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Width/Length-Weight and Relationships of the Blue Crab (*Callinectes sapidus* Rathbun, 1986) Population Living in Camlik Lagoon Lake (Yumurtalik)

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Abstract: In this study, the width/length-weight relationships of the blue crab population (*Callinectes sapidus* Rathbun, 1986) living in Camlik Lagoon Lake (Adana) were investigated considering sex and maturity. A total of 743 samples were collected and analyzed. The Carapace Width (CW) distribution ranged from 2.30 to 17.80 cm and the weight distribution ranged from 0.70 to 301 g. Carapace width/carapace length-weight relationships was found to be as $W = 0.4782CL^{3.106}$ (R = 0.987) and $W = 0.0902CW^{2.932}$ (R = 0.982).

Key words: *Callinectes sapidus*, blue crab, Camlik Lagoon Lake, width/length-weight relationship

INTRODUCTION

Economically, the Portunidae is one of the most important families of Brachyura or true crabs, which contains some species such as *Callinectes sapidus* (blue crab), *Portunus pelagicus,* in commercial fisheries in southern part of Turkey. Although, the blue crab is originally a western Atlantic coast species, it has also been found in Mediterranean Sea in 20th century (Holthuis, 1991). It is a coastal species with a variety of substrates and lives in shallow and saline continental waters (Enzenross and Enzenross, 1990).

Due to its high economical value, the importance of the commercial and recreational fishing of the blue crab is increasing and the occurrence and ecological significance of the blue crab is receiving more and more interest along the Mediterranean coasts of Turkey. The sampling of *C. sapidus* was made from Camlik Lagoon Lake (a lake extended to the west of Yumurtalik, which is a city located at the north-west of Iskenderun Bay) (Fig. 1). A few studies has been found on biological structure of blue crab in Iskenderun Bay (Türeli, 1999), such as weight-length relationship in Beymelek Lagoon (Atar and Secer, 2003), distribution of blue crab in Turkey (Enzenrob *et al*., 1997) and fishery (Atar *et al*., 2002) However, the weight-length relationship and stock status of the blue crab in Camlik Lagoon hasn't been studied and still remains unknown and there is no official statistical data about blue crab harvest in Turkey.

An understanding of length-weight relationships may allow shifting the growth-in-length equations to growth-in-weight, which may be very useful for stock assessment models, the biomass estimation through length observations and for estimate of the condition of the fish. This relationship is also useful to study the regional comparisons and histories of certain species (Goncalves *et al*., 1997; Froese and Pauly, 1998; Moutopoulos and Stergiou, 2002). The determining of the relationships between the lengths of different types of these Mediterranean species, for which little information seems available now, is also very important for comparative growth studies (Froese and Pauly 1998).

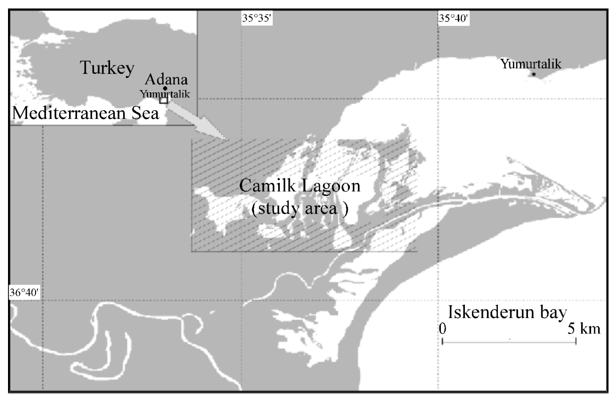

Fig. 1: Map of study area

In this study, therefore, some biological aspects of the of the blue crab, including data on Carapace Width (CW)/Carapace Length (CL)-Body Weight (W) and CW-CL the relationships and the size frequency distributions for juvenile, male and female individual samples taken from the lagoon were studied.

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MATERIALS AND METHODS

Blue crabs were collected by seine netting in the Camlik Lagoon Lake, Adana, Turkey. All sampling was conducted in August, 2005. The total length of the seine net was 17 m with two wings of 8 m lengths and a codend of 1 m length. All meshes of the seine net were 4 mm bar length square mesh. The seine net, used in a maximum depth of 1 m, was trawled manually along the shallow areas of the Camlik Lagoon Lake.

The Carapace Width (CW), Carapace Length (CL) of the juvenile, female and male blue crabs were measured nearest 1 mm and Weight (W) was balanced nearest 0.1 g. Totally 743 individuals were analyzed.

The length-weight relationships of all collected samples were determined by the expression $W= a*L^b$, where W is the derived weight (g), L is CW (cm) and a is the intercept of the regression curve and b (slope) are most easily estimated by linear regression based on logarithms; $\log (W) = \log (a)+b \log (L)$ (Lagler, 1968). The significance of regression was assessed by analysis of variance (ANOVA). Equations expressing the width/length-weight relationships of blue crabs were calculated in relation to sex and being juvenile.

RESULTS

Size composition: In this study we collected and measured CW total of 743 *C. sapidus* specimens, ranging from 2.30 to 17.80 cm and Figure 2 presents size-frequency distribution of blue crab according to 1 cm CW group. Mean CW of juvenile, female and male individuals of blue crab's were 3.42 (0.098 SE), 8.36 (0.137 SE) and 8.87 (0.125 SE), respectively. Analysis of Kolmogorov-Smirnov test detected no significant differences ($p>0.05$) in morphometry between females and males (Table 1).

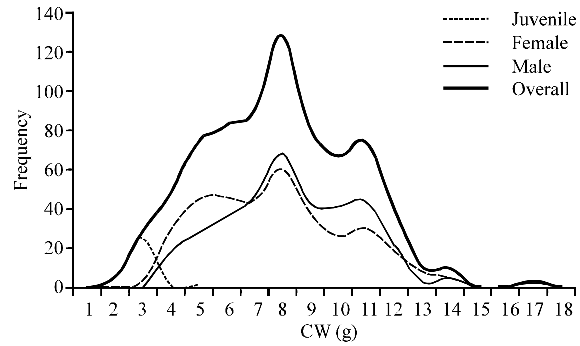

Fig. 2: Size frequency distribution by size groups of blue crab for each sex and overall individuals

Width/length-weight relationship: The weight of *C. sapidus* ranged from 0.70 to 10.40 g in juveniles, from 4.20 to 253 g in females and from 4.90 to 301 g in males (Table 2 and Fig. 3). Relationships between CW and W were expressed by equations: $W = 0.0356CW^{3.604}$ ($R^2 = 0.887$; n = 32) for juveniles, $W = 0.1016CW^{2.872}$ ($R^2 = 0.984$; n = 355) for females, $W = 0.1065CW^{2.861}$ ($R^2 = 0.972$; n = 356) for males and $W = 0.0902CW^{2.932}$ ($R^2 = 0.982$; n=743) for all individuals. ANOVA test detected highly significant differences in regression coefficients between the regression of W and CW for all sexes (Table 3). The carapace width/length-weight relationships show isometric growth except that of juvenile crabs (positive allometry). The carapace width-length regressions were also highly significant ($p<0.01$). Width-length relationships of blue crab were given in the Fig. 4.

DISCUSSION

In this study a total of 743 specimens 356 male (47.91%), 355 female (47.77%) and 32 juveniles (4.30%) of

Table 1: CW, CL and W characteristics of the blue crab. Mean±SE, minimum (Min) and maximum (Max)

		CW (cm)			CL (cm)			W(g)		
	N	Mean±SE	Min	Max	Mean±SE	Min	Max	Mean±SE	Min	Max
Juvenile	32	3.42±0.10	2.30	5.10	1.82±0.06	1.10	2.70	3.37±0.33	0.70	10.40
Female	355	8.36±0.14	3.90	17.30	4.32±0.06	2.10	7.50	57.24±2.63	4.20	253.00
Male	356	8.87±0.13	4.00	17.80	4.59±0.06	2.20	7.70	65.31±2.47	4.90	301.00
Total	743	8.39±0.10	2.30	17.80	4.34±0.05	1.10	7.70	58.79±0.10	0.70	301.00

Table 2: Regression parameters of the relationship between W and CW, W and CL and CL and CW

	$W = a*CW^b$				$W = a*CL^b$				CL = b*CW+a			
	a	b	SE(b)	r^2	a	b	SE(b)	r^2	a	b	SE(b)	r^2
Juvenile	0.0356	3.604	0.234	0.887	0.4766	3.077	0.126	0.952	-0.168	0.582	0.030	0.924
Female	0.1016	2.872	0.020	0.984	0.4868	3.090	0.020	0.986	0.440	0.464	0.004	0.971
Male	0.1065	2.861	0.026	0.972	0.4829	3.102	0.260	0.975	0.454	0.466	0.004	0.977
Total	0.0902	2.932	0.015	0.982	0.4776	3.106	0.013	0.987	0.378	0.472	0.003	0.977

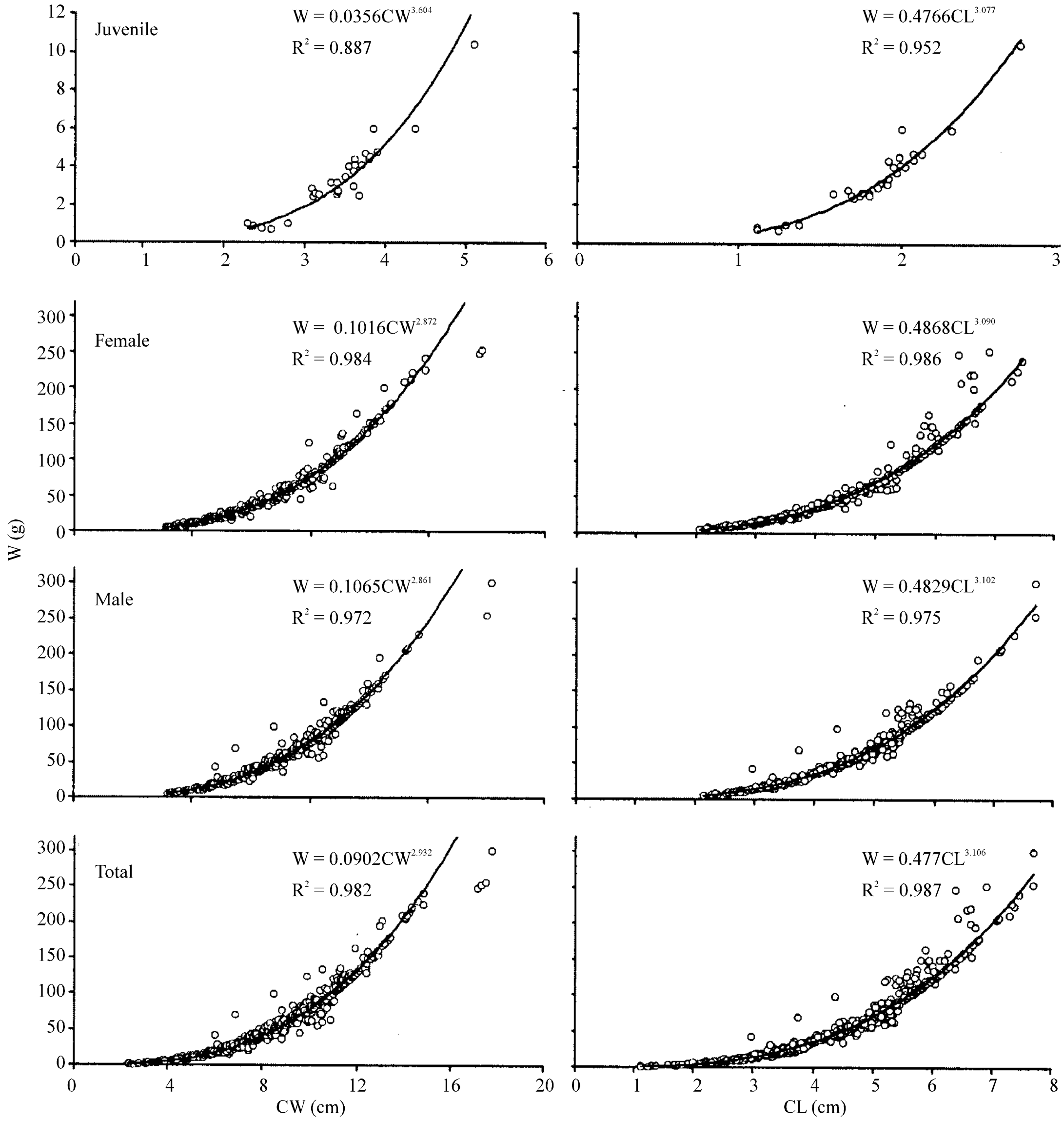

Fig. 3: Weight/width-length relationships of blue crab

Table 3: ANOVA test about regression coefficients

Model	Model	df	MS for W-CW	MS for W-CL	MS for Cl-CW
Juvenile	Regression	1	10.928**	11.728**	3.229**
	Error	30	0.046	0.0196	0.0089
Female	Regression	1	287.512**	288.115**	506.577**
	Error	353	0.0133	0.0116	0.0431
Male	Regression	1	225.796**	226.694**	429.388**
	Error	354	0.0187	0.0162	0.0290
Total	Regression	1	761.682**	765.068**	1162.518**
	Error	741	0.0187	0.0141	0.0367

**p<0.01; MS, Mean Square

C. sapidus from Camlik Lagoon were examined from August 2005. In the study, these individuals (disregarding sex and maturity differences) were measured 2.30 to 17.80 cm in carapace width, 1.10 to 7.70 cm in carapace length and 0.70 to 301 g in weight. Several investigators have also reported similar patterns in their studies (Archambault *et al.*, 1990; Ryer *et al.*, 1990; Türeli and Erdem 2003; Pauly, 1984).

The relationships between carapace CW/CL-W and CW-CL have many benefits. They are, for example, indicators of the condition and can be used to calculate biomass and to estimate the recovery of edible meat from crabs of various sizes (Lagler, 1968). They also provide such a practical advantage as making it possible to convert length into weight and vice versa. Moreover, body weight and total length, carapace length and carapace width are the most frequently used dimensions in the study of crustaceans (Sukumaran and Neelakantan, 1997).

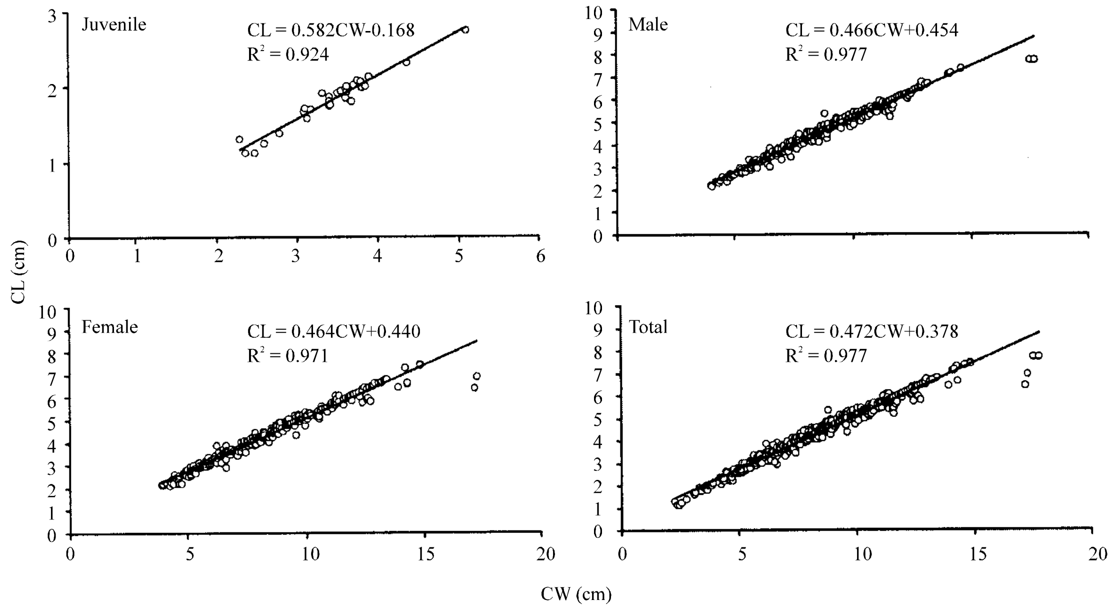

Fig. 4: Width-length relationships of blue crab

The b value in width/length-weight of males (2.861; 3.102) and females (2.872; 3.090) was lower than that of juveniles (3.604; 3.077). The b value ranged from 2.04 to 3.24 and 2.56 to 2.93 for *Callinectes sapidus* from Georgia and in Turkey's Beymelek Lagoon Lake and this shows similar results with the b values of the present study (Atar and Secer, 2003; Stickney, 1972). In general, from the length-weight regression equations, the exponent b often lies between 2.5 to 3.5 and is usually close to 3 (Stickney, 1972; Petrakis and Stergiou, 1995; Dulcic and Kraljevic, 1996; Jones *et al*., 1999). According to Pauly (1984), from an extraordinarily large number of length-weight data taken from a wide variety of fishes, values of b<2.5 or b>3.5 are generally based on a very small range of sizes and such values of b are most likely to be erroneous. An exponent b value of 3 indicates symmetrical or isometric growth; values other than 3 indicate allometric growth. In this study, just like another Beymelek lagoon study Atar and Secer (2003) the values remained below 3 and the calculated width/length-weight equation was allometric growth except that of juvenile crabs. Results independently obtained by many workers show that the change of b values depends primarily on the shape and fatness of the species and various factors such as salinity, temperature, food, sex, time of year and stage of maturity (Pauly, 1984; Sparre and Venema, 1992) may be responsible for the differences in parameters of the width/length-weight relationships between seasons and years. For example, adults male crabs tend to remain in low salinity waters while mature female crabs prefer the higher salinities of the lower estuary and adjacent marine waters.

Although juvenile crabs occur over a broad range of salinities, they are most abundant in low to intermediate salinities characteristic of middle and upper estuarine waters (Swingle, 1971; Perry and Stuck, 1982). Furthermore, growth of blue crabs is strongly affected by temperature. One of the most obvious effects of temperature on growth rate is the length of time required for crabs to reach maturity.

In the light of these results and evaluations, some biological aspects of the blue crab, among of which are some data on carapace width/carapace length-weight and width-length relationships for all individuals from blue crab taken the Camlik lagoon, were determined.

Consequently, there is currently little published biological data about blue crabs from Lagoon Lake in Turkey. This study is thought to be helpful and a guideline for future studies to be carried out in other waters.

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