Jr. of Industrial Pollution Control 30(2)(2014) pp 345-350

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RELATIONSHIP AND ANALYSIS OF MORPHOMETRIC AND ALLOMETRIC CHARACTERISTICS IN FRESHWATER CRAB: *BARTYTELPHUSA CUNICULARIES* (WESTWOOD, 1836)

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Key words : Freshwater crab, *Bartytelphusa cunicularis*, Regression, Frequency

(Received ..... February, 2014; accepted ....., 2014)

ABSTRACT

The study aims to investigate the relationship between morphometric and allometric analysis of the freshwater crab *Barytelphusa cunicularis*. Samples of the specimens were collected and examined, damaged crabs with regeneration or anomalous limbs were discarded. A total of 393 specimens were measured with the help of vernier calliper up to 0.01mm accuracy. Each sample were subjected to descriptive analysis that included computations of mean, standard error, median, mode, standard deviation, sample variance, kurtosis, skewness, range, minimum, maximum, sum and count. Regression and frequency was calculated for each group separately. The analysis was based on the biometric data, observing changes in the relative growth of some body parts related to other. The analysis suggests that the relative growth follows the allometric function (y=mx+c).

INTRODUCTION

The morphometric and allometric analyses or relationship among various parts of the body is functionally important in biology. In decapods, different criteria of analysis have been used to identify sexual maturity. Allometric study plays a key role in the estimation of the proportion between the sizes of different body parts during a given phase of animal's life cycle. Mostly it is studied at the onset of maturity in a specific population. Thus, the allomertic relationship provides important information regarding comparative growth of various body parts. The concept of allometry relied on the analysis of the chelae related to body size, i.e., the relationship between the relative dimension of different parts of the body of an individual and its overall size (Gayon, 2000). The biometric relationships between the carapace (length and width), the major chela propodus (length, width and depth) and the abdomen for each sex in crab, Ucides cordatus (Pinheiro and Hattori, 2006). Surprisingly there has been paucity of information on morphometry and allometry characteristics of crab species of Indian sub continent. Therefore, a detailed study is undertaken to establish relationship among measurements of various body parts in *Barytelphusa cunicularis* (family: Potamonide) freshwater crab, widely distributed in the tropical and sub-tropical regions of the

Indian subcontinent.

MATERIALS AND METHODS

All specimens of freshwater crab (*Barytelphusa cunicularis*) were collected from the field and nearby ponds located in and around Bhilai (21°13' N, 81°26' E), India. Samples of specimens were collected and examined during different seasons. Crab specimens were preserved in a 40% solution of buffered formalin and stored for later sorting, identification and analysis. The following characteristics of 393 specimens were examined. 1. The crabs were sexed on the basis of the shape of the abdomen. 2. The percentage of male and female crabs was analysed separately and their number was counted. 3. The number of male and female left-handed (Left major, right minor) and right handed (right major, left minor) crabs was separately counted.

A series of morphometric measurements in millimetres were taken (Figure 1 and 2). Measurements were taken only on body parts that show no evidence of regeneration. All the measurements were done with the help of Vernier calliper up to 0.01 mm accuracy.

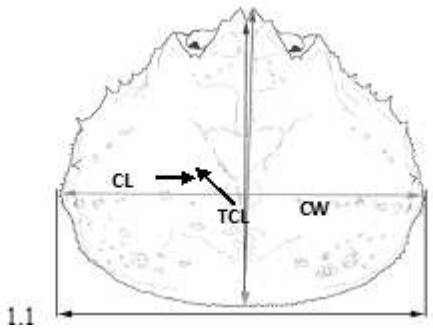

Fig. 1 Dorsal view of crab showing carapace length (CL); carapace width (CW); and total carapace length (TCL)

Fig. 2 Lateral view showing chela height (ChH) and chela length (ChL)

Statistical analysis

All measurements of 393 crabs were analyzed separately. Data were analyzed with the help of software, namely SPPC, CoStat (CoHort Software; Version: 4.02, ©1990) and Analysis ToolPak (Microsoft Excel). Data were analyzed employing t-test, Chi-square test, multiple regression and correlation analyses.The analyses of following parameters were conducted: CL, carapace length; CW, carapace width; TCL, total carapace length; TLChL, total length chela (left); TLChR, total length chela (right); ChWL, chela width (left); ChWR, chela width (right); ChLL, chela length (left); ChLR, chela length (right). Each sample was subjected to descriptive analysis that included computations of mean, standard error, median, mode, standard deviation, sample variance, kurtosis, skewness, range, minimum, maximum, sum and count. Regression and frequency was calculated for each group separately. All analyses were based on the allometric function ($y = mx + c$).

RESULTS

A total of 393 specimens of *B. cunicularis* were captured for the morphological study (224 males, 139 females and 30 Juveniles). The percentage of male and female adult crabs was 62 and 38, respectively; whereas the percentage of juvenile male and female crabs was 87 and 13, respectively. Generally one chela is dominant over the other. The left chela was dominant, irrespective of gender . Thus, the frequency of left handedness was more as compared to right handedness in the population of males and females. In general, one chela was bigger in size than other chela, irrespective of gender. In 139 females, 118 were leptochelous (larger left chela) and only 21 are brachychelous (larger right chela). In 224 males, 193 had leptochelous chela and 31 had brachychelous chela. Table 2 and 3 depict comparison of morphometric variables between male and female crabs in leptochelous and brachychelous categories. In the former category statistically significant differences were witnessed for all variables, namely CL, carapace length; CW, carapace width; TCL, total carapace length; TLChL, total length chela (left); TLChR, total length chela (right); ChWL, chela width (left); ChWR, chela width (right); ChLL, chela length (left); ChLR, chela length (right), when means obtained for females were compared with that of the males (Table 2). However, in case of brachychelous category statistically

Fig. 3 Frequency of larger left or right chela (width) in females, (i) Larger left chela – left chela width; (ii) Larger left chela – right chela width; (iii) Larger right chela – left chela width; (iv) Larger right chela – right chela width. Abscissa represents frequency and coordinate represents different groups based on measurements of body parts.

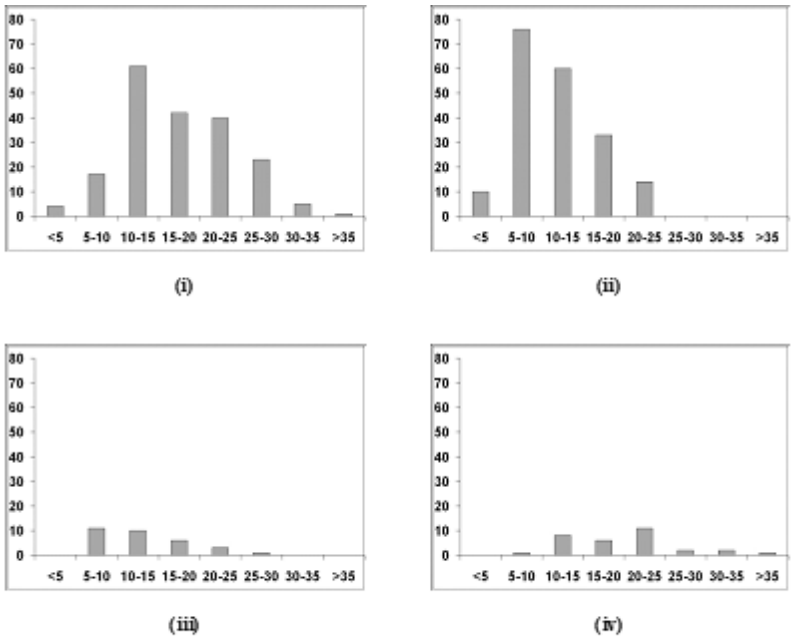

Fig. 4 Frequency of larger left or right chela (width) in males, (i) Larger left chela – left chela width; (ii) Larger left chela – right chela width; (iii) Larger right chela – left chela width; (iv) Larger right chela – right chela width.

significant differences could not be validated for the comparisons between male and female groups for the above variables (Table 3). Results reveal highly significant positive relationship between all the variables irrespective of group and gender. This shows that with increase in the length of carapace, width and variables of chela morphometry increase. All correlation coefficients are statistically significant at ? = 0.01. The carapace width and length increase in tandem and show a proportionate increment with the size of the

animal. The regression equations obtained in the relative growth analysis indicate an isometric relationship between various body parts.

Table 1. Handedness in adult crabs as function of gender

Handedness	Male		Female	
	n	%	n	%
Left handed	193	86.16	118	84.89
Right Handed	31	13.84	21	15.11
Total	224		139	

DISCUSSION

The present study describes the relative growth of *B. cunicularis* analyzing the biometric relationships between the carapace (length, width and total length) and the length and width of major and minor chelae in both sexes. The carapace width and length depend on each other and show a proportionate increment with the increase in the size of the animal. With the increase in the body weight, the CL and CW of the crab increase. The external morphological characters and changes in the growth are related to one of the landmarks to determine the maturity in many decapods; this is the criterion that is commonly used to classify the individuals as mature or immature (Somerton, 1980, 1981; Conan and Comeau, 1986; Paul, 1992; Sainte-Marie *et al.*, 1995). Biometric changes in the chelae, abdomen and pleopods are evident in both sexes and in the developmental stages of crustaceans, principally during the transition from the immature to the mature stage. The carapace length and total length suggest a linear correlation. Similarly, Kuris *et al.* (1987) and Pinheiro and Fransozo (1993) observed that the morphometric variables related to the carapace are isometric. According to Pinheiro and Hattori (2006) in Ucides cordatus the greater increment of CW size from 59 mm might be associated with the increase in the size of the gill chamber in the adult phase. Branco (1993) recorded isometric growth in *U. cordatus* with reference to CL and CW relationship using the linear function (y = a + bx).

Although most of the studies on allometry in crab claws have dealt exclusively with the major claw (Williams *et al.*, 1980; Frith and Brunemeister, 1983; Green and Schochet, 1990), in the portunids the morphological structure of chela has been analyzed because of their importance in predation techniques and prey selection mechanism The morphometric relationships between the carapace length-width and the dimensions of the chelipeds could be used to estimate the size at the onset of morphological maturity. Morphometric changes on the other hand point to allometric changes in the growth of different parts of the body related to functional maturity. The morphometric characteristics and their allometric relationship to a larger extent are influenced by age, local conditions and population density of the species. It seems that the patterns of somatic growth and maturity are important attributes in crustaceans for a better comprehension of population and reproductive biology. In the present study, the relationship between the chela width and length shows a linear correlation, i.e., as the chela length increases, the width of the chela also increases. The present findings provide a

Table 2 Comparison between the morphological variables of crab as function of gender

Variable	Female	Male	df	t value	P value
CL	29.87 ± 0.67*	27.11 ± 0.54	252	3.22	< 0.001
CW	41.31 ± 0.93	37.29 ± 0.73	248	3.43	< 0.001
TCL	50.29 ± 1.12	46.01 ± 0.86	243	3.03	0.014
TLCh L	49.83 ± 1.12	45.41 ± 1.03	265	2.8	0.003
TLCh R	39.55 ± 1.08	36.77 ± 0.91	263	1.97	0.025
ChWL	19.67 ± 0.61	17.29 ± 0.47	243	3.11	0.001
ChWR	13.91 ± 0.55	11.78 ± 0.34	208	3.31	< 0.001
ChLL	28.49 ± 0.74	26.38 ± 0.66	270	2.13	0.017
ChLR	20.79 ± 0.61	19.52 ± 0.59	286	1.51	0.066

*Mean ± SEM

CL= Carapace length; CW = Carapace width; TCL = Total carapace length; TLChL = Total length chela (left); TLChR = Total length chela (right); ChWL = Chela width (left); ChWR = Chela width (right); ChLL = Chela length (left); ChLR = Chela length (right)

Table 3. Frequency distribution of chela

Frequency	Female with Larger Left Chela		Female with Larger Right Chela		Male with Larger Left Chela		Male with Larger Right Chela		All Crabs with Larger Left Chela		All Crabs with Larger Right Chela	
	ChWL	ChWR	ChWL	ChWR	ChWL	ChWR	ChWL	ChWR	ChWL	ChWR	ChWL	ChWR
<5	0	2	0	0	4	10	0	0	4	12	0	0
5-10	1	34	6	1	17	76	11	1	18	110	17	2
10-15	38	35	8	6	61	60	10	8	99	95	18	14
15-20	19	33	3	6	42	33	6	6	61	66	9	12
20-25	36	11	4	3	40	14	3	11	76	25	7	14
25-30	17	1	0	3	23	0	1	2	40	1	1	5
30-35	5	1	0	0	5	0	0	2	10	1	0	2
>35	2	1	0	2	1	0	0	1	3	1	0	3
Total	118	118	21	21	193	193	31	31	311	311	52	52

comprehensive account of the morphometric and allometric characteristics of the freshwater crab, *Barytelphusa cunicularis*.

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