ISSN: 2642-9020

Research Article

Journal of Marine Science Research and Oceanography

Morphometrics and Relative Growth of *Portunus Segnis* (Forskal, 1775) (Crustacea: Portunidae) from Balochistan

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Submitted: 2024 Mar 04; **Accepted:** 2024 Mar 25; **Published:** 2024 Mar 29

Citation: Rasheed, S., Mengal, E. U. (2024). Morphometrics and Relative Growth of *Portunus Segnis* (Forskal, 1775) (Crustacea: Portunidae) from Balochistan. *J Mari Scie Res Ocean, 7*(1), 01-08.

Abstract

Sexual maturity attained by relative growth by different body parts of crab Portunus segnis. Relative growth, short carapace width (SCW compare) to other body parts of male crabs have 48 to 135 mm SCW and female crabs having 38 to 140 mm SCW. Relationship of Total body weight (TBW) and total carapace width (TCW) with SCW was isometric in both sexes. Relationship of carapace length (CL) and abdomen length (AL) to SCW was isometric correlated in females and negative in males. Chelar Propodus width (CPW) with SCW indicated isometric in male and negative female crabs. Size at sexual maturity by Chelar Propodus length (CPL)/ SCW show positive growth in both mature and immature phases of male and female crabs. Pleopod length (PL)/ SCW show positive isometry in both phases in male and puberty moult occurs between 75-80 mm SCW. Relationship of Abdominal width (AW) to SCW was positively correlated in female and negative in male and puberty moult occurs between 68-78 mm SCW in female crabs. In case of female, smallest mature crab had 70 mm SCW while the largest immature crab had 92 mm SCW.

Keywords: *Portunus Segnis,* Sexual Maturity, Isometry, Pleopod

1. Introduction

All over the world, approximately 4500 species of crabs have been discovered so far. There are two hundred species of crabs are found in coastal waters of Pakistan, among them *Portunus segnis* (Forskal, 1775) is the most commercially important and edible crab (Lai et al. 2010) [1]. *P. segnis* is portunid crab which belonging to the family portunidae and this family is also known as swimming crabs [2]. In Pakistan *P. segnis* is typically collected by capturing base gill netting or shrimp trawling. Local people are not affectionate of crab meat therefore consumption of crab meat is short in Pakistan.

Study of reproductive biology for specially sexual maturity attained by relative growth of different body parts is meaningful to have a full of the inhabitant‘s elements of every crustacean species. Important data identified with the population dynamics and biology of *P. segnis* is indispensable for strategy creators, and chiefs should be set up guideline measures to save the population. In this manner, an investigation of reproductive biology of *P. segnis* can be commercial important for the administration of crab population in this region as well as in other zones. Measures of fecundity estimates have increasingly become the favored proportions of stock reproductive potential and might be bonded into logical recommendations that provide biological reference points (BRPs) for sustainable fisheries management [3-6].

The present study was conducting on sexual maturity by relative growth to decide variations in the structure size of the pleopods, abdomen, and chelipeds during maturity. Information on of these characteristic and size connections in sexually mature individuals is of specific significance in the study of commercially profitable crustaceans. The development rate generally changes with variety in natural factors, for example; salinity, temperature and pH. These factors influence growth to a large extent age, starting relatively high and decreasing as the animal grows bigger. Such information can be helpful for additional investigations on the existence history of the species and in the improvement of its fishery, resource management, and culture. The numerical length-weight relationship consequently yields data on the overall prosperity of individuals, variety in development as indicated by sex, size at first maturity, and reproducing season. For developing fishery of *P. segnis* in our country and particular Balochistan. This study will be useful to provide basic knowledge for managing and utilizing resources in a sustainable manner.

2. Materials and Methods

2.1 Sampling Site

Sampling of *Portunus segnis* were collected from commercial landing site of Dam Sonmiani at (25°09' N, 66°29' E) Lasbela, Pakistan coast (Figure 1), from August 2017 to May 2018, monthly wise. Crabs were immediately transported to the laboratory. The crabs have been sexed, weighed and measured in the laboratory.

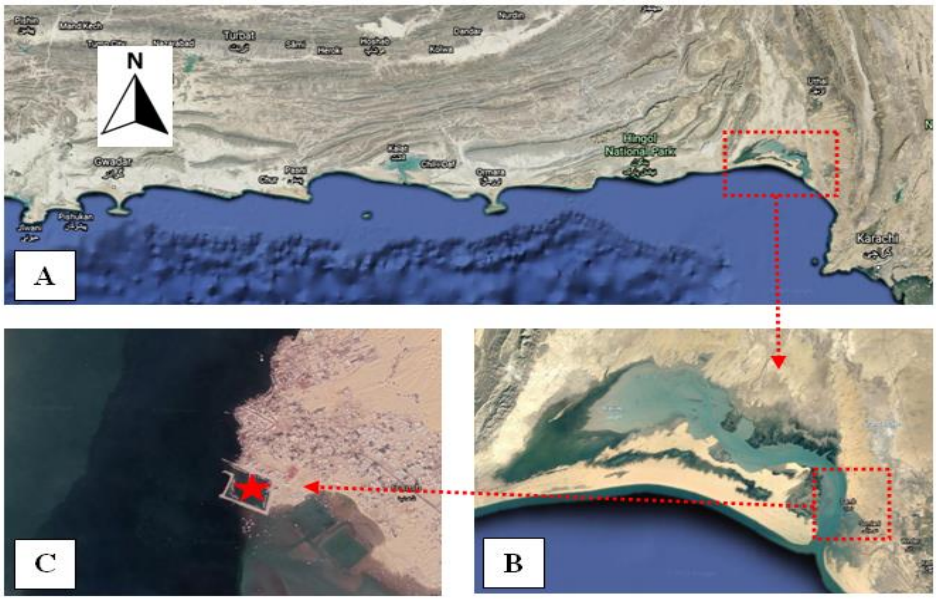
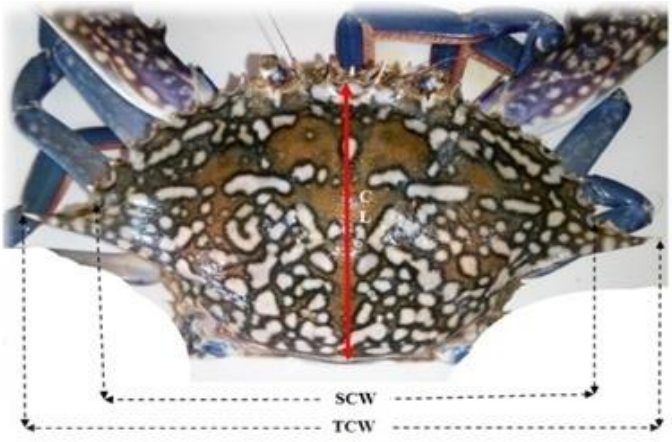


Figure 1: Map demonstrating the area of Dam Sonmiani fish landing site (study area) Balochistan, Pakistan. (A) Balochistan coast (B) Miani hor (C) Damb, Sonmiani

Measurements of different parts of the body were conducted for the analysis of relative crab growth using the digital Vernier Caliper (Digimatic Caliper CD-6 'CSX). Total width of the carapace (TCW) was taken from the tips of the ninth antero-lateral teeth, whereas the Short Carapace Width (SCW) was taken from the base of the ninth antero-lateral teeth. While the length of the carapace (CL) was estimated from the anterior to the posterior edge of the carapace (indicated by the red line) (Figure. 2a). Abdominal width (AL) was taken from the uppermost part of abdomen (Figure. 2 b and c) it was taken in females and males both. Propodus Width was also measured (Figure. 2 d). After blotting with a paper towel, crabs with intact appendages were weighted by electrical balance to the nearest gram.



(a)

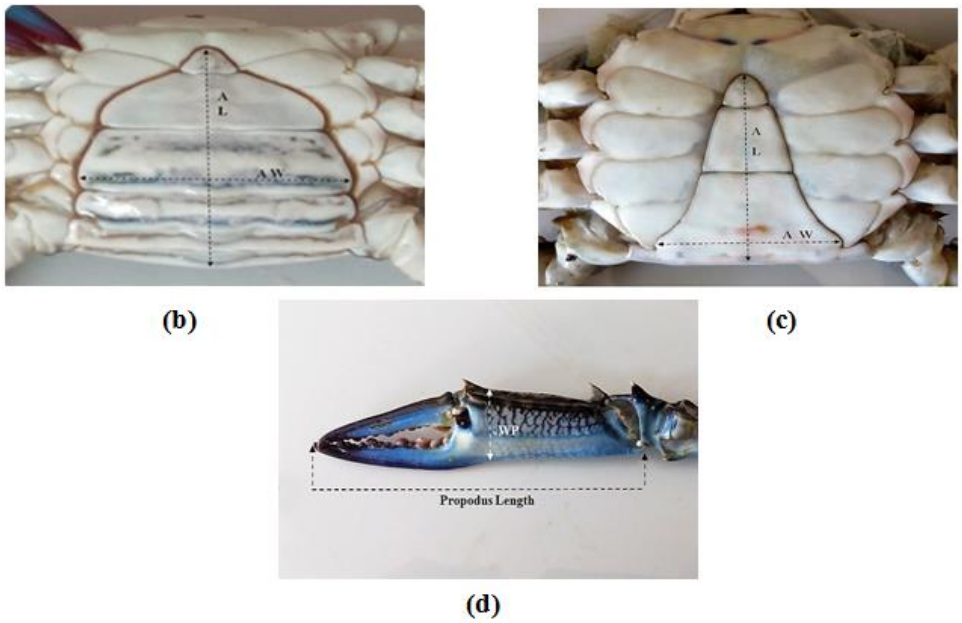


Figure 2: *Portunus segnis*: Measurements for Relative growth of (a) short carapace width (SCW) and Total Carapace Width (TCW) and carapace length (CL); (b) abdomen length (AL) of female crab, (c): Abdomen Length (AL) of male crab; (d) Chelar propodus Width (CPW).

Using MINITAB (Version 15), Curve Specialist (1.4) statistical tools and Microsoft Excel, the statistical analysis was conducted. If the value of 'b' is bigger than 1, there is a beneficial allometry, which means that the liver grows faster than the body. There is a negative allometry if 'b' is less than 1, with the organ growing slower than the body. If the value of 'b' is equal to 1, then isometry happens and at the same rate the organ and body expand [7]. Student t-test will be used to measure the relevance of the values defined [8].

3. Results

285 crabs were collected from August 2017 to May 2018 to estimate the relative growth of crab P. segnis. 150 male crabs with a SCW of 49 to 136 mm (mean 94.86 ± 20.61 S.D) and 135 female crabs with a SCW of 39 to 141 mm (mean 91.95 ± 27.20 S.D) were assessed for relative growth.

3.1 Relative growth between SCW and TBW

Figure 3 indicate the relationships between SCW and Total body weight (TBW), while the equations of regression are presented in Table 1.Weight of male crabs, ranged from 20 to 365 g (mean 132.50 ± 18.59 S.D) while female body weight ranged from 12 to 360 g (mean 134.37 ± 94.44 S.D). The b values are 3.039 for male which derived from log-transformed data and 3.009 for female, which are substantially equivalent to 3 for both male and female crabs, suggesting isometric growth (t= 0.3846 for male and 0.1027 for female; α = 0.05).

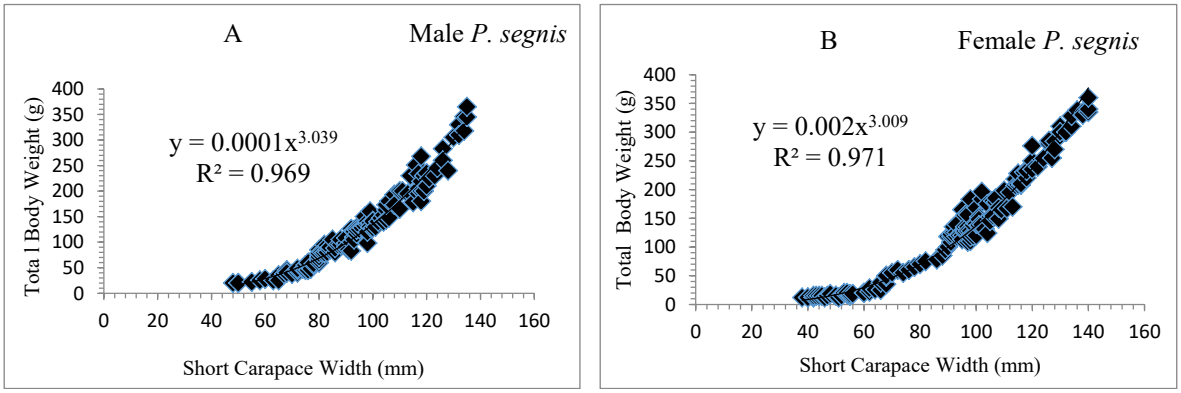


Figure 3: Relative growth between short carapace width (SCW) and total body weight (TBW) of (A) male crab and (B) female crabs of P. segnis.

Y-Variable	Sex	SCW (mm)	Equations of Regression	R^2	b	All	S.E b	T(b=3)
T B W	M	48-135	TBW= 0.0001 SCW $^{3.039}$	0.969	3.039	Iso	0.1014	0.3846
			Log TBW= -3.948 + 3.039 log SCW	0.969				
	F	38-140	TBW= 0.002 SCW$^{3.009}$	0.971	3.009	Iso	0.0876	0.1027
			Log TBW=- 3.882 + 3.009 Log SCW	0.971				

R^2, coefficient of determination; b, regression coefficient (slope of the line); All, allometry; Iso, isometric; S.E. b, standard error of b; T, student's t-test.

Table 1: Statistical analysis of relative growth of short carapace width (SCW) with Total Body Weight (TBW) of male (M) and female (F) crabs of *P. segnis*.

3.2 Relative growth between SCW and TCW

A relationship between SCW and Total Carapace Width (TCW) for male presented in Figure 4 A, for female in Figure 4 B while equations of regression are shown in Table 2. The average width of the carapace (TCW) ranged from 62 to 155 mm (mean 113.17 ± 20.32 S.D) in males and ranged from 50 to 170 mm (mean 112.37 ± 30.66 S.D) in female crabs. In both male and female crabs, the values of b for male gained from log-transformed data are 0.903 and for female are 0.934, which are equal to 1 (t= 11.8581 for male and 9.6209 for female; α = 0.05). The results indicated isometric allometry growth.

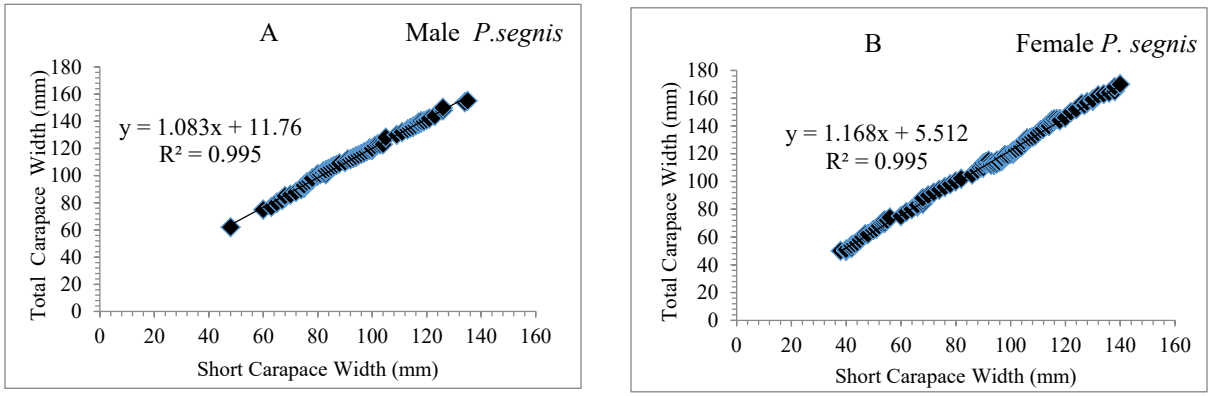


Figure 4: Relative growth between short carapace width (SCW) and total carapace width (TCW) of male crabs (A) and female crabs (B) of P. segnis.

Y-Variable	Sex	SCW (mm)	Equations of Regression	R^2	b	All	S.E b	T(b=3)
T B W	M	48-135	TCW= 11.76+ 1.083 SCW	0.995	0.903	Iso	0.0082	11.858
			Log TCW = 0.273+ 0.903 Log SCW	0.995				
	F	50-170	TCW = 5.512 + 1.168 SCW	0.995	0.934	Iso	0.0069	9.620
			Log TCW = 0.219 + 0.934 Log SCW	0.996				

R^2, coefficient of determination; b, regression coefficient (slope of the line); All, allomertry; Iso, isometric; S.E. b, standard error of b; T, student's t-test.

Table 2: Statistical analysis of Relative growth of short carapace width (SCW) with total carapace width (TCW)of male (M) and female (F) crabs of *P. segnis*.

3.3 Relative growth between SCW and CL

In male, carapace length (CL) ranged from 30 to 75 mm (mean 52.08 ± 9.41 S.D) and in female ranged from 22 to 78 mm (mean 50.94 ± 14.85 S.D). Figures 5 show the relationships between SCW and CL of both sexes and Table 3 shows the equations of regression. The b values are 0.876 for male and 1.002 for female from log-transformed data obtained. The results shows that the allometric growth negative in males because the b value of male crabs was less than 1 and isometric growth in females because b value was almost equal to1 (t= 15.7560 for male and 0.3623 for female; α = 0.05).

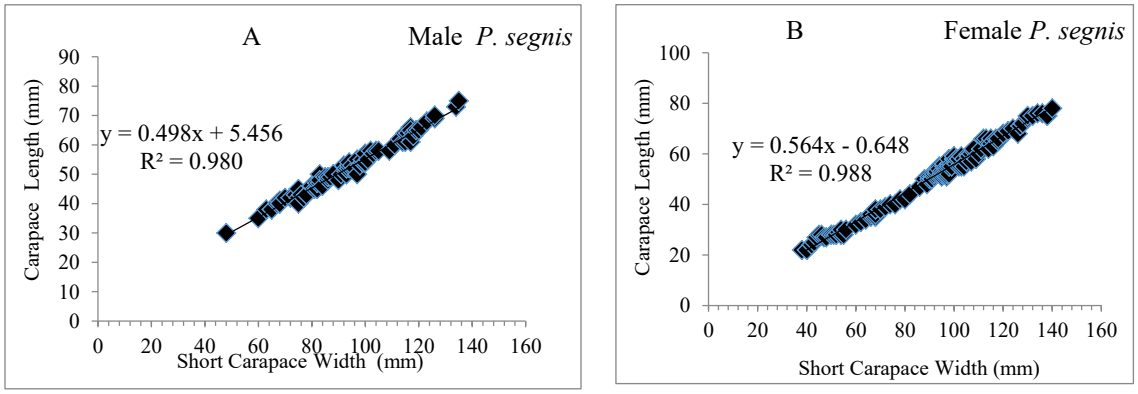


Figure 5: Relative growth between short carapace width (SCW) and carapace length (CL) of (A) male crabs and (B) female crabs of P. segnis.

Y-Variable	Sex	SCW (mm)	Equations of Regression	R^2	b	All	S.E b	T(b=3)
CL	M	48-135	CL = 5.456+ 0.498 SCW	0.980	0.876	-ve	0.008	15.756
			Log CL= - 0.010 + 0.876 Log SCW	0.978				
	F	38-140	CL = - 0.648 + 0.934 SCW	0.988	1.002	Iso	0.0055	0.3623
			Log CL = - 0.259 + 1.002 Log SCW	0.989				

R^2, coefficient of determination; b, regression coefficient (slope of the line); All, allomertry; Iso, isometric; -ve, negative; S.E. b, standard error of b; T, student's t-test.

Table 3: Statistic study of Relative growth of short carapace width (SCW) with carapace length (CL) of male (M) and female (F) crabs of *P. segnis*.

3.4 Relative growth between SCW and AL

Abdominal length (AL) of male crab of P. segnis, ranged from 18 to 50 mm (mean 36.19 ± 7.09 S.D) and in female ranged from 16 to 56 mm (mean 36.74 ± 11.07 S.D). In figures 6 for male and female, the relationships between SCW and AL are highlighted, while the equations of regression are shown in table 4. The b values are 0.985 for male and 1.038 for female from log-transformed data collected. The results revealed that allometric development was isometric in both sexes, as the b value of male and female crabs was almost equal to 1 (t= 1.7201 for male and 6.2397 for female; α = 0.05).

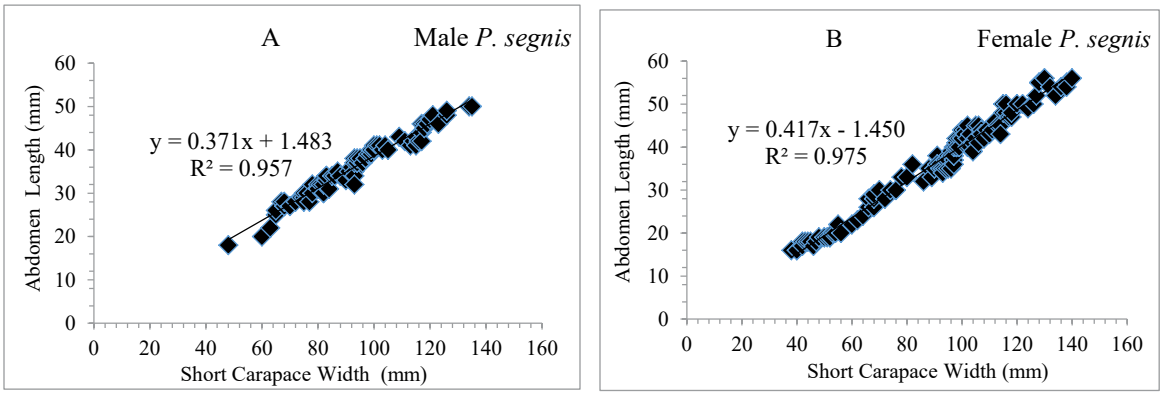


Figure 6: Relative growth between short carapace width (SCW) and abdomen length (AL) of (A) male crabs and (B) female crabs of P. segnis.

Y-Variable	Sex	SCW (mm)	Equations of Regression	R^2	b	All	S.E b	T(b=3)
AL	M	48-135	AL= 1.483 + 0.371 SCW	0.957	0.985	Iso	0.0087	1.720
			Log AL= - 0.384 + 0.985 Log SCW	0.956				
	F	38-140	AL = - 1.450 + 1.002 SCW	0.975	1.038	Iso	0.0061	6.239
			Log AL = - 0.472 + 1.038 Log SCW	0.989				

R^2, coefficient of determination; b, regression coefficient (slope of the line); All, allometry; Iso, isometric; S.E. b, standard error of b; T, student's t-test.

Table 4: Statistical analysis of Relative growth of short carapace width (SCW) with Abdominal length (AL) male (M) and female crabs (F) of P. segnis

3.5 Relative growth between SCW and CPW

Chelar Propodus width (CPW) of the male, varied between 10 and 25 (mean 17.31 ± 3.39 S.D) and (CPW) of female varied between 10 and 30 mm (mean 19.66 ± 5.25 S.D). Figures 7 A for male and 7 B for female explain the relationships between SCW and CPW, while the equations of regression are shown in table 5. The b values obtained from the log-transformed data are 0.928 for males and 0.893 for females. The findings indicated that allometric growth was negative in females and isometric in males, since all sexes had less than one b value (t= 12.50 for males and 19.4545 for females; $\alpha = 0.05$). The results show that allometric growth was negative in females and isometric in males.

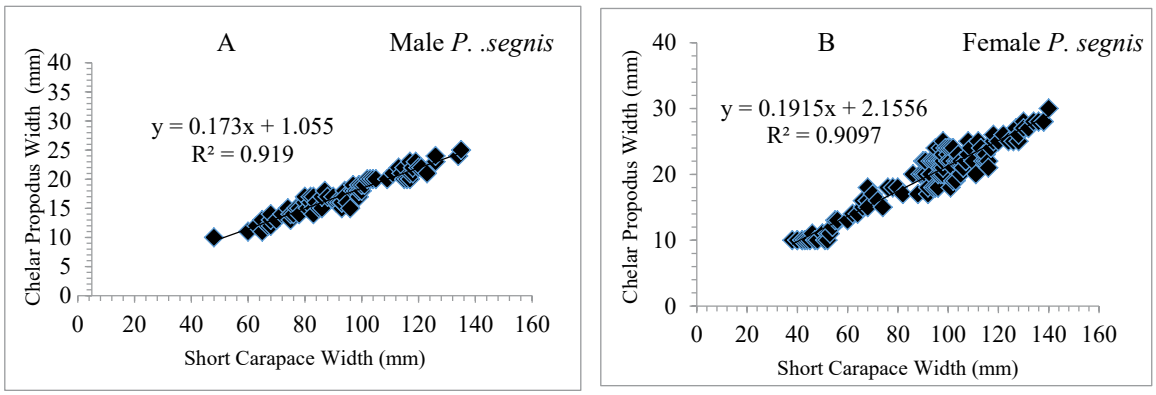


Figure 7: Relative growth between Short Carapace Width (SCW) and Chelar Propodus Width (CPW) of (A) male crabs and (B) female crabs of P. segnis.

Y-Variable	Sex	SCW (mm)	Equations of Regression	R^2	b	All	S.E b	T(b=3)
CPW	M	48-135	CPW = 1.055 + 0.173 SCW	0.919	0.928	Neg.	0.0058	12.50
			Log CPW = - 0.592+ 0.928 Log SCW	0.915				
	F	38-140	CPW = 2.155 + 0.191 SCW	0.909	0.893	Neg.	0.0055	19.454
			Log CPW = - 0.457+0.893 Log SCW	0.932				

R^2, coefficient of determination; b, regression coefficient (slope of the line); All, allometry; Iso, isometric; S.E. b, standard error of b; T, student's t-test.

Table 5: Statistical analysis of Relative growth of short carapace width (SCW) with chelar Propodus width (CPW) male (M) and female crabs (F) of P. segnis

4. Discussion

For the study of relative growth, various growth parameters of *P. segnis* have been calculated during the current study. The association between total body weight (TBW) and short carapace width (SCW) in both sexes of crabs were isometric. Moreover, the results showed that the females adult are slightly heavier than males. Present research findings are agreed to Sukumaran et al. from Manglore, Parsad et al. from Karwar, Sukumaran and Neelakantan in from Manglore [9-11]. These findings disagree with the results of Hajjej et al., who found a positive growth pattern in male weight and a negative allometric pattern in females and reported that males are slightly larger and heavier than females [12]. Rasheed and Mustaquim recorded from Pakistan's coastal waters that males are heavier than females of P. pelagicus and *P. sanguinolentus* [13]. In Portunid crabs, Potter et al. found that males appeared to be heavier than females [14]. It is known from the findings of these scientists that there are noticeable differences when comparison of carapace width and body weight of swimming crabs from different areas of the world. Josileen reported that P. pelagicus females are up to 120-125 mm carapace diameter, slightly heavier than males, and then males are heavier than females [15].

Other morphometric parameters also including in present research like SCW-TCW and SCW-CL. The results of SCW with TCW indicated isometric growth in both male and female crabs while SCW and CL of both sexes were shows that negative growth in males and isometric in females. Present findings are agreed with Rasheed and Mustaquim in the case of male crabs who observed that the relationship of SCW-TCW was negative allometry in male P. pelagicus but results are not agreed in the case of female [13]. Moreover, they reported that the relationship of SCW-CL was negative growth pattern in male crabs. Hajjej et al. reported that the relationship of CW-CL was negative growth in males of *P. segnis* [12]. The present research finding are not agreed to Tina reported very high significant positive correlation between blue swimming crab carapace length and carapace width [16]. Sahoo et al. stated that the relationship between carapace width and carapace length was isometric growth in both sexes [17].

SCW and abdomen length (AL) was shows that the allometric growth was isometric in both sexes. Present research findings of SCW-AL are not agreed with Josileen because who reported highly positive growth between carapace width and abdomen length in male and female P. pelagicus, and Hosseini et al. also found positive allometry in both sexes of *P. segnis* [7,18].

Present SCW-CPW findings showing negative allometric development for both males and females. These findings are not related to Josileen who reported SCW-CPW results were positive allometric growth in male P. pelagicus [15]. Yang et al. reported positive allometry growth between carapace width and chelar propodus Width in both sexes of *P. sanguinolentus*. Hosseini et al. recorded highly positive growth of SCW-CPL both sexes of P. segnis. Present results of SCW-CPW show that the allometric growth was negative in male and females [18,19].

However, nothing is investigated about this species in this belt of the Balochistan coastline. There is likewise a complete lack of fishery management for this shellfish asset. Considering these realities, this investigation was attempted to accomplish this arrangement of objectives have to permit balanced administration conventions which will encourage the current exploitation of *P. segnis* benefit around close shore environments of Balochistan, Pakistan.

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