



# Carapace width and length to weight relationship of edible crabs from the coastal waters of Alappuzha, Kerala

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Received: 22 July 2022 Revised: 24 Nov 2022  
Accepted: 28 Nov 2022 Published: 29 Apr 2023

Short communication

## Abstract

The present study evaluated the relationships between carapace width, length and body weight increments among different species of marine edible crabs of coastal Alappuzha, Kerala. A total of 1127 specimens of four species, *Portunus pelagicus*, *Portunus sanguinolentus*, *Charybdis feriatus* and *Charybdis lucifera* were collected for the study. The b values obtained ranged from 2.396 to 3.456 in the carapace width-weight relationship and 2.386 to 3.073 in the carapace length-weight relationship. The results indicated a positive allometry ( $b > 3$ ) in *P. pelagicus* in the carapace width-weight relationship ( $b = 3.456$ ) and *C. feriatus* in the carapace length-weight relationship ( $b = 3.073$ ). The species *P. sanguinolentus* and *C. lucifera* showed negative allometric growth ( $b < 3$ ) in both relationships. *P. pelagicus* male exhibited positive allometry in both relationships. The present study showed that growth patterns varied among various species and different sexes of crabs.

**Keywords:** Marine crabs, growth coefficient, allometric growth, *Portunus*, *Charybdis*.

## Introduction

Crustaceans have a significant role in Indian fishery as they contribute 13% of India's marine production with the crabs contributing 12% of the crustacean fishery (CMFRI, 2019). In addition to their delicious taste, high protein content and nutritive value, they are habitat specific and act as excellent bio-indicators of habitat health and environmental degradation. Their distribution depends greatly on the availability of food, shelter, salinity and temperature. In the coastal waters, they are caught from 10 m to 60 m depths in by-catches of trawlers.

The crab resources of India are mostly from Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat fishery (Josileen, 2017) with *Scylla* spp. (Mud crabs), *Portunus pelagicus* (Blue swimmer crab), *Portunus sanguinolentus* (Three spotted crab), *Charybdis feriatus* (Crucifix crab), *Charybdis lucifera* (Yellowish brown crab), *Charybdis natator* (Line crab) and *Podophthalmus vigil* (Long eyestalk crab) dominating the fishery. These crab species have high demand in the international markets and are exported abroad in live conditions (Sathiya and Valarmathi, 2018). Thus, crab fishery plays a significant role in the livelihood and economy of India. In the present study, we aimed to determine the relationships between carapace width/ carapace length and body weight of four species of marine crabs *P. pelagicus*, *P. sanguinolentus*, *C. feriatus* and *C. lucifera* from the coastal waters of Alappuzha district, Kerala.

## Material and methods

A total of 1127 crabs were collected from the trawl by-catch of intertidal zones of the Alappuzha district (9° 11' 3" N and 9° 11' 30" N latitudes and 76° 20' 8" E to 76° 25' 25" E longitudes) during 2019-2021. The crabs collected were identified up to the species level using standard literature (Manisseri *et al.*, 2003; Mizzan and Vianello, 2009; Josileen, 2017) and the growth parameters were analyzed. Males and females were segregated based on their morphological characteristics and the shape of the abdomen. The carapace width ( $C_w$ ), carapace length ( $C_L$ ) and total weight ( $T_w$ ) were measured using a Vernier Caliper and electronic balance respectively. Carapace width- total weight ( $C_w-T_w$ ) and carapace length- total weight ( $C_L-T_w$ ) relationships were estimated using the exponential equation  $W = aL^b$ , where,  $W$  = total weight,  $L$  = Carapace width (or carapace length),  $a$  = 'y' intercept or the initial growth coefficient and  $b$  = the slope or growth coefficient (Pauly, 1983; Le Cren, 1951). The values

of constants 'a' and 'b' were calculated by the least square's method and were represented as positively allometric ( $b > 3$ ), negatively allometric ( $b < 3$ ) or isometric ( $b = 3$ ) (Bagenal, 1978; Pauly, 1984; Sparre and Venema, 1992). The carapace width-weight and length-weight relationship of males, females and combined sexes were also determined. The results were expressed as mean  $\pm$  standard deviation. Data were analyzed by linear regression using the statistical software SPSS version 20.

## Results and discussion

The carapace width, length, and total weight of four species of marine edible crabs are presented in Table 1. Among the four species, the carapace width was maximum in *P. pelagicus* (19 cm) and minimum in *C. lucifera* (5.1 cm). *C. feriatus* had a maximum carapace length and weight (10 cm and 570.95

gm) and *P. sanguinolentus* had a minimum carapace length and weight (2.2 cm and 10 gm). The  $C_w$ - $T_w$  relation indicated that the growth coefficient varied among different sexes of the same species. The range of the b value in  $C_w$ - $T_w$  relation was 2.396-3.456, whereas in  $C_L$ - $T_w$  relation it was between 2.386 and 3.073 (Table 2, 3). A significant difference ( $p = 0.05$ ) was observed between the sexes in both  $C_w$ - $T_w$  and  $C_L$ - $T_w$  relationships and males exhibited higher b values in all cases compared to females. Similar observations were reported by Josileen (2011) in *P. pelagicus* from the Mandapam region and Dineshbabu (2011) and Anaiappan *et al.* (2018) in *C. feriatus* collected from Karnataka and Tamil Nadu. Greater carapace length and weight of male crabs than those of females might have resulted from variations in cheliped size, foraging behaviour and metabolic rate between the sexes (Thirunavukkarasu and Shanmugam, 2011). In the case of the estimated parameters, the most significant

Table 1. Growth parameters of four species of crabs collected from the coastal waters of Alappuzha (N: number of samples,  $C_w$ : Carapace width;  $C_L$ : Carapace length;  $T_w$ : Total weight; M: Male; F: Female; C: Sexes combined)

Species	Sex	N	$C_w$ (cm)		$C_L$ (cm)		$T_w$ (g)	
			Range	(Mean $\pm$ SD)	Range	(Mean $\pm$ SD)	Range	(Mean $\pm$ SD)
<i>P. pelagicus</i>	M	115	7.8-19	11.53 $\pm$ 2.41	3.5-8.2	5.37 $\pm$ 1.25	18-335	100.92 $\pm$ 78.37
	F	170	7.2-17.5	12.06 $\pm$ 2.21	3.2-8.3	5.63 $\pm$ 1.22	17-344.67	108.87 $\pm$ 70.25
	C	285	7.2-19	11.84 $\pm$ 2.30	3.2-8.3	5.53 $\pm$ 1.23	17-344.67	105.66 $\pm$ 73.60
<i>P. sanguinolentus</i>	M	231	5.4-16.3	10.24 $\pm$ 1.87	2.2-7.2	4.73 $\pm$ 0.84	10-238.83	68.87 $\pm$ 41.51
	F	245	5.7-17.7	10.63 $\pm$ 1.86	2.5-8	4.88 $\pm$ 0.87	12.91-202.57	69.75 $\pm$ 33.99
	C	476	5.4-17.7	10.44 $\pm$ 1.87	2.2-8	4.80 $\pm$ 0.86	10-238.83	69.33 $\pm$ 37.79
<i>C. feriatus</i>	M	114	5.5-14.5	8.63 $\pm$ 1.90	3.6-10	5.64 $\pm$ 1.26	15.1-570.95	118.02 $\pm$ 103.70
	F	92	5.4-11.8	7.83 $\pm$ 1.32	3.2-7.6	5.10 $\pm$ 0.85	22.2-219.9	74.16 $\pm$ 42.67
	C	206	5.4-14.5	8.27 $\pm$ 1.71	3.2-10	5.40 $\pm$ 1.12	15.1-570.95	98.43 $\pm$ 84.93
<i>C. lucifera</i>	M	127	5.1-9.5	6.30 $\pm$ 0.88	3-6.7	3.91 $\pm$ 0.58	12.13-146.12	34.20 $\pm$ 20.98
	F	33	5.1-9	5.96 $\pm$ 0.79	3-5.3	3.66 $\pm$ 0.48	12.84-95.18	26.96 $\pm$ 15.20
	C	160	5.1-9.5	6.23 $\pm$ 0.87	3-6.7	3.85 $\pm$ 0.57	12.13-146.12	32.71 $\pm$ 20.10

N= Number

Table 2. Carapace width–Total weight relationship of crabs collected from the coastal waters of Alappuzha during 2019-2021

Crab species	Sex	Regression Parameters					
		a	b	r <sup>2</sup>	95% CL of a	95% CL of b	S.E. of b
<i>P. pelagicus</i>	M	0.163	3.504	0.865	0.1246-0.2148	3.247-3.762	0.130
	F	0.176	3.427	0.885	0.1439-0.2157	3.240-3.616	0.095
	C	0.171	3.456	0.876	0.1456-0.2013	3.305-3.608	0.077
<i>P. sanguinolentus</i>	M	0.464	2.527	0.681	0.3701-0.5823	2.302-2.752	0.114
	F	0.586	2.282	0.741	0.4863-0.7061	2.100-2.465	0.093
	C	0.525	2.396	0.693	0.4543-0.6077	2.252-2.540	0.073
<i>C. feriatus</i>	M	0.436	2.997	0.738	0.3199-0.5957	2.664-3.331	0.168
	F	0.510	2.795	0.765	0.3823-0.6805	2.472-3.120	0.163
	C	0.444	2.965	0.758	0.3603-0.5488	2.735-3.196	0.117
<i>C. lucifera</i>	M	0.450	2.859	0.627	0.3296-0.6139	2.471-3.250	0.197
	F	0.482	2.735	0.563	0.2437-0.9550	1.853-3.618	0.433
	C	0.444	2.869	0.626	0.3369-0.5857	2.521-3.218	0.176

(a, b: growth parameters; r<sup>2</sup>: coefficient of determination; CL: Confidence Level; S.E.: Standard Error; M: Male; F: Female; C: Sexes combined)

Table 3. Carapace length–Total weight relationship of crabs collected from the coastal waters of Alappuzha during 2019-2021

Crab species	Sex	Regression Parameters					
		a	b	r <sup>2</sup>	95% CL of a	95% CL of b	S.E. of b
<i>P. pelagicus</i>	M	0.710	3.091	0.869	0.6035-0.8344	2.868-3.314	0.112
	F	0.876	2.804	0.848	0.7657-1.0030	2.624-2.985	0.091
	C	0.800	2.926	0.858	0.2655-0.8869	2.787-3.066	0.071
<i>P. sanguinolentus</i>	M	1.037	2.591	0.713	0.8994-1.1985	2.378-2.805	0.109
	F	1.344	2.197	0.705	1.1889-1.5219	2.018-2.377	0.091
	C	1.186	2.386	0.705	1.0800-1.3047	2.247-2.525	0.071
<i>C. feriatus</i>	M	0.649	3.209	0.853	0.5385-0.7811	2.960-3.458	0.126
	F	0.900	2.727	0.73	0.7039-1.1491	2.381-3.074	0.175
	C	0.712	3.073	0.822	0.6169-0.8220	2.877-3.271	0.100
<i>C. lucifera</i>	M	0.807	2.877	0.695	0.6610-0.9851	2.540-3.214	0.170
	F	0.836	2.79	0.636	0.5423-1.2930	2.018-3.561	0.378
	C	0.804	2.878	0.694	0.6750-0.9589	2.578-3.178	0.152

(a, b: growth parameters; r<sup>2</sup>: coefficient of determination; CL: Confidence Level; S.E.: Standard Error)

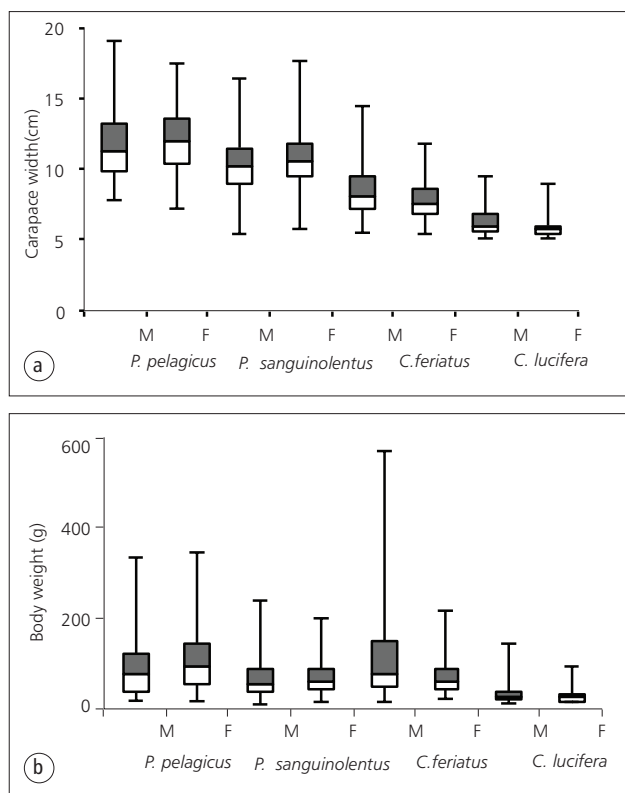


Fig. 1. (a). Differential carapace width and (b) total weight of the male and female of four crab species.

relation was for *P. pelagicus* males ( $r^2=0.865$  and  $0.869$ ) and the least was that of the females of *C. lucifera* ( $r^2=0.563$  and  $0.636$ ). Box plots obtained according to carapace width and the total weight of male and female crabs are represented in Fig. 1. The size-to-weight growth pattern of the crabs exhibited differences among each species, which might be due to the differential responses to environmental, physiological, and

ecological factors. The differential growth pattern in various crab species and sexes depended on carapace width, length, and weight among them. The results obtained from this study will be helpful to assess the population dynamics of brachyuran crabs, a major crustacean fishery of the Alappuzha coast on the Southwest coast of India.

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