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Studies on morphometry of freshwater crab, *Barytelphusa cunicularis* (Decapoda, Potamonidae)

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ABSTRACT

Secondary sexual organ chela of *Barytelphusa cunicularis*, a freshwater crab was measured in females and males collected random at field from backwaters of Jayakwadi Dam. Segmental growth of major and minor chela was analyzed among sexes. In male all the segments in major and minor chela showed positive allometric growth while in female, merus and propodus only showed positive allometric growth. Analysis of covariance (ANCOVA) of growth of major and minor chelae segments indicated that there was a significant difference in growth pattern between major and minor chela in males whereas in females the growth constants of major and minor chela segments did not differ significantly however, intercepts differ significantly.

Introduction

Decapod crustaceans generally show sexual dimorphism in their external morphology, particularly in relation to positioning of opening of gonoduct. Sexual difference observed in the growth of several body parts relative to carapace size have often been used to examine the relationship between morphometrics and sexual activity, in addition to morphometric difference among populations or species (Kanno, 1972; Huber, 1985; Aiken and Waddy, 1989). Brachyuran males and some other Decapod species develop the pereiopods especially the chelipeds, for combat, display and courtship (Hartnoll, 1974, 1982). Mariappan (2004) studied developments of individual segments of pereiopods in *Macrobrachiumnobilii* and reported that ratio between cheliped length and carapace length is species specific. Recently Suzuki and Kasamura (1997) differentiated two prawn species on the basis of length and width of dactyl of second pereiopod. Kubo (1988) studied the sexual difference in pereiopods of *P.japonics* and reported that males tended to have longer pereiopods than females of the same carapace size. The freshwater crabs, *Barytelphusa cunicularis* are widely distributed in the region and consumed by socio- economically poor people to obtain their energy requirements. Moreover studies on functional maturity and individual segments of chelipeds are very scanty, so present work was done.

Material and method

Male and females of *Barytelphusa cunicularis* were collected from backwaters of the Jayakwadi dam. Crabs were collected twice a month over one year in 2007. Average annual temperature was approximately 32^0Cthroughout the year. Sex determination was based on the morphology of the abdomen and number of pleopods.

Pereiopods (Chela) length:Pereiopods (major and minor) in male and female were measured from the dactylus to the distil end of ischium. Individual segments (Ischium, Merus, Carpus,

Propodus and dactylus) were also measured in male and female and ANCOVA was performed. The first two proximal segments i.e. coxa and basis were ignored since their length was small when compared to the total length chelipeds (Nagamine and Knight, 1980; Kuris et al 1987).

All the measurements were taken to the nearest 0.1 mm by using verniercaliper.

Regression analysis and ANCOVA

ANCOVA was performed. In this context the derived slope value b referred as allometric growth constant was designed as: 1) isometric when 'b' ranged from 0.9 to 1.1 (Kuris and Carlton, 1977), 2) positive if more than 1 and 3) negative if less than 1 (Tessier, 1960; Hartnoll, 1982) Additionally, ANCOVA for comparing slopes (Zar, 1996) was done to test significant differences between juveniles and adults. All calculations were done manually.

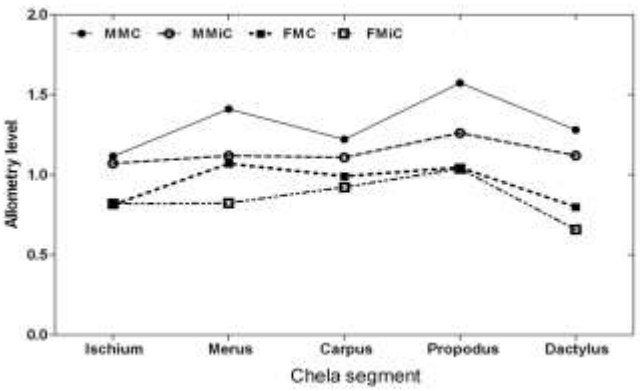

Fig. 1: Allometry levels of major and minor segments of male and female, *Barytelphusa cunicularis.* MMC – Male major chela, MMiC – Male minor chela, FMC – Female major chela, FMiC – Female minor chela

Results

Segmental growth of major and minor chela with reference to carapace length of *Barytelphusa cunicularis* was analyzed among sexes.

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Table 1: *Barytelphusa cunicularis*. Analysis of covariance (ANCOVA) to test slopes (b) and elevations (a) of regression equation for males and females

Character	Sex and Size	Regression	compared	Slop	Elevation
Pleopod	F CL < 37 versus F CL > 37	-1.45+2.26x	-0.81+1.79 x	21.13***	319.04***
	M CL < 26 versus M CL > 26	-1.47+2.28x	0.37+0.77x	205.05***	10.91***
	F CL < 37 versus M CL < 26	-1.45+2.26x	-1.47+2.28x	3.381 ND	471.97***
	F CL > 37 versus M CL > 26	-0.81+1.79 x	0.37+0.77x	77.020***	6178.4***
	F CL < 37 versus M CL > 26	-1.45+2.26x	0.37+0.77x	242.53***	819.06***
Abdomen	F CL < 37 versus F CL > 37	-2.32+2.69x	-1.70+2.30x	14.454***	4302.8***
	M CL < 33 versus M CL > 33	-2.06+2.52x	0.50+0.88x	779.85***	607.94***
	F CL < 37 versus M CL < 33	-2.32+2.69x	-2.06+2.52x	1.608 ND	3278.9***
	F CL > 37 versus M CL > 33	-1.70+2.30x	0.50+0.88x	208.08***	345.35***
	F CL < 37 versus M CL > 33	-2.32+2.69x	0.50+0.88x	1212.5***	443.23***
Mj Chela	F CL < 32 versus F CL > 32	-0.13+1.29x	0.41+0.98x	11.146***	126.86***
	M CL < 37 versus M CL > 37	-0.16+1.30x	-0.29+1.41x	1.048 ND	221.70***
	F CL < 32 versus M CL < 37	-0.13+1.29x	-0.16+1.30x	0.1820 ND	18.84***
	F CL > 32 versus M CL > 37	0.41+0.98x	-0.29+1.41x	20.153***	45.951***
	F CL < 32 versus M CL > 37	-0.13+1.29x	-0.29+1.41x	0.9358 ND	79.303***
Mn Chela	F CL < 32 versus F CL > 32	0.09+1.12x	0.86+0.66x	70.103***	47.136***
	M CL < 37 versus M CL > 37	0.01+1.16x	-0.76+1.27x	2.451 ND	0.281 ND
	F CL < 32 versus M CL < 37	0.09+1.12x	0.01+1.16x	1.159 ND	22.011***
	F CL > 32 versus M CL > 37	0.86+0.66x	-0.06+1.27x	51.8***	120.83***
	F CL < 32 versus M CL > 37	0.09+1.12x	-0.06+1.27x	0.686 ND	35.261***

*Statistically different (P<0.05): $F_{(1)}$ 1, 124 = 3.92
*** Statistically highly different (P<0.001): $F_{(1)}$ 1, 124= 11.4
ND Statistically not different (P>0.05): $F_{(1)}$ 1, 124 = 3.92

Table 2: *B. cunicularis*: Regression equation for individual segments of major and minor chela in relation to carapace length

Parameter	Intercept (a)	Slope (b)	Allometry
	Male – Major chela		
Ischium	-0.842	1.116	+
Merus	-1.031	1.411	+
Carpus	-0.623	1.221	+
Propodus	-1.291	1.573	+
Dactylus	-0.727	1.281	+
	Male – Minor chela		
Ischium	-0.887	1.071	+
Merus	-0.511	1.119	+
Carpus	-0.469	1.108	+
Propodus	-0.478	1.261	+
Dactylus	-0.476	1.120	+
	Female – Major chela		
Ischium	-0.402	0.811	-
Merus	-0.429	1.070	+
Carpus	-0.041	0.991	0
Propodus	-0.322	1.046	+
Dactylus	-0.090	0.798	-
	Female – Minor chela		
Ischium	-0.504	0.819	-
Merus	-0.082	0.823	-
Carpus	-0.036	0.923	0
Propodus	-0.365	1.038	+
Dactylus	-0.182	0.657	-

+ Positive allometry - Negative allometry, 0 Isometry

Table :3 *Barytelphusa cunicularis* Comparison or regression equation for individual segments (y) of major and minor chelae in relation to carapace length (x) in males.

Character	Regression Equation		Comparison of	
	Major	Minor	Slope Value	Elevation Value
		Male		
Ischium	-0.842+1.116x	-0.887+1.071x	5.889***	55.007***
Merus	-1.031+1.411x	-0.511+1.119x	23.772***	178.964***
Carpus	-0.623+1.221x	-0.469+1.108x	2.569***	142.947***
Propodus	-1.291+1.573 x	-0.478+1.261x	13.145***	770.952***
Dactylus	-0.727+1.281x	-0.476+1.120x	5.100***	98.738***
		Female		
Ischium	-0.402+0.811x	-0.504+0.819x	0.497^{NS}	25.451***
Merus	-0.429+1.070x	-0.082+0.823x	2.743***	20.603***
Carpus	-0.041+0.991x	-0.036+0.923x	1.644*	38.060***
Propodus	-0.322+1.046x	-0.365+1.038x	0.011^{NS}	79.089***
Dactylus	-0.090+0.798x	-0.182+0.657x	1.268*	6.350***

*Statistically significant (P<0.05): $F_{(.)}$ 60, 60 = 1.53

*** Statistically highly significant (P<0.001): $F_{(.)}$ 80, 80 = 2.01

NS Statistically not significant (P>0.05): $F_{(.)}$ 60, 60 = 1.53

Table 4 - *Barytelphusa cunicularis* Comparison or regression equation for individual segments (y) of major and minor chelae in relation to carapace length (x) in males

Character	Regression Equation		Comparison of	
	Male	Female	Slope Value	Elevation Value
		Major		
Ischium	-0.842+1.116x	-0.402+0.811x	2.957***	8.466***
Merus	-1.031+1.411x	-0.429+1.070x	4.438***	-24.582^{NS}
Carpus	-0.623+1.221x	-0.041+0.991x	13.000***	618.690***
Propodus	-1.291+1.573 x	-0.322+1.046x	39.870***	117.599***
Dactylus	-0.727+1.281x	-0.090+0.798x	17.683***	162.860***
		Minor		
Ischium	-0.887+1.071x	-0.504+0.819x	1.405^{NS}	145.250***
Merus	-0.511+1.119x	-0.082+0.823x	22.083***	96.455***
Carpus	-0.469+1.108x	-0.036+0.923x	10.082***	978.567***
Propodus	-0.478+1.261x	-0.365+1.038x	8.778***	883.578***
Dactylus	-0.476+1.120x	-0.182+0.657x	20.931***	1.282^{NS}

***Statistically significant (P<0.05): $F_{(.)}$ 60, 80 = 1.48

NS Statistically not significant (P>0.05): $F_{(.)}$ 60, 80 = 1.48

Among the five segments, propodus was the longest segment followed by merus and carpus in female but in male dactylus was longer than carpus and ischium wassmallest segment in both chelae of male and female (Table. 1, 3) In male all the segments in major and minor chela showed positive allometric growth.

In female, merus and propodus only showed positive allometric growth. Further carpus of major and minor exhibited isometric growth. Ischium and dactylus in major and minor chelae showed negative allometric growth. Analysis of covariance (ANCOVA) of growth of major and minor chelae segments indicated that there was a significant difference in growth pattern between major and minor chela

in males whereas in females the growth constants of major and minor chela segments did not differ significantly however, intercepts differ significantly (Table. 3 & 4). The length increment of each segment differed one from another in major (except merus) in male and females. There was not significant difference in relative growth pattern of ischium and dactylus in male and female. Among sexes, propodus had a maximum allometry level, which declined to the minimum in dactylus and ischium (Fig.1)

Discussion

In decapods, The importance of chelar dimensions to characterize sexual dimorphism or to estimate size at sexual maturity in males have been reported in detail (Hartnoll, 1974, 1982) Like other crustacean groups in *Barytelphusacunicularis* the growth of the male chelipeds had positive allometry with reference to carapace length but in females it was isometric..In *M.malcolmsonii*, Jayachandran (1998) reported that carpus was longer than the palm. Mariappan (2004) in *M. nobilii* reported that carpus was shorter than the propodus while the level of allometry was higher when compared to propodus. Koshy (1973) and Nagamine and knight (1980) also made similar findings in *M.dayanum and M.rosenbergii*, respectively where the propodus was longer than the carpus. In *Barytelphusa cunicularis*, propodus was shorter than dactylus but had higher allometry compared to other segments. In *M. rosenbergii*, Kuris (1987) differentiated three male morphotypes (blue claw and orange claw) on the basis of total chela length. In *Trapezia ferruginea*, allometric level was negative in normal while it was positive among berried females (Finney and Abele, 1981). In male *B. cunicularis*, in both chela the growth of propodus and dactylus had positive allometry. In females major chela growth of dactylus had negative allometry but it was positive for propodus and growth of carpus had isometry in both chelae.

Huxley (1932) observed a growth center in chelipeds of species like *Ucapugnax*, where the maximum allometry was at propodus, which declined towards dactylus and coxa. Dawes (1934) observed such growth center in propodus of *Alpheus dentipes.*In the right chela of male *Pagurusbernhardus* the growth gradient changed from the merus to propodus when the crab grows (Huxley, 1932). In *Barytelphusa cunicularis*, the growth of propodus had maximum positive allometric in both chelae and both sexes and presence of sexual dimorphism was an agreement with the earlier findings in other decapods. The present study provides an alternative to the determination of legal size for stock management. From the present work, we also concluded that morphometric characters could be employed to describe the species.

Conclusion

This study demonstrated that in *Barytelphusa cunicularis* the morphologic changes were associated with gonadal development and propodus was shorter than dactylus but had higher allometry compared to other segments in both chela and both sexes.

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