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A study on the morphometric characteristics of *Astacus leptodactylus* inhabiting the Thrace region of Turkey

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ABSTRACT

Key-words: *crayfish, morphometric characters, length-weight relationship, allometric growth, Thrace region*

This study was carried out to determine some morphological characteristics, and the length-length and length-weight relationships of freshwater crayfish (*A. leptodactylus* Eschscholtz 1823) in the area of Tekirdağ, in the Thrace region of Turkey. The total length and wet weight for all individuals ranged from 33 to 156 mm and 0.64 to 96.42 g, respectively. Although the average length of both sexes was nearly the same, the average weight of male crayfish was higher than that of females. The total length-wet weight relationships for males, females and combined sexes of wet weight were found to be: $WW = 7.10^{6}TL^{3.293}$, $WW = 2.10^{5}TL^{3.022}$ and $WW = 9.10^{6}TL^{3.224}$, respectively. Isometric growth for female crayfish and positive allometric growth for male crayfish were observed in all populations. The carapace length, carapace width, and chela length and width increased allometrically with total length (TL) in both sexes. In conclusion, the morphometric relations in *A. leptodactylus* observed in the present study could provide information for future studies and management plans.

RÉSUMÉ

Une étude des caractéristiques morphométriques d'*Astacus leptodactylus* dans la région de la Thrace en Turquie

Mots-clés : *écrevisse, caractères morphométriques, relations longueur-poids, croissance allométrique, région Thrace*

Cette étude a été conduite pour déterminer quelques caractéristiques morphologiques, les relations longueur-longueur et longueur-poids de l'écrevisse d'eau douce (*A. leptodactylus* Eschscholtz 1823) dans la zone de Tekirdağ, dans la région Thrace de Turquie. Les longueurs totales et les poids frais de tous les individus vont de 33 à 156 mm et de 0,64 à 96,42 g respectivement. Bien que les longueurs moyennes des deux sexes soient très proches, le poids moyen des écrevisses mâles est supérieur à celui des femelles. La relation longueur totale (LT)-poids frais pour les mâles, femelles et sexes combinés, sont : $WW = 7{,}10^{6}TL^{3{,}293}$, $WW = 2{,}10^{5}TL^{3{,}022}$ et $WW = 9{,}10^{6}TL^{3{,}224}$ respectivement. Une croissance isométrique pour les écrevisses femelles et allométrique positive pour les mâles a été observée dans toutes les populations. Les longueurs et largeurs de carapace et de pince croissent allométriquement avec la longueur totale dans les deux sexes. En conclusion, les relations morphométriques observées chez *A. leptodactylus* dans cette étude peuvent apporter des informations pour des études ultérieures et les plans de gestion.

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INTRODUCTION

The length-weight relationship is a useful tool for estimation of the characteristics of a crayfish population as well as an important characteristic of species to estimate growth rate and size at sexual maturity (Lindqvist and Lathi, 1983). In addition, relations between the body parts are used for male-female separation and to compare crayfish populations from different lakes (Köksal, 1988; Harlıoğlu, 1999; Köksal *et al*., 2003; Balık *et al*., 2005a, 2005b; Güner, 2006; Büyükçapar *et al*., 2006). Moreover, length-weight data are more easily measured and standardized in field sampling (Mazlum *et al*., 2007).

Allometric or relative growth patterns in various crayfish species have been observed widely (Skurdal and Qvenıld, 1986; Pursiainen *et al*., 1988; Huner *et al*., 1990; Correia, 1993; Garvey and Stein, 1993; Austin, 1995; Gillet and Laurent, 1995; Romaire *et al*., 1977; Acosta and Perry, 2000; Eversole *et al*., 2006; Rajkovič *et al*., 2006). For example, *A. leptodactylus* was studied in Mogan Lake by Karabatak and Tüzün (1989), in Ayrancı Dam Lake by Erdem (1994), in the Ağın region of Keban Dam Lake by Harlıoğlu (1999), in Keban Dam Lake (Duman and Gürel, 2000), in Beyşehir Lake by Erdemli (1982), in Hotamış Lake and in Mamasın Dam Lake by Erdemli (1987), in Dikilitaş Reservoir by Köksal *et al.* (2003), in İznik Lake (Balık *et al*., 2002), in the Lakes of Akşehir, Eber and Apa Dam Lake (Erdemli, 1982), and in Eğirdir Lake (Balık *et al.*, 2002). Formerly, in the region of Thrace, Güner (2006) studied the length-weight relationship in *A. leptodactylus* inhabiting Terkoz Lake and Deval *et al.* (2007) examined the age determination of *A. leptodactylus* for some habitats which we examined for this study. In the studies of Deval, not only the individiuals from the fyke nets were observed, but juveniles were also collected by hand during the night/evening and these were added to the age-length determinations. However, in the present study, only the individuals caught by the fyke nets were evaluated.

The Thrace region of Turkey has two freshwater crayfish species: *A. leptodactylus* Eschscholtz 1823 and *Austropotamobius torrentium* (Shrank, 1803). The narrow-clawed crayfish, *A. leptodactylus*, is the native freshwater crayfish species in Turkey. It is widely distributed in lakes, ponds and rivers throughout the country (Köksal, 1988). In addition, it has been uncontrollably transferred into many freshwaters in recent years to establish new populations and to restore the crayfish stocks devastated by the plague disease (*Aphanomyces astaci*) in Turkey (Harlıoğlu and Holdich, 2001; Harlıoğlu and Harlıoğlu, 2009). In addition to *A. leptodactylus*, the presence of two populations of *A. torrentium* was found in the Thrace region in the last decade (Trontelj *et al.*, 2005; Harlıoğlu and Güner, 2006, 2007; Machino and Holdich, 2006; Güner and Harlıoğlu, 2010). Being a threatened species with a relatively small size make it of little commercial interest (Harlıoğlu and Güner, 2006, 2007; Güner and Harlıoğlu, 2010). However, *A. leptodactylus* harvesting in Turkey has been used to constitute a major part of the European market.

Although numerous studies have been carried out on the morphological characteristics of *A. leptodactylus* living in the Asian part of Turkey, only length-based estimates of growth parameters, mortality rates and recruitment of *A. leptodactylus* in some unexploited inland waters of the northern Marmara region, in the European part of Turkey, have been studied by Deval *et al.* (2007).

MATERIAL AND METHODS

The study was conducted in four freshwater reservoirs (Bayramşah, Bıyıkali, Karababa and Karacakılavuz), which are within an area with a radius of 11 km in the area of Tekirdağ, in the Thrace region (Figure 1). The physical characteristics of these sites are outlined in Table I. In the ponds subjected to this study, there were no native fish species. These ponds were artificially constructed and the following fish species were stocked in them: ***Rutilus rutilus, Perca fluvuatilis, Carassius gibelio, Cobitis taenia*** and ***Rhodeus sericeus amarus***.

Specimens were collected during eight scientific sampling trips carried out between March 2005 and May 2006 in waters of 5–7 m depth. In the samplings, multifilament, knotted

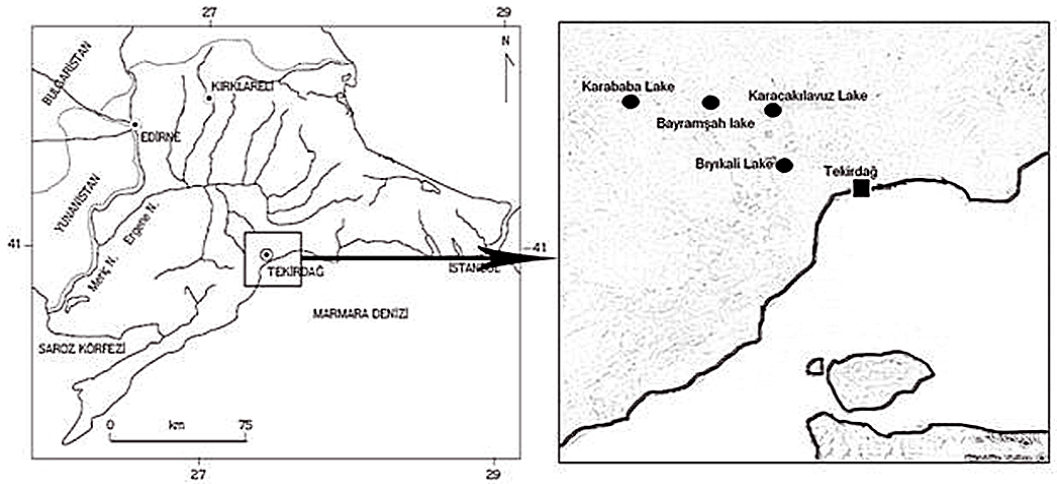

Figure 1
Sampling areas of the study (Karababa, Karacakılavuz, Bayramşah and Bıyıkali Lakes) (Akova, 2002).

Figure 1
Aires d'échantillonnage (Lacs Karababa, Karacakılavuz, Bayramşah Bıyıkali) (Akova, 2002).

Table I
Description of freshwater reservoirs (complied from S.A.T., 1979, 1983, 1985, 1987).

Tableau I
Description des réservoirs d'eau douce (compilée d'après S.A.T., 1979, 1983, 1985, 1987).

Freshwater reservoirs	Location	Surface area (ha)	Maximum depth (m)	Substrates
Bayramşah	41 °07′ 49 N 27° 27′ 04.09 E	34	7	Sandy clay (rich in phosphor and potassium)
Bıyıkali	41° 00′ 45.59 N 27° 23′ 20.52 E	62.6	8	Sandy clay (rich in phosphor and potassium)
Karababa	41° 08′ 02.93 N 27° 00′ 10.33 E	14.1	6	Silty clay, clay (rich in phosphor and potassium)
Karacakılavuz	41° 07′ 05.89 N 27° 21′ 28.30 E	34	7	Sandy clay loam (rich in phosphor and potassium)

polyamide (PA) twine [210 Td × 18 (6 × 3)] fyke nets (without bait), *i.e.*, 500 nets of 32 mm PA for commercial catching, and 250 nets of 20 mm PA to catch smaller individuals, were used.

The carapace length (CL, from the tip of the rostrum to the posterior median edge of the cephalotrax), carapace width (CW), chela length (ChL, tip of propodus to carpal joint), chela width (ChW, greatest palm width), chela depth (ChD) and total length (TL) of each specimen were measured to the nearest 0.1 mm (Rhodes and Holdich, 1984), while weight was measured to the nearest 0.01 g, and each specimen was sexed (Rhodes and Holdich, 1979). In total, 2916 crayfish were measured. To evaluate differences in the sex ratio, a χ^2-test was used for the entire sample by length classes. Regression analyses were performed on each sex and also on combined sexes, regarding all of their morphological attributes TL-CL, TL-CW, CL-CW, TL-ChW, TL-ChW and ChL-ChW by the equation: $W = a \times TL^b$ (Ricker, 1973), and log base 10 equation Log W = Log a + b Log L, where W is WW (wet weight) (g), and TL is the total length (mm) (Romaire *et al*., 1977). The significance of the regression was assessed by ANOVA, and a and b constants, and the b-value for each sex was tested by *t*-test to verify if it was significantly different from the isometric growth (b = 3) (Sokal and Rohlf, 1987). The association degree between the variables was calculated by the determination coefficient (r^2).

Table II
Descriptive statistics of various morphometric measurements of A. leptodactylus *(ESC, 1823) (TL, total length; CL, carapace length; CW, carapace width; W, wet weight, ChL, chela length; ChW, chela width; AL, abdomen length; AW, abdomen width).*

Tableau II
Statistiques descriptives des diverses mesures morphométriques d'*A. leptodactylus* (ESC, 1823) (TL, longueur totale ; CL, longueur de carapace ; CW, largeur de carapace ; W, poids frais ; ChL, longueur de pince ; ChW, largeur de pince ; AL, longueur de l'abdomen ; AW, largeur de l'abdomen).

Variables	Sex	*n*	Min.	Max.	Mean	SE	*t*-test
TL	M	1558	33	156	103.7	0.47	$p < 0.05$
	F	880	38	143	101.6	0.59	
	BS	2438	33	156	102.9	0.37	
CL	M	1558	16	78	49.6	0.24	$p < 0.05$
	F	880	19	67	46.2	0.28	
	BS	2438	16	78	48.4	0.18	
CW	M	1556	7	38	24.4	0.14	$p < 0.05$
	F	677	8	39	22.5	0.16	
	BS	2433	7	39	23.7	0.11	
W	M	1558	0.64	96.42	34.5	0.47	$p < 0.05$
	F	880	2.88	82.7	26.1	0.43	
	BS	2438	0.64	96.42	31.5	0.35	
ChL	M	1520	9	90	42.3	0.38	$p < 0.05$
	F	851	9	80	29.5	0.28	
	BS	2371	9	90	37.7	0.29	
ChW	M	1522	2	30	14.3	0.13	$p < 0.05$
	F	851	2	21	10.8	0.10	
	BS	2373	1	30	13.1	0.09	
AL	M	1561	6	70	52.4	0.26	$p > 0.05$
	F	881	13	73	53.5	0.38	
	BS	2442	6	73	52.6	0.21	
AW	M	1561	6	36	21.1	0.11	$p < 0.05$
	F	881	8	40	24.2	0.18	
	BS	2442	6	40	22.2	0.10	

The *F*-test revealed the existence of significant differences between the length-length and length-weight relationships with sexes.

RESULT

In this study, because there was no significant difference in measured parameters ($F = 2.16$, $p < 0.05$) between the crayfish caught from the reservoirs, data were pooled. A total sample of 2442 individuals (1561 males (63.92%), 881 females (36.08%)), with total length ranging from 33.0 to 156.0 mm and wet weight ranging from 0.64 to 96.4 g, were collected from four ponds. From 2442 crayfish, 2376 selected with normal chelipeds were used to determine chela length and width measurements of the population.

The sex ratio was found to be 1:1.77 (females/males). This value significantly differs from the theoretical 1:1 value ($\chi^2 = 3.95$, $p < 0.05$). The rate of crayfish individuals caught was 35.7% and 47% for females, and 32.5% and 32.9% for males in the summer and autumn, respectively. In the winter and spring the rates were 26.6% and 8% for males, and 15.2% and 2.1% for females, respectively. There is a significant difference between female and male specimens in different seasons ($\chi^2 = 7.81$ (212.56), $p < 0.05$).

The analyses of the biometrical data are shown in Table II. The total length (TL) of males ranged from 33 to 156 mm with a mean of 103.7 ± 0.5 mm, and females ranged from 38 to 143 mm with a mean of 101 ± 0.6 mm. Significant difference in mean total length was found between sexes ($t = 2.8$, $p < 0.05$). The mean wet weight of the males and the females was 34.5 ± 0.47 g and 26.1 ± 0.43 g, respectively. There was a significant difference between sexes

Table III
Descriptive statistics and estimated parameters of weight-length and biometric relationships for both sexes of A. leptodactylus *(ESC, 1823) in Tekirdağ, in the northern Marmara region of Turkey. (N, number of individuals; W, weight (g); TL, total length (mm); CL, carapace length (mm); CW, carapace width (mm); ChL, chela length (mm); ChW, chela width (mm); S.E., standard error; A-, negative allometry; A+, positive allometry).*

Tableau III
Statistiques descriptives et paramètres estimés des relations biométriques sont présentés pour les deux sexes d'*A. leptodactylus* (ESC, 1823) en Tekirdağ, région Nord-Marmara de Turquie. (*N*, nombre d'individus ; W, poids (g) ; TL, longeur totale (mm) ; CL, longueur de carapace (mm) ; CW, largeur de carapace (mm) ; ChL, longueur de pince (mm) ; ChW, largeur de pince (mm) ; S.E., erreur-standard ; A-, allométrie négative ; A+, allométrie positive).

Relation		*N*	Equation	r^2	S.E. of b	Relationship *t*-test
W/TL	M	1558	Log W = −5.1545 + 2.356 × Log TL	0.939	2.356	A^+
	F	880	Log W = −4.6898 + 3.0222 × Log TL	0.939	3.022	I
	Both	2438	Log W = −5.0432 + 3.224 × Log TL	0.921	3.224	A^+
W/CL	M	1558	Log W = −3.7338 + 3.079 × Log CL	0.925	3.079	A^+
	F	880	Log W = −3.4604 + 2.9062 × Log CL	0.915	2.906	A^-
	Both	2438	Log W = −3.6949 + 3.0524 × Log CL	0.929	3.052	A^+
CL/TL	M	1556	Log CL = −0.3676 + 1.023 × Log TL	0.929	1.023	A^+
	F	878	Log CL = −0.287 + 0.9723 × Log TL	0.924	0.972	A^-
	Both	2434	Log CL = −0.3539 + 1.0124 × Log TL	0.92	1.012	A^+
CL/CW	M	1556	Log CW = −0.5591 + 1.147 × Log CL	0.925	1.147	A^+
	F	877	Log CW = −0.5624 + 1.149 × Log CL	0.989	1.147	A^+
	Both	2433	Log CW = −0.5689 + 1.1529 × Log CL	0.951	1.153	A^+
CW/TL	M	1556	Log CW = −0.9922 + 1.179 × Log TL	0.868	1.179	A^+
	F	879	Log CW = −0.9023 + 1.1219 × Log TL	0.923	1.122	A^+
	Both	2435	Log CW = −0.9755 + 1.1665 × Log TL	0.874	1.166	A^+
CHL/TL	M	1520	Log CHL = −2.1177 + 1.8494 × Log TL	0.879	1.849	A^+
	F	851	Log CHL = −1.3248 + 1.3872 × Log TL	0.801	1.387	A^+
	Both	2371	Log CHL = −1.9285 + 1.7315 × Log TL	0.725	1.732	A^+
CHL/CHW	M	1522	Log CHW = −0.3473 + 0.924 × Log CHL	0.832	0.924	A^-
	F	851	Log CHW = −0.4064 + 0.977 × Log CHL	0.681	0.977	A^-
	Both	2373	Log CHW = −0.3247 + 0.9128 × Log CHL	0.805	0.913	A^-
CHW/TL	M	1519	Log CHW = −2.288 + 1.7003 × Log TL	0.715	1.700	A^+
	F	851	Log CHW = −1.5284 + 1.2689 × Log TL	0.478	1.269	A^+
	Both	2370	Log CHW = −2.0947 + 1.5853 × Log TL	0.587	1.585	A^+

in wet weight (t = 13.13, $p < 0.05$). The abdomen length showed no significant difference between sexes (t = 0.91, $p < 0.05$). However, abdomen width was different (t = 14.58, $p < 0.05$) between males and females. Mean chela length (ChL), mean chela width (ChW) and their range were calculated for males and females (Table II). Males were found to have longer ChL than females (t = 27.25, $p < 0.05$). The same trend was observed in mean ChW for males, but a significant difference was observed between males and females (t = 28.99, $p < 0.05$). In this research, it was determined that the carapace length of the male individuals was longer than that of females. The chela length and width were longer and wider than those of the females, and the abdomen of female individuals was wider and longer (Table II).

The results obtained for the weight-length (WW/TL, WW/CL), length-length (CL/TL, ChL/TL) and width-length (CW/TL, CW/CL, ChW/TL) relationships, along with some descriptive statistics, are given in Table III. The WW/TL relationships indicate isometric growth for female (b = 3) individuals and positive allometric growth for male individuals for all of the populations (b > 3). Weight-length relationships were highly significant (all $r^2 > 0.94$, $p < 0.05$). Except for the WW/CL relationship for females ($r^2 > 0.915$, $p > 0.05$), analysis of the CL/TL (except for females) and ChL/TL relationships showed positive allometry (b > 3) (Table III, Figures 2–4). Chela length and width increased allometrically with TL for both sexes (all $r^2 > 0.73$, $r^2 > 0.59$, $p < 0.05$) (Table III). In addition, chela length-width relationships were positively

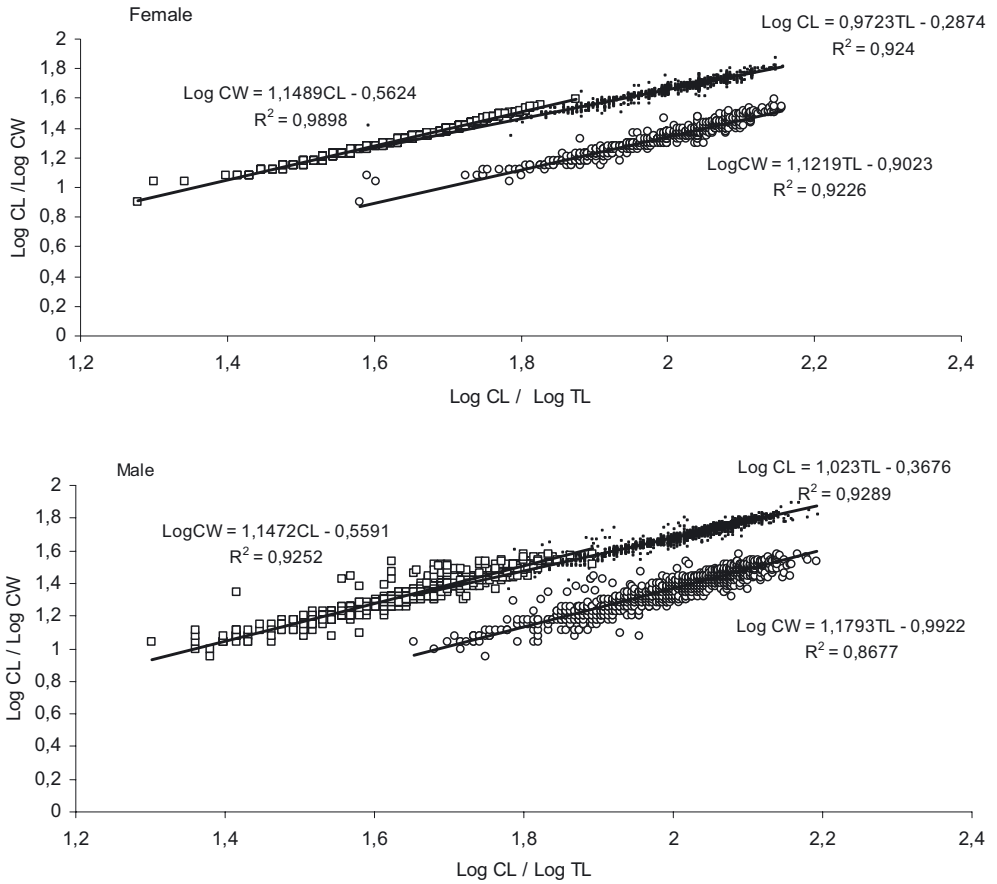

Figure 2
Linear regression lines and length-length relationships for females, males and combined sexes of A. leptodactylus *(ESC, 1823), and the association degrees between variables (R^2, determination coefficient; CL, carapace length; TL, total length; CW, carapace width).*

Figure 2
Régressions linéaires et relation longueur-longueur pour les mâles, les femelles et les sexes combinés d'*A. leptodactylus* (ESC, 1823), et degrés d'association entre variables (R^2, coefficient de détermination ; CL, longueur de carapace ; TL, longueur totale ; CW, largeur de carapace).

correlated with sex (all $r^2 > 0.85$, $p < 0.05$) (Table III). The slope and intercepts of regression for males were not significantly different from those for the females (Table III).

DISCUSSION

In the study, 2442 *Astacus leptodactylus* were measured and descriptive statistic values for males, females and combined sexes are presented separately in Table II. It was determined that mean TL, CL and WW of the male individuals were heavier and longer than those of females. In addition, the chela length and width of the males was higher than those of females. On the other hand, the abdomen of females was wider and longer (Table II). As seen in Table II, because the chela length is longer than the females', the male members were considerably heavier than the female ones.

The results of the present study are consistent with the findings of other research carried out for some other crayfish species, such as *A. astacus* (Lindqvist and Lahti, 1983), *A. pallipes* (Rhodes and Holdich, 1979), *P. clarkii* and *P. acutus* (Romaire *et al*., 1977), and *O. propinquus* (Stein, 1976). These results were also consistent with the findings of other research carried

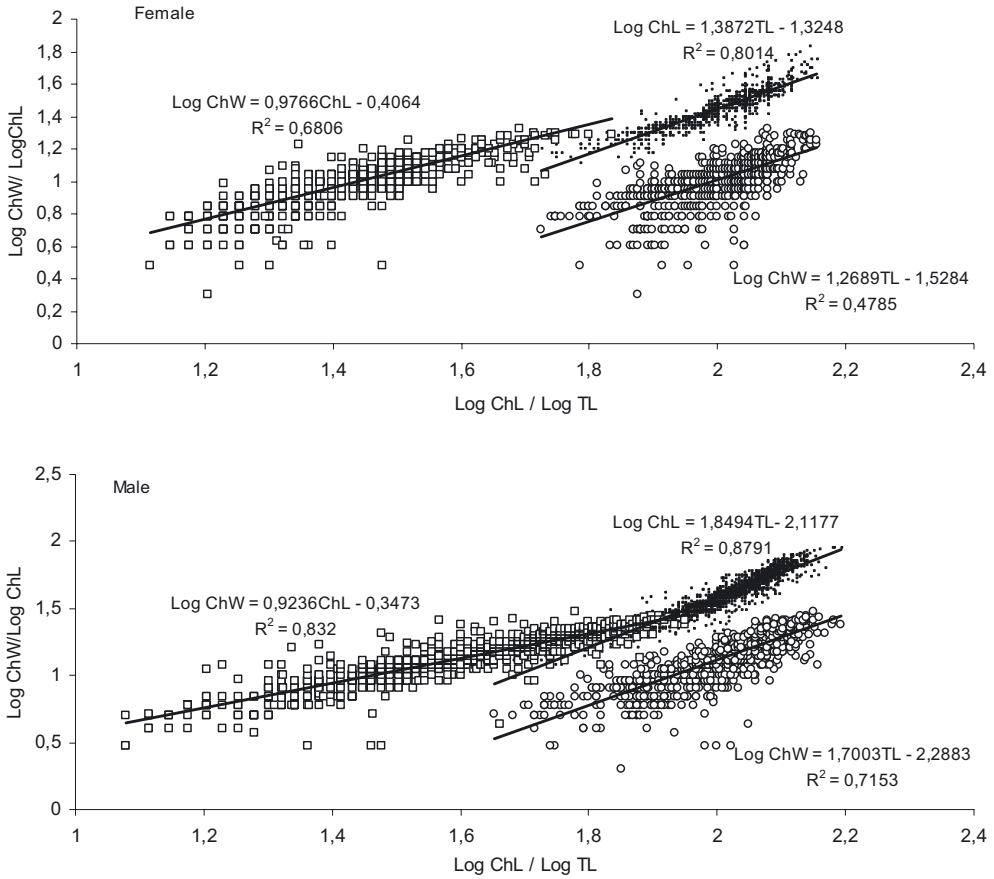

Figure 3
Linear regression lines and length-length relationships for females, males and combined sexes of A. leptodactylus *(ESC, 1823), and the association degrees between variables (R^2, determination coefficient; TL, total length; ChL, chela length; ChW, chela width).*

Figure 3
Régressions linéaires et relation longueur-longueur pour les mâles, les femelles et les sexes combinés d'*A. leptodactylus* (ESC, 1823), et degrés d'association entre variables (R^2, coefficient de détermination ; TL, longueur totale ; ChL, longueur de pince ; ChW, largeur de pince).

out in the freshwaters of Anatolia. Average length and weight values are shown in Table IV. Across the freshwaters of Turkey, length values were recorded as being between 96.66 mm and 117 mm and the weight values between 21.94 g. and 52.91 g (Table IV). When average TL values of the female individuals determined in our study were compared with those of the Anatolian lakes (Akşehir Lake, Apa Dam Lake, Apolyont Lake, Beyşehir Lake, Eber Lake, Eğridir Lake, Demirköprü dam, Dikilitaş irrigation reservoir, Işıklı Lake, İznik Lake, Işıklı Lake, Hotamış Lake, Mamasın Dam Lake, Miliç Morgan Lake and Seyhan Dam Lake), for which similar studies have been done for this species, it was shown that these values are higher than 27% of the lakes in terms of length and lower than 73%, and in terms of weight these values are higher than 13% of the lakes and lower than 87%. It was determined that the average length and weight values of the male individuals are higher than those of 53% of the lakes, and lower than 47% (Köksal, 1980; Erdemli, 1982, 1987; Karabatak and Tüzün, 1989; Çevik, 1993; Bolat, 1996; Güner, 2000; Erdem *et al.*, 2001; Köksal *et al.*, 2003; Balık *et al.*, 2005a, 2005b). In the lakes Terkoz and Miliç, which are located in Trachia, crayfish length and weight were found to be smaller in the studies carried out in these lakes (Köksal, 1980). Although all of the studies were carried out on *A. leptodactylus*, the reason for the average

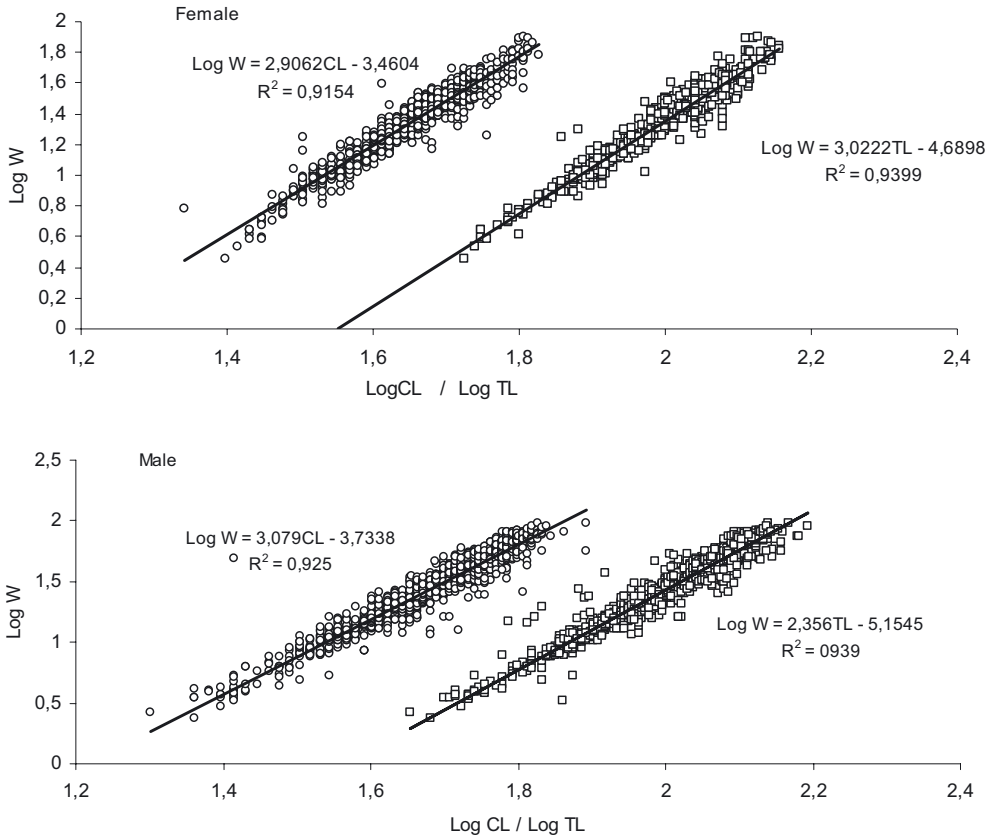

Figure 4
Regression lines and length-weight relationships for females, males and combined sexes of A. leptodactylus *(ESC, 1823), and the association degrees between variables (R^2, determination coefficient; CL, carapace length; TL, total length; W, weight).*

Figure 4
Régressions linéaires et relation longueur-longueur pour les mâles, les femelles et les sexes combinés d'*A. leptodactylus* (ESC, 1823), et degrés d'association entre variables (R^2, coefficient de détermination ; TL, longueur totale ; CL, longueur de carapace ; W, poids).

length variance among the populations in different regions is due to the differentiation caused by diverse ecological conditions.

The specimens sexed were 2442, of which 1561 were males (63.92%) and 881 females (36.08%). The total of the sex ratio was: 1:1.77 (females/males) and significantly different from the theoretical 1:1 value ($\chi^2 = 3.95$, $p < 0.05$). The sex ratio in natural crayfish populations is about 1:1 (Abrahamsson, 1971; Kirjavainen and Westman, 1999); a number of authors have reported male-biased catches during at least part of the year (Fenouil and Chaix, 1985; Ackefors, 1999; Alekhnovich *et al.*, 1999) and some attributed this bias to the use of a particular collection technique (*e.g.*, trapping tends to be biased toward males). In this study, it was found that *A. leptodactylus* catches were male-biased during the research period. Köksal (1988) reported that the males of *A. leptodactylus* were more active than the females, and also females were inactive during the breeding season (November to June) and the proportion of females per catch ranged from 29–43% from November to the end of June. The lower catches during winter and spring with respect to summer and autumn could be related to minor activity of crayfish after breeding and later, for females only, after spawning (Gherardi *et al.*, 1997; Kirjavainen and Westman, 1999; Grandjean *et al.*, 2000; Capurro *et al.*, 2007). Differences in sex ratios over seasons could mainly be due to differences in the activity pattern of males and females (Westin and Gydemo, 1989; Hudina *et al.*, 2008).

Table IV
Results of the average length and weight values obtained from our studies on Astacus leptodactylus*.*

Tableau IV
Résultats de longueur et poids moyen obtenus dans nos études sur *Astacus leptodactylus*.

Author	Place	Sex	TL (mm)	W (g)	♀/♂ rates
Köksal, 1980	Eğirdir	♀	101.17	24.95	1.09/1.00
		♂	101.06	29.57	
	Akşehir	♀	111.15	35.52	1.74/1.00
		♂	102.82	32.95	
	Apolyont	♀	106.94	29.05	0.73/1.00
		♂	110.00	35.42	
	Eber	♀	101.17	24.95	0.61/1.00
		♂	101.38	21.94	
	İznik	♀	103.33	28.60	0.86/1.00
		♂	103.07	32.88	
	Manyas	♀	114.50	38.46	1.22/1.00
		♂	115.45	47.68	
	Miliç	♀	102.25	29.05	1.10/1.00
		♂	98.61	26.11	
	Terkos	♀	98.23	22.17	0.94/1.00
		♂	96.66	26.33	
Erdemli, 1982	Eğridir	♀	96.30	30.65	1.56/1.00
		♂	103.02	32.05	
	Akşehir	♀	106.89	36.31	0.94/1.00
		♂	117.47	48.41	
	Beyşehir	♀	105.92	35.41	1.24/1.00
		♂	97.90	31.36	
	Eber	♀	106.62	35.71	1.00/1.00
		♂	114.36	45.04	
	Apa	♀	107.17	36.84	1.17/1.00
		♂	113.42	42.70	
Erdemli, 1987	Hotamış	♀	98.90	32.18	1.00/1.00
		♂	109.92	35.41	
	Mamasın	♀	103.74	35.24	
		♂	116.72	42.19	
Karabatak and Tüzün, 1989	Mogan	♀	104.45	31.92	1.22/1.00
		♂	105.44	36.98	
Çevik, 1993	Seyhan	♀	108.50	37.40	1.00/1.00
		♂	116.00	45.57	
Bolat, 1996	Eğridir	♀	92.67	29.18	0.60/1.00
		♂	107.21	52.91	
Güner, 2000	Işıklı	♀	104.36	31.72	1.86/1.00
		♂	99.75	32.88	
Köksal *et al.*, 2003	Dikilitaş	♀	102.04	32.24	
		♂	102.50	33.11	
		♀+♂	102.26	32.66	
Erdem *et al.*, 2001	İznik	♀	101.1	28.594	0.89/1.00
		♂	99.3	30.912	
		♀+♂	100.20	29.792	
Balık *et al.*, 2005	Demirköprü	♀+♂	91.06	25.03	
This study		♀	101.6	26.1	1/1.77
		♂	103.7	34.5	
		♀+♂	102.9	31.44	

The length-weight, carapace length-carapace width, carapace width-total length, chela length-total length and chela width-total length relationships of males and females showed positive allometric growth (b $>$ 3). Similar results were found for *Procambarus zonangulus* (Romaire *et al*., 1977), *P. clarkii* (Correia, 1993) and *P. alleni* (Acosta and Perry, 2000). In addition, *Cherax quadricarinatus*, *C. destructor* and *P. clarkii* showed allometric growth of 3.04, 3.18 and 3.22, respectively. These results were consistent with the other crayfish research in Turkey (Harlıoğlu, 1999; Harlıoğlu and Harlıoğlu, 2004; Erdem *et al*., 2001; Balık *et al*., 2005a, 2005b). At the end of these studies, it can be said that females show isometric growth and males show positive allometric growth since fishing is forbidden in these ponds.

The carapace length-total length and carapace length-weight relationships of females, and chela length-chela width relationship of males, females and both sexes showed negative allometric growth (b $<$ 3). Moreover, female chela length and width increased allometrically in *Procambarus clarkii* and *P. a. Acutus* (Mazlum *et al*., 2007). Although the change in b values depends primarily on the shape and fatness of the species, various factors may be responsible for the difference in parameters of the length and weight relationships among seasons; food, sex, time of year, and sexual stages (Lindqvist and Lathi, 1983).

Although there are many studies on the *A. leptodactylus* widespread in Anatolian lakes and ponds, there are only a few studies published on the Thrace streams. For example, existence of *A. leptodactylus* in Bayramşah, Bıyıkali, Karababa and Karacakılavuz ponds was first reported by Deval *et al*. (2007). With this study, metric attributes of the species were determined and contributions were made to the distribution area and biology of the species. It is concluded that, so as to economically benefit the species and enable sustainable management, studies should be continued in this area. Additionally, the Thrace region is a suitable crayfish production area as an alternative to the Anatolian part of Turkey. As far as catching is concerned, there are only a few facilities in the region to make this industry seem promising.

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