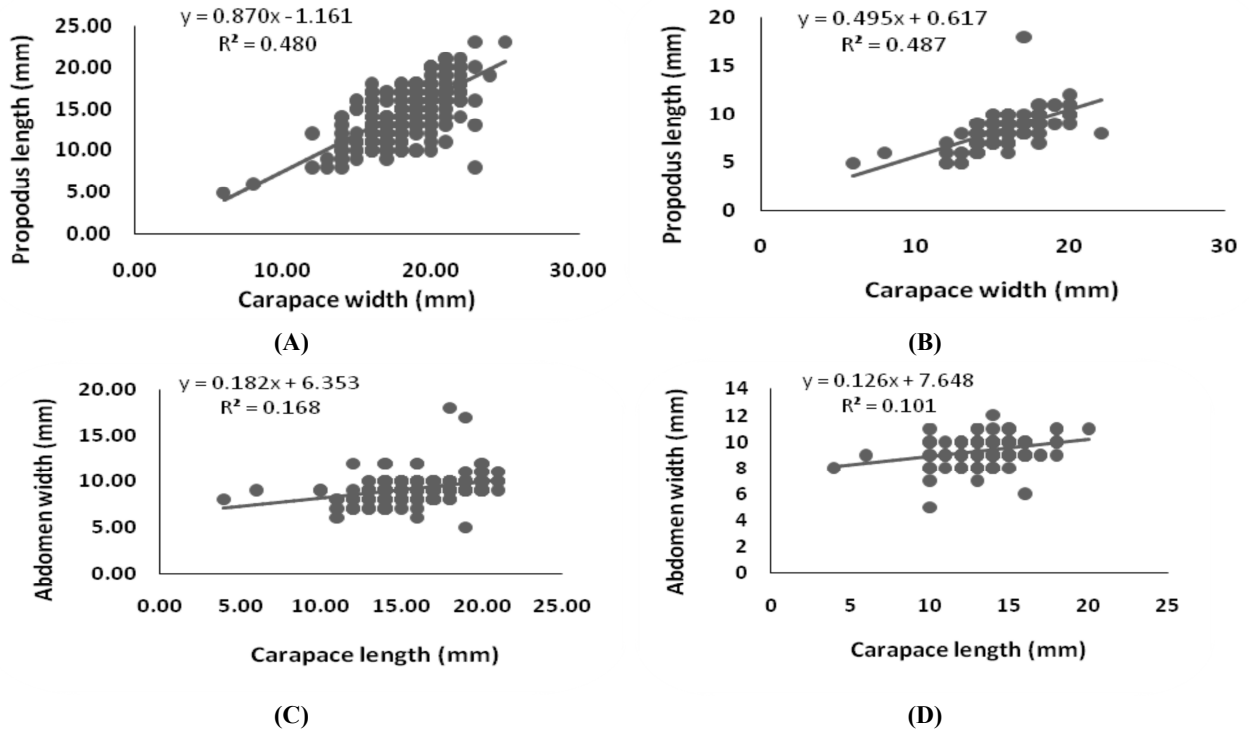


Figure 2: Linear relationship between carapace width and propodus length (A -in male, B- in female), carapace length and abdomen width (C-in male, D- in female)

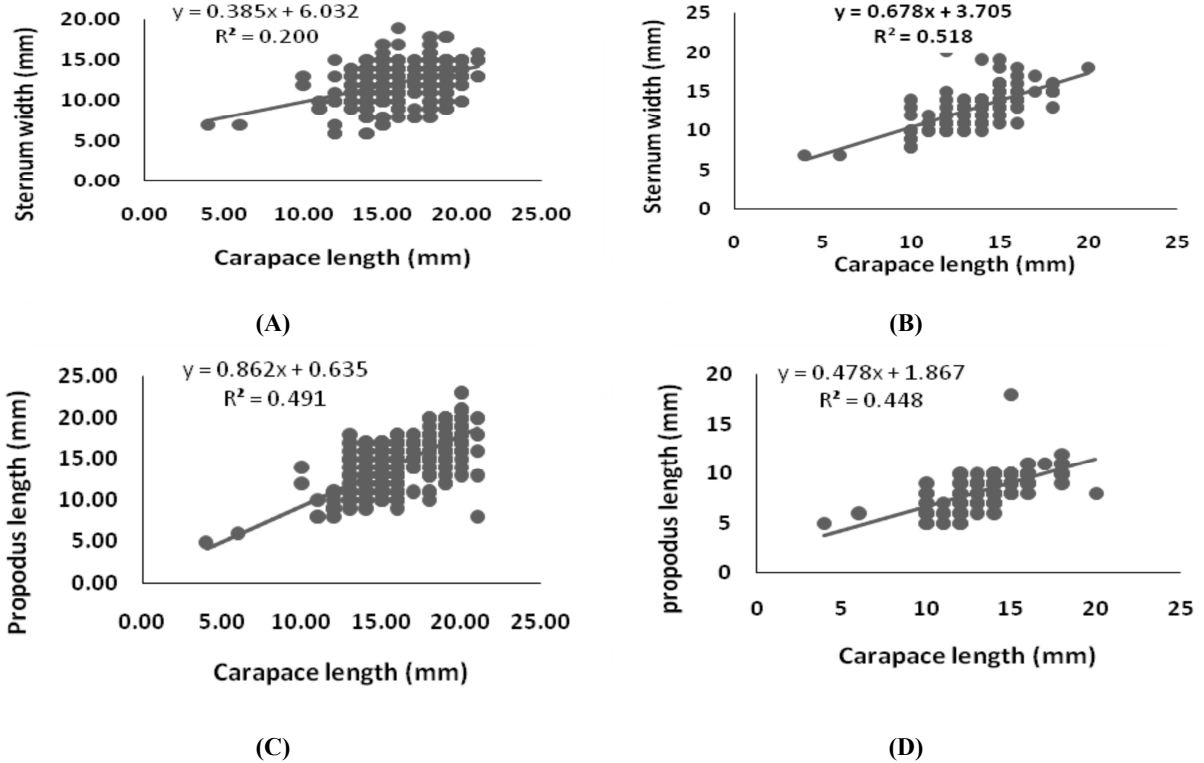


Figure-3: Linear relationship between carapace length and sternum width (A-in male, B- in female), carapace length and propodus length (C-in male, D- in female)

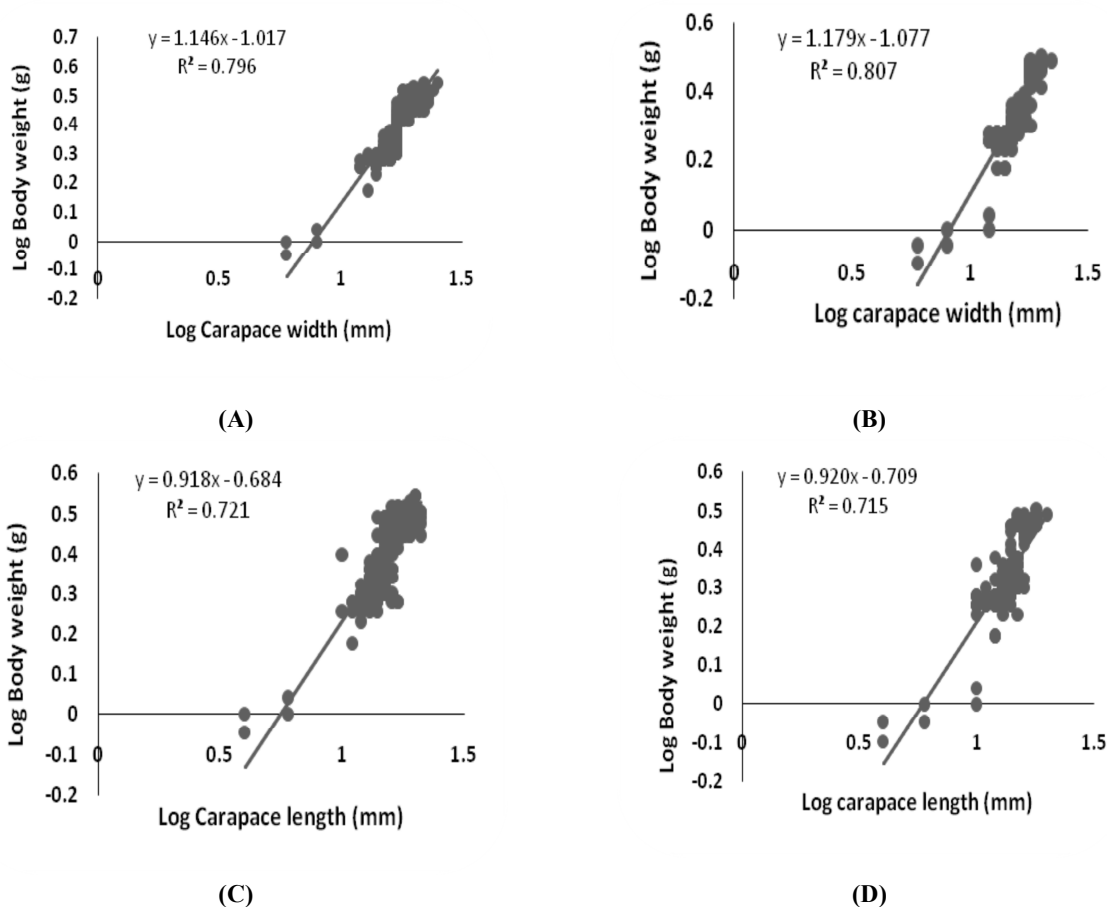


Figure-4: Linear relationship between carapace width and body weight (A-in male, B- in female), carapace length and body weight (C-in male, D- in female), sternum width and body weight (E-in male, F-in female)

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REFERENCES

Akin-Oriola G., Anetekhai M. and Olowonirejuaro K., 2005. Morphometric and meristic studies in two crabs: *Cardiosoma armatum* and *Callinectes pallidus*. Turk J. Fish Aquat Sci., 5(2).

Bezerra Ribeiro F., Matthews Cascon H. and Arruda Bezerra L.E., 2013. Morphometric sexual maturity and allometric growth of the crab *Sesarma rectum* Randall, 1840 (Crustacea:

Sesarmidae) in an impacted tropical mangrove in northeast Brazil. Lat. Am. J. Aquat Res., 41 (2).

Castiglioni D.D.S. and Negreiros-Fransozo M.L., 2004. Comparative analysis of the relative growth of *Uca rapax* (Smith) (Crustacea, Ocypodidae) from two mangroves in São Paulo, Brazil. Rev. Bras. Zool., 21(1): 137-144.

Devi P.L., Joseph A. and Ajmal Khan S., 2014. Diversity of brachyuran crabs of Cochin backwaters, Kerala, India. Marine faunal diversity in India: Taxonomy, ecology and conservation, Zoological Survey of India, Academic Press, Elsevier, Oxford, UK, 75-87.

Flores A. and Negreiros - Fransozo M.L., 1999. Allometry of the secondary sexual characters of the shore crab *Pachygrapsus transverses*

- (Gibbes, 1850) (Brachyura, Grapsidae).
Crustaceana, **72**(9): 1051-1066.
- Hajjej G., Sley A. and Jarboui O., 2016. Morphometrics and length-weight relationship in the blue swimming crab, *Portunus segnis* (Decapoda, Brachyura) from the gulf of Gabes, Tunisia. Int. J. Eng. Appl. Sci.
- Hartnoll R.G., 1974. Variation in growth pattern between some secondary sexual characters in crabs (Decapoda Brachyura). *Crustaceana*, **27**(2):131-136.
- Josileen J., 2011. Morphometrics and length-weight relationship in the blue swimmer crab, *Portunus pelagicus* (Linnaeus, 1758) (Decapoda, Brachyura) from the Mandapam coast, India. *Crustaceana*, **84**(14): 1665-1681.
- Keenan C.P., Davie P.J.P. and Mann D., 1998. A revision of the genus *Scylla* (de Haan, 1833) (Crustacea: Decapoda: Brachyura: Portunidae). Raffles Bull. Zool., **46**: 217-245.
- Ricker W.E., 1973. Linear regressions in fisheries research. J. Fish Res. Board Can., **30**(3): 409-434.
- Zar J.H., 1999. Biostatistical Analysis. 4th edition. Upper Saddle River, New Jersey, Prentice-Hall.