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Relative growth and sexual dimorphism in the hermit crab *Clibanarius signatus* Heller, 1861 (Anomura, Diogenidae) from the northern coast of the Persian Gulf, Iran

Mahdieh Ahmadi[1] | **Ahmad Noori**[1] | **Bita Kalvani Neitali**[2] | **Marcelo Antonio Amaro Pinheiro**[3]

[1]Department of Fisheries Science, Faculty of Marine Science and Technology, University of Hormozgan, Bandar Abbas, Iran

[2]Independent Researcher, Bandar Abbas, Iran

[3]Laboratory of Conservation Biology for Crustaceans and Coastal Environments, Instituto de Biociências (IB), Campus do Litoral Paulista (CLP), Research Group in Crustacean Biology (CRUSTA), UNESP – Universidade Estadual Paulista (UNESP), São Paulo, Brazil

Correspondence
Ahmad Noori, Department of Fisheries Science, Faculty of Marine Science and Technology, University of Hormozgan, Bandar Abbas, Iran.
Email: nooryahmad@gmail.com

Abstract

The purpose of this study was to investigate the relative growth and sexual dimorphism in the hermit crab *Clibanarius signatus*. The evaluation was done with 955 specimens (494 males, 251 females, and 210 intersexes) captured in Persian Gulf (Iran) during January to December 2015. Animals were submitted to measurements related to weight (BW, total wet weight) and body size related to cephalic shield (SW, width; and SL, length) and propodus of both chelipeds (CPL, length; and CPW, width). Males were larger and heavier than females and intersexes. Both males and females showed a negative allometric growth for the SL–BW and SL–SW relationships, but a positive allometric growth to intersex specimens. To SL–CPL relationship, a negative allometric growth was confirmed in males and females independent of the laterality of the CPL, whereas a contrast was verified in intersexes, with a positive allometric growth occurred for both hands. To SL–CPW relationship, a negative allometric growth ($b < 1$) occurred in females, independent of the laterality of the CPW, while in males, a positive allometric pattern was confirmed. In intersexes, this relationship was positive except for the right CPW which was isometric. Sexual dimorphism was evident in *Clibanarius signatus*, with males being the largest and females the smallest specimens in the population.

KEYWORDS

biometry, intersex, size, weight

1 | INTRODUCTION

Morphological studies are common and informative in aquatic organism surveys, especially in crustaceans where growth is molt-dependent and discontinuous (Clayton, 1990; Syama, 2009). As a result, the growth process in these animals is seasonal, when some dimensions of the body may present a broad change with a remarkable growth in the transition of juvenile to adult phases (puberty molt). These morphometric changes (growth rate) in different body structures/somites (e.g. chelipeds, pleopods, and abdomen) are known as relative growth (Hartnoll, 1978, 1982, 1988). Therefore, analysis evolving morphological and relative growth studies are relevant tools in the assessment and interpretation of sex-related characters, allometric growth patterns, size at sexual maturity, and physiological and behavioural patterns (Kuris et al., 1987; Noori et al., 2015; Pardal-Souza and Pinheiro, 2013; Pinheiro and Fiscarelli, 2009).

The power function weight-length equation ($Y = aX^b$) (Huxley, 1950) frequently used to assess the relative growth

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is fitted to the empirical points of biometric relationships evolving body weight, and size is obtained. This equation is basic, but is so informative that it is extensively used in many studies with different aquatic animals, including crustaceans (Froese, 2006; Le Cren, 1951). This widely used equation provides a variety of useful biological interpretations of the studied animals, as expressed by '*b*'-value relative to the pattern of body weight rate by size, but allows to compare values (e.g., between sexes, among development phases, etc.) and evaluate these specific growth rates. In these cases, deviations of '*b*' from 3 (for weight–length relationships) or from 1 (for body metric size relationships) indicate an allometric growth pattern (Fairbairn, 1997; Hines, 1982), represented as positive or negative allometry, when '*b*'-values are inferior or superior of these reference values, respectively.

Morphological studies in crustaceans have been directed to species of economic importance such as certain crab species (Araújo et al., 2011; Dan et al., 2013; Haefner, 1990; Mohapatra et al., 2010; Zainal, 2017) and shrimps (Araneda et al., 2008; Cheng and Chen, 1990; Chow and Sandifer, 1991; Primavera et al., 1998), while in non-economic crustacean species (e.g., hermit crabs), these studies are relevant in the ecological point of view. A large number of studies have been carried out on different species of hermit crabs, including *Paguristes erythrops* (Biagi and Mantelatto, 2006), *Petrochirus diogenes* (Bertini and Fransozo, 1999), *Diogenes alias* (Nirmal et al., 2020), *Calcinus tibicen* (Fransozo et al., 2003), *Calcinus latens* (Obuid-Allah et al., 2019), *Pagurus filholi* (Imafuku and Ikeda, 2014), *Clibanarius vittatus* (Sampaio and Masunari, 2010) and *Clibanarius erythropus* (Tirelli et al., 2007). These studies mostly considered the morphometric and relative body growth (Biagi and Mantelatto, 2006; Fransozo et al., 2003; Mantelatto and Martinelli, 2001), gastropod shells occupied by sex (Benvenuto and Gherardi, 2001; Mantelatto and Garcia, 2000; Mantelatto and Meireles, 2004), sexual dimorphism (Biagi and Mantelatto, 2006; Harvey, 1990; Mantelatto et al., 2001; Yasuda et al., 2017), and ecological and population studies (Garcia and Mantelatto, 2001; Mantelatto et al., 2002; Turra and Leite, 2000). However, studies on *C. signatus* are rare and limited to a few aspects, such as shell selection and population biology (Ismail, 2018; Kheirabadi et al., 2015; Seyfabadi et al., 2015), possible bio-indicators for some environmental pollutants (Matin et al., 2019; Sinaei et al., 2018) as well as behavioural physiology (Ismail, 2012).

The aim of the present contribution was to study the relative growth and weight–length relationship in *C. signatus* at the Persian Gulf, Iran. We also discuss the sexual dimorphism found in this species.

2 | MATERIALS AND METHODS

2.1 | Study area and sampling procedure

Specimens of hermit crabs *C. signatus* were monthly collected during 1-year (January–December 2015), from Bandar Kong (26°35'6.332"N, 54°55'58.083"E), northern coast of the Persian Gulf, Iran (Figure 1). The mean water temperature and salinity in the sampling area were recorded as 25.1 ± 0.8°C for temperature (ranged from 14.5°C in December to 33°C in August) and 36.5 ± 0.1 ppt for salinity (fluctuated from 34.5 ppt in December to 38 ppt in August), respectively. The general view of the sampling area was that it was a wild field, populated with mollusks (*Trochus* sp., *Euchelus* sp., *Nerita* sp., *Cerithium* sp., *Nassarius* sp., and

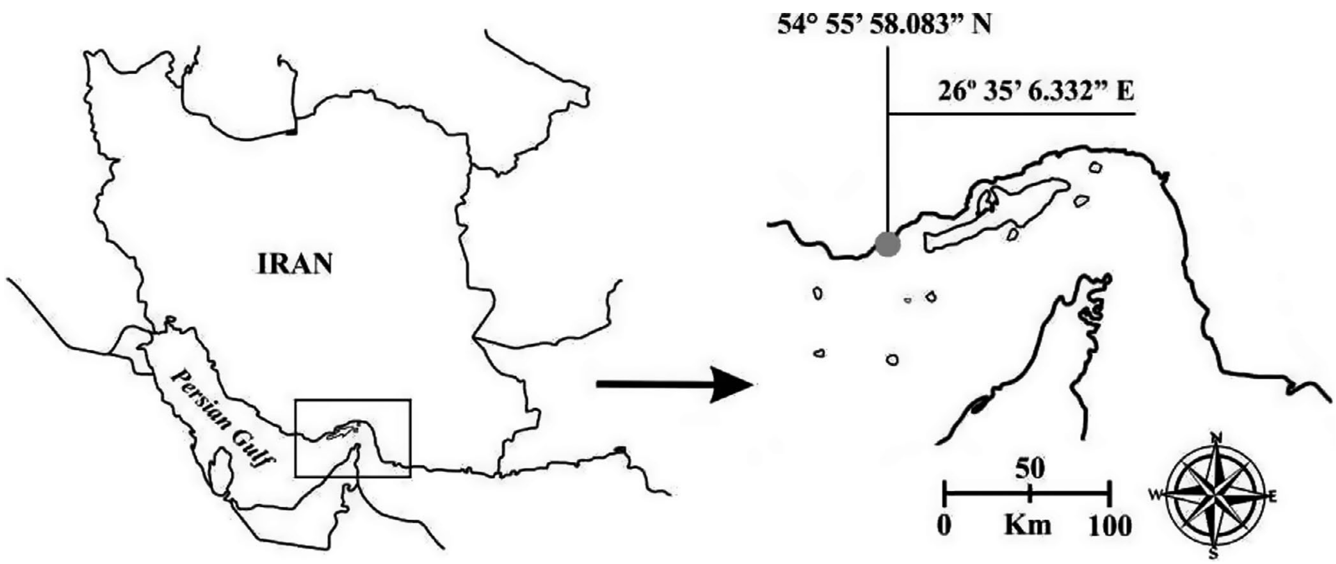

FIGURE 1 Location of the study site depicting the coordinates of the northern coast of the Persian Gulf (Iran) where the population was studied

Tenguella sp.) and without any serious anthropogenic impacts. Individuals were captured by hand during low tides, in depressions found in the intertidal zone, where these animals were grouped in small pools of water or cracks in exposed rocks (as verified in the other congeners species – see (Fransozo and Mantelatto, 1998; Mantelatto and Garcia, 1999). Hermit crabs were placed in plastic bags with crushed ice in a cooler and transported to the laboratory for further examination. The number of individuals sampled each month was not equal and ranged from 30 to 58 for females, 18 to 27 for males, and 8 to 28 for intersexes.

2.2 | Morphological measurement procedures

In the laboratory, hermit crabs were carefully removed from their gastropod shells and grouped into four categories: (a) males with gonopores on the basis of the fifth pereopods; (b) females with gonopores on the basis of the third pereopods; (c) intersex individuals with gonopores on the bases of both (third and fifth) pereopods; and (d) ovigerous, due to presence of eggs adhered to the pleopods. Individuals of uncertain sex were omitted from statistical analysis. Evaluation of the maturity status of the studied specimens is not included in this study.

After each specimen was over crio-anesthetized, it was pulled out from its shell. Then each individual was weighd (BW, body wet weight) using a digital scale (A&D, FX-400, Japan – precision of 0.01 g) and measured with a vernier caliper (IP67, Guanglu, China – precision of 0.01 mm) for the following characters: cephalothoracic shield length (SL) from the tip of the rostrum to the V-shaped groove at the posterior edge of the shield; cephalothoracic shield width (SW) between medial margins; left and right cheliped propodus length (LPL and RPL respectively); and left and right cheliped propodus width (LPW and RPW respectively). The body dimensions were measured according to Teoh and Chong (2015).

2.3 | Statistical analysis

The significance of the relationship between body weight and shield length as well as between each measured body part with shield length was evaluated at the level of 0.05 (2-tailed). To compare the *b*-value for each pair, the *t*-student test was applied after removing the effects of body size on the morphological traits (Lleonart et al., 2000). The differences of the evaluated traits between sexes were analysed by ANOVA followed by Tukey's post hoc test after removing the effects of body size. Departures from isometry (H_0: $b = 1$; H_1: $b \neq 1$ for size dimensions and H_0: $b = 3$; H_1: $b \neq 3$ for weight) were tested using the Student's *t*-test on the obtained '*b*'-values (slopes of power function). All statistical procedures performed were based on Zar (2010), considering a statistical level of 5%.

TABLE 1 Statistical summary for comparison of the obtained '*b*'-value from of the linearized relationship between body weight and shield length for females ($n = 494$), males ($n = 251$), and intersexes ($n = 210$) of the hermit crab, *Clibanarius signatus*

Sex	*t*-value	Significance of *b* between sexes
F-M	11.092	$p < .001$ (*)
F-I	10.319	$p < .001$ (*)
M-I	18.375	$p < .001$ (*)

Abbreviations: F, female; I, intersex; M, male.

*Significant.

3 | RESULTS

In this study, a total of 955 specimens of hermit crab, *C. signatus*, were analysed, comprising 494 females (51.7%), 251 males (26.3%), and 210 intersexes (22%). The mean SL of females (3.398 ± 0.006) was significantly smaller than that of the males (5.756 ± 0.005) and intersexes (4.783 ± 0.004). The same was observed when mean BW where compared among these three groups (females: 0.254 ± 0.005; males: 0.956 ± 0.013; intersexes: 0.590 ± 0.006). For females, the coefficient of variation (CV %) of SL was 3.72 ± 0.127, significantly higher than that of the males (1.48 ± 0.085) and intersexes (1.17 ± 0.056). These values of CV % demonstrated the same trend for BW (females: 41.13 ± 0.105; males: 21.64 ± 0.207; intersexes: 15.63 ± 0.092).

3.1 | Body weight–shield length relationship

Weight–length relationships of all the three categories (females, males, and intersexes) of hermit crabs showed significant and positive relationships ($p < .05$), with regression coefficients ranging from 97% to 98%. Comparing the exponent '*b*' obtained from the linearized weight–length relationships among the sexes (Table 1) showed that males have the lowest exponent and intersexes have the highest exponent value, thus indicating a higher weight increment in intersexes than females and males. The overall exponent '*b*' ranged from 2.33 to 3.25, with intersexes showing positive allometry ($b > 3$), whereas females and males exhibited negative allometry ($b < 3$; Table 2).

TABLE 2 Equations for the relationships between shield length and body weight for each sex of hermit crab, *Clibanarius signatus*

		SL (mm)			BW (g)				
Sex	*n*	Min.	Max.	$\bar{x} \pm SE$	Min.	Max.	$\bar{x} \pm SE$	Weight–length relationship ($BW = aSL^b$)	*t*-test (H0: b = 3) (Allometry direction)
F	494	1.51	4.46	3.33 ± 0.55	0.10	0.46	0.25 ± 0.10	$BW = 0.0091SL^{2.7166}$	$p < .05$ (NA)
M	251	4.82	7.58	5.73 ± 0.49	0.63	1.85	0.96 ± 0.21	$BW = 0.0163SL^{2.3258}$	$p < .05$ (NA)
I	210	4.16	5.24	4.77 ± 0.22	0.41	0.77	0.59 ± 0.09	$BW = 0.0036SL^{3.2525}$	$p < .05$ (PA)

Abbreviations: BW, body weight; F, female; I, intersex; M, male; Max., maximum; Min., minimum; , mean; n, number of samples; NA, negative allometry; PA, positive allometry; *SE*, standard error; SL, shield length.

3.2 | Relative growth of body parts

Relationships between shield length with different body parts, including shield width, cheliped propodus length, and cheliped propodus width for different sexes of hermit crab were significant ($p < .05$). Comparing the exponent of the relationship between shield length and shield width for each sex demonstrated a significant difference among sexes (Table 3) with the greatest exponent '*b*' found in intersexes and the lowest value was obtained in males. Allometry analysis revealed negative allometric growth ($b < 1$) in both males and females but positive allometric growth ($b > 1$) in intersexes (Table 4).

TABLE 3 Statistical summary for comparison of the obtained '*b*'-value from the relationship between shield length and different parts of the body for females ($n = 494$), males ($n = 251$), and intersexes ($n = 210$) of the hermit crab, *Clibanarius signatus*

Relationship	Sex	*t*-value	Significance of *b* between sexes
SL–SW	F–M	5.307	$P < .05$ (*)
	F–I	2.811	$P < .05$ (*)
	M–I	7.109	$P < .05$ (*)
SL–LCPL	F–M	0.197	$P > .05$ (ns)
	F–I	3.235	$P < .05$ (*)
	M–I	2.788	$P < .05$ (*)
SL–RCPL	F–M	3.150	$P < .05$ (*)
	F–I	5.567	$P < .05$ (*)
	M–I	1.800	$P > .05$ (ns)
SL–LCPW	F–M	2.008	$P < .05$ (*)
	F– I	3.616	$P < .05$ (*)
	M–I	4.201	$P < .05$ (*)
SL–RCPW	F – M	2.282	$P < .05$ (*)
	F – I	1.480	$P > .05$ (ns)
	M–I	3.192	$P < .05$ (*)

Abbreviations: F, female; LCPL, left cheliped propodus length; LCPW, left cheliped propodus width; I, intersex; M, male; ns, non-significant; RCPL, right cheliped propodus length; RCPW, right cheliped propodus width; SL, shield length; SW, shield width.

*Significant.

The exponents '*b*' of the relationship between shield length and cheliped propodus length in females were significantly lower than that of males and intersexes for both left and right hands. However, in intersexes, this parameter was significantly higher than the males. The allometry analysis showed negative allometric growth ($b < 1$) in both females and males, whereas in intersexes, a positive allometric growth ($b > 1$) was found (Table 5).

Statistical analysis revealed the lowest value of the exponent '*b*' in females for the relationships between shield length and left and right cheliped propodus width. However, this exponent was not significantly different between males and intersexes. Comparing the exponent '*b*' among the sexes demonstrated a negative allometric growth ($b < 1$) in females, whereas a positive allometric growth ($b > 1$) was observed in both males and intersexes (Table 6) except for the right CPW in intersexes which was isometric.

4 | DISCUSSION

The studied morphological characteristics of *C. signatus* demonstrated a sex-related growth pattern in this species of hermit crab. Females possessed the smallest values of the measured parameters than males and intersex individuals. However, in the population, the males had the biggest ones and the intersex individuals showed a tendency to present intermediate sizes between males and females. Males having larger body size is common among crustaceans (de Barros et al., 2020; Noori et al., 2015; Öndes et al., 2017) as well as hermit crabs. The results are in line with those reported in other hermit crabs, such as *Calcinus tibicen* (Fransozo and Mantelatto, 1998), *Loxopagurus loxochelis* (Mantelatto et al., 2002), *Petrochirus diogenes* (Turra et al., 2002), *Diogenes moosai*, *D. lopochir*, *C. infraspinatus* (Teoh and Chong, 2015), *Isocheles sawayai* (Fantucci et al., 2009), *Dardanus insignis* (Branco et al., 2002), *C. antillensis*, *C. sclopetarius*, and *C. vittatus* (Turra and Leite, 2000) that males are heavier and larger than females. In contrast, the sizes of females and males of *Ceonobita rugosus* and *Ceonobita purpureus* showed no statistical differences (Nakasone, 2001). Sexual dimorphism is a consequence of

TABLE 4 Equations for the relationships between shield length and shield width for each sex of hermit crab, *Clibanarius signatus*

		SL (mm)			SW (mm)				
Sex	n	Min.	Max.	$\bar{x} \pm SE$	Min.	Max.	$\bar{x} \pm$ SE	Length–length relationship ($SW = aSL^b$)	t-test (H0: b = 1) (Allometry direction)
F	492	1.51	4.46	3.33 ± 0.55	1.27	3.59	2.63 ± 0.42	$SW = 0.8655SL^{0.9259}$	$p < .05$ (NA)
M	251	4.82	7.58	5.73 ± 0.49	3.57	5.24	4.11 ± 0.32	$SW = 0.8787SL^{0.883}$	$p < .05$ (NA)
I	210	4.16	5.24	4.77 ± 0.22	3.00	3.90	3.49 ± 0.18	$SW = 0.6665SL^{1.06}$	$p < .05$ (PA)

Abbreviations: F, female; I, intersex; M, male; Min., minimum; Max., maximum; , mean; n, number of samples; NA, negative allometry; SE, standard error; SL, shield length; SW, shield width; PA, positive allometry.

discrepancies between the sexes in different aspects of reproduction, such as mating activities. Males with larger body size have more chance to overcome the fight for accessing the females and protecting them during the courtships. However, the studies that covered the characteristics and morphological sizes of intersex, as a separate group, are few. Turra (2004) demonstrated successful copulation between intersexes with females in three species of hermit crabs, including *Clibanarius antillensis*, *Clibanarius sclopetarius*, and *Clibanarius vittatus*. In that study, like many others, the intersex individuals were grouped with males as they were sexually functioning as males. As a result, the morphological parameters of this group were not considered as a separate group but as joint with males. However, in some other studies like Gusev and Zabotin (2007), Obuid-Allah et al. (2019), Sant'Anna et al. (2009), the intersexes are not mixed with males, but considered as a separate group. Almost in all of these studies, the intersex individuals have a greater size than females and smaller or equal size to males.

The increment of body weight in relation to the shield length revealed a negative allometric growth in both *C. signatus* females and males, whereas, in intersexes, the allometric growth rate was obtained as positive. As the mean body weight in males was 3.84 times greater than that of females, an acceleration in the exponent of growth rate in intersex to reach this level is postulated. So, a negative allometric growth in females with the exponent '*b*' around 2.72 increased to 3.25 in intersexes to provide large body size in males after sex transforming, whereas this value again decreased to 2.33 in males. In *C. infraspinatus*, females and males demonstrated a negative allometric growth in body weight–shield length relationship (Teoh and Chong, 2015), which is in agreement with the present findings in *C. signatus*. This is consistent with the findings in *Calcinus tibicen* (Fransozo et al., 2003), *Diogenes lopochir* (Teoh and Chong, 2015), and *Paguristes erythrops* (Biagi and Mantelatto, 2006) that the same allometry equations on the value of the body weight in relation to the shield length in females were obtained. In the majority of the studied species, either a positive allometric or isometric growth was obtained in the males. This discrepancy may be related to this fact that almost in all of these species, the frequency of intersex individuals is limited to few numbers (Fantucci et al., 2008) or grouped with males in the analysis (Fantucci et al., 2009; Turra, 2004). In the present study, however, the frequency of the intersex was as much as 22% and the morphometric analysis was done for them as a separate sex group.

The hermit crab *C. signatus* was also sexually dimorphic in the relative growth of other body parts. Intersex individuals demonstrated a higher specific growth rate in shield width, followed by females and then males. Both males and females had negative allometric growth, but intersexes showed a positive pattern. It means that the specific growth rate of the shield width in the intersexes was much more than that of the females and males. As the males had the largest mean shield width in the population, this high specific growth rate in intersex individuals is predictable to provide favourite width in this body part after sexual transforming to males. Fantucci et al. (2009) showed that the growth rate in the shield width of *Isocheles sawayai* exhibited a negative allometric growth in both females and males, which corroborated the data in the present study. The shield width-specific growth rate of males and females in *Diogenes moosai* and *Diogenes lopochir* was both obtained the same as negative allometric, but in *Clibanarius infraspinatus*, males exhibited positive allometric, while the females showed a negative pattern (Teoh and Chong, 2015). The specific growth rate of the shield width not only is different among species but may also be altered with changing geographical locations in one species. Ismail (2018) showed a change in shield width in *C. signatus* in three different geographical locations. For this discrepancy, it can be concluded that environmental variations affect the shape of the shield dimensions. In this regard, the presence of suitable empty shells to accommodate the veritable requirements are necessary (Blackstone, 1985; Mantelatto and Meireles, 2004; Payson Wilber, 1990).

Males had larger propodus cheliped than females and intersex individuals in both aspects of length and width. Sexual dimorphisms in propodus cheliped size are reported in other hermit crabs like *Pagurus nigrofascia* (Yasuda et al., 2011), *Pagurus filholi* (Matsuo et al., 2015), *Diogenes nitidimanus* (Yoshino et al., 2011), and *Pagurus bernhardus* (Briffa and Dallaway, 2007; Doake et al., 2010). In *Paguristes erythrops*, size at sexual maturity was estimated based on cheliped in

TABLE 5 Equations for the relationships between shield length and cheliped propodus length for each sex of hermit crab, *Clibanarius signatus*

Sex	*n*	SL (mm)			CPL (mm)				Length–length relationship	t-test (H0: b = 1)
		Min.	Max.	$\bar{x} \pm SE$		Min.	Max.	$\bar{x} \pm SE$	($CPL = aSL^b$)	(Allometry direction)
F	471	1.51	4.46	3.32 ± 0.55	RCPL	1.49	3.59	2.65 ± 0.36	$RCPL = 1.047SL^{0.774}$	$p < .05$ (NA)
					LCPL	1.41	3.38	2.56 ± 0.35	$LCPL = 0.999SL^{0.785}$	$p < .05$ (NA)
M	247	4.82	7.58	5.72 ± 0.49	RCPL	3.94	6.06	4.65 ± 0.37	$RCPL = 0.982SL^{0.891}$	$p < .05$ (NA)
					LCPL	3.76	5.84	4.48 ± 0.37	$LCPL = 0.884SL^{0.931}$	$p < .05$ (NA)
I	204	4.16	5.24	4.77 ± 0.22	RCPL	3.06	4.26	3.72 ± 0.23	$RCPL = 0.510SL^{1.272}$	$p < .05$ (PA)
					LCPL	2.98	4.05	3.58 ± 0.22	$LCPL = 0.504SL^{1.253}$	$p < .05$ (PA)

Abbreviations: CPL, cheliped propodus length; F, female; I, intersex; LCPL, left cheliped propodus length; M, male; Min., minimum; Max., maximum; $\bar{x}$, mean; *n*, number of samples; NA, negative allometry; PA, positive allometry; RCPL, right cheliped propodus length; SE, standard error; SL, shield length.

the males (Biagi and Mantelatto, 2006). Larger chelipeds have several advantageous for males as they may be useful like a real weapon in male–male competition for mates (Yoshino and Goshima, 2002; Yoshino et al., 2011). Matsuo et al. (2015) demonstrated the importance of male body size and cheliped regeneration for protecting the female from the intruders. However, the cheliped dimension is a more reliable indicator of struggle consequence and critically important in defining male mating victory (Arnott and Elwood, 2007; Elwood et al., 2006; Yasuda et al., 2011). Besides, as the males have larger body sizes in the population, to protect themselves, they need larger shells too. The larger shell, the bigger the opening of the shell. The chelipeds are used to close up the opening of the shells when the males want to retreat inside for safety. Payson Wilber (1990) showed that the cheliped growth rate in *Pagurus longicarpus* can be affected by the type of the shell occupied. Other reports also corroborated the relationship between the shell size occupied and the hermit crab cheliped dimensions (Blackstone, 1986; Dowds and Elwood, 1985; Imafuku, 1989; Kakui, 2019). In the present study, the mean total length of the males' gastropod shells (3.30 ± 0.11 mm; ranged from 2.19 to 5.38 mm) was around 20% larger than the total length of those occupied by females (2.61 ± 0.09 mm; ranged from 1.56 to 3.55 mm) and intersexes (2.75 ± 0.06 mm; ranged from 1.72 to 3.75 mm). Although the shape and size of the openings of the gastropod shells occupied by the hermit crabs were not characterized in the present study, the possible effects of these shells on hermit crab growth encourage us for further investigation. So, to clarify the possible effects of the type and size of the shells on hermit crab body dimensions and the possible relationship between the morphological parameters of the specimens and the selected shells as well as the geographical alterations in this species, supplementary studies are needed.

In conclusion, *C. signatus* demonstrated a sex-related relative growth in different body parts. Males showed the largest body weight, followed by intersexes, whereas females showed the smallest body weight. Females exhibited a negative allometric patterns in all the studied body part relationships. Males demonstrated the same allometric pattern in all the studied traits except for the cheliped propodus width, which had a positive allometry. However, in intersexes, all the studied traits showed positive allometric patterns, except the right cheliped propodus width, which was isometric. This study showed that the growth rate in different body parts is significantly higher in intersexes than in females and males.

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TABLE 6 Equations for the relationships between shield length and cheliped propodus width for each sex of hermit crab, *Clibanarius signatus*

Sex	*n*	SL (mm)				CPW (mm)			Length–length relationship	*t*-test (H0: b = 1)
		Min.	Max.	$\bar{x} \pm SE$		Min.	Max.	$\bar{x} \pm SE$	(CPW = aSL^b)	(Allometry direction)
F	468	1.51	4.46	3.33 ± 0.56	RCPW	0.78	2.21	1.65 ± 0.26	RCPW = 0.561SL$^{0.897}$	$P < .05$ (NA)
					LCPW	0.94	2.28	1.71 ± 0.26	LCPW = 0.603SL$^{0.868}$	$p < .05$ (NA)
M	248	4.82	7.58	5.73 ± 0.49	RCPW	2.35	3.86	2.80 ± 0.27	RCPW = 0.431SL$^{1.072}$	$p < .05$ (PA)
					LCPW	2.41	3.94	2.89 ± 0.28	LCPW = 0.449SL$^{1.068}$	$p < .05$ (PA)
I	204	4.16	5.24	4.77 ± 0.22	RCPW	2.01	2.62	2.35 ± 0.12	RCPW = 0.460SL$^{1.043}$	$p > .05$ (IS)
					LCPW	2.09	2.71	2.43 ± 0.13	LCPW = 0.458SL$^{1.067}$	$p < .05$ (PA)

Abbreviations: CPW, cheliped propodus width; F, female; I, intersex; IS, isometry; LCPW, left cheliped propodus width; M, male; Min., minimum; Max., maximum; $\bar{x}$, mean; *n*, number of samples; NA, negative allometry; PA, positive allometry; RCPW, right cheliped propodus width; *SE*, standard error; SL, shield length.

ORCID

Ahmad Noori https://orcid.org/0000-0001-5161-609X

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