

Observation on the age, growth and somatic condition of *Carasobarbus luteus* (Heckel, 1843) and *Capoeta trutta* (Heckel, 1843) (Cyprinidae) in the Tigris River, Turkey

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Abstract

This study was carried out to determine some biological characteristics including age, growth and somatic condition of *Carasobarbus luteus* and *Capoeta trutta* in the Turkish part of the Tigris River. The examined samples of *C. luteus* were distributed between II-IX years of age. The length-weight relations of females and males were calculated as $\text{Log } W = -4.7314 + 3.0113 \text{ Log } \text{FL}$ and $\text{Log } W = -4.7631 + 3.0263 \text{ Log } \text{FL}$ respectively. Von Bertalanffy growth equations were estimated as $L_t = 40.09 [1 - e^{-0.087036(t+1.55004)}]$ for females and $L_t = 38.14 [1 - e^{-0.080056(t+2.34838)}]$ for males. The somatic condition was 1.9667 ± 0.1751 for females and 1.9967 ± 0.4205 for males. The observed samples of *C. trutta* were distributed between I-VI years of age. The length-weight relationship of females and males were calculated as $\text{Log } W = -4.6845 + 2.9303 \text{ Log } \text{FL}$, $\text{Log } W = -4.7784 + 2.9746 \text{ Log } \text{FL}$, respectively. Von Bertalanffy growth equations were estimated as $L_t = 35.36 [1 - e^{-0.082817(t+4.82738)}]$ for females and $L_t = 28.82 [1 - e^{-0.12380(t+4.40235)}]$ for males. The somatic condition in female and male individuals were determined as; 1.4434 ± 0.1682 and 1.4722 ± 0.1984 respectively. Both species are economic fish in the Tigris River. Biological characteristics of the species determined in the present study, may contribute to a better understanding of the life cycle, thus providing useful data for its conservation and management.

Keywords: *Carasobarbus luteus*, *Capoeta trutta*, Reproduction, Fecundity, Gonadosomatic index.

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Introduction

Investigations on biology of fish are essential for planning better conservation and management strategies of fishery resources (Ali and Kadir, 1996; Kalkan, 2008; Muchlisin, 2014) and for evaluating the impacts of environmental variability on the dynamics of fish populations (Schlosser, 1990). In addition, information on the biology of the candidate species is very much essential for the development of the aquaculture industry (Priyadharsini *et al.*, 2013).

Capoeta trutta (Heckel, 1843) and *Carasobarbus luteus* (Heckel, 1843) belonging to family Cyprinidae have a wide distribution and are the most common species in both Euphrates and Tigris basins, as well as in natural and artificial lakes in Mesopotamia (Kuru, 1979; Ünlü, 1991; Coad, 2010) and Iran (Ramin *et al.*, 2014; Esmaili *et al.*, 2015). These two species were chosen because they are among the most economically important and abundant species in the region.

There have been some studies on some biological characteristics such as age, growth, somatic condition and reproduction of *C. trutta* and *C. luteus* in Tigris and Euphrates River System in Turkey (Ünlü, 1991; Duman, 2004; Yalçın-Özdilek *et al.*, 2004; Başusta and Cicek, 2006; Kalkan, 2008; Oymak *et al.*, 2008; Özcan, 2008; Aydın *et al.*, 2012; Düşükcan and Çalta, 2012; Canpolat and Çaltı, 2013; Aral *et al.*, 2014; Canpolat and Çaltı, 2014) in Iraq (Ahmed *et al.*, 1984; Naama and

Muhsen, 1986; Bartel *et al.*, 1996; Rahemo and Al-Shatter, 2012; Mohamed, 2014) in Iran (Patimar and Farzi, 2011; Eydizadeh *et al.*, 2013; Biriya *et al.*, 2014; Esmaili *et al.*, 2014; Eydizadeh, 2014; Eydizadeh *et al.*, 2014; Poria *et al.*, 2014; Niya *et al.*, 2015) and in Syria (Al-Hazzaa and Hussein, 2003; Al-Hazzaa, 2005). Their parasitoses were also studied by Pazooki and Masoumian (2012). However, research on the biology of *C. trutta* in Tigris River in Turkey is out-of date. Besides, there is no study on biology of the *C. luteus* population in the upper part of the Tigris River (Turkey).

Tigris River and its tributaries are spread over a wide geographical area. The populations of these species in the Turkish waters of the Tigris River differ from those of Iraq, Iran and Syria (Patimar and Farzi, 2011). Thus knowledge of biological characteristics is critically important in understanding the future of the species due to environmental changes. Therefore, this study was carried out to determine some biological characteristics including age, growth and somatic condition of *C. trutta* and *C. luteus* in the Turkish part of the Tigris River.

Material and methods

Samples of *C. trutta* and *C. luteus* were collected monthly from Tigris River between Diyarbakir Province and Bismil Town in an area about 10 km southeast of Anatolia of Turkey (Fig. 1) during the period starting from April 2012 to May 2013.



Figure 1: The map of Turkey and sampling localities in the Tigris River (Bismil town, Southeast of Anatolia).

The stations were located at a latitude of 37°50'N 40°36'E and altitude of 545m. Totally 307 *C. luteus* and 394 *C. trutta* specimens were collected from this site by using gill nets of various mesh sizes (18X18, 24X24 and 30X30). Specimens were immediately transported to the laboratory in a portable icebox. Water temperature, dissolved oxygen, pH and electrical conductivity were measured in the field by a multiparameter equipment (Hache Lange marka HQ40) to determine some physico-chemical parameters of the studied station. Fishes were identified to the species level with the identification keys given by Kuru (1980) and Coad (2010).

Fork length (FL) and weight (W) were measured with an accuracy of 1.0 mm, and 1.0 g, respectively. Sex in mature specimens was easily determined with the naked eye, but microscopic examination was used for differentiating sex in juveniles (Ünlü, 1991; Gökçek and Akyurt, 2008).

Age was determined from scales (Polat, 1987; Gökçek and Akyurt, 2008; Baboli and Sayahi, 2014). For this purpose, approximately 10 scales from each fish were mounted between two glass microscope slides and they were assessed by Kindermann microfiche reader.

Growth was examined as a ratio of length and weight. The relative growth in length (RGL) and weight (RGW) were calculated by the following formulae:

$$RGL = \frac{L_t - L_{t-1}}{L_{t-1}} \times 100, \quad RWL = \frac{W_t - W_{t-1}}{W_{t-1}} \times 100$$

Length - weight relationship ratios were calculated by applying the exponential regression $W = aL^b$, where W is the fish weight (g) and L the fork (TL, cm) (Le Cren, 1951; Tesch, 1968; Ricker, 1968). Growth type (isometric and allometric) was determined by Student's t-test ($p < 0.05$). The analysis of covariance (ANCOVA) was used to determine the effects of sex on the

weight-length relationship. The t-test was performed in order to evaluate the difference of the b slope of length-weight relationship from 3 (Arslan *et al.*, 2007).

The Von Bertalanffy (1938) growth equation was used in order to determine the relationship between age-length:

$$L_t = L_{\infty}[1 - e^{-k(t-t_0)}]$$

where L_t is the length at age t ; K is a growth constant, determining the rate of change in the length increment; and t_0 is the hypothetical age when the length is zero.

Somatic Condition (Fulton factor) (K) was estimated for males and females using the equation:

$K = W \times 10^5 / L^3$, where W is the body weight (g) and L is the fork length (mm) (Tesch, 1968). To test for possible significant differences between sexes ($p < 0.05$) we used Student's t-test for comparison of same age group. Statistically significant differences were considered at $p < 0.05$.

Results

Physico-chemical properties

Monthly physico-chemical parameters of water during the study period of April 2012 through May 2013 are given in Table 1.

Low levels of oxygen were measured between May and November months when high temperatures and low water levels were observed.

Age, length and weight distribution

A total of 307 *C. luteus* (138 females and 169 males) and 394 *C. trutta* (269 females and 125 males) specimens were achieved. The caught specimens of *C. luteus* were composed of eight age groups (from II to IX years) for females and five age-groups (II to VI years) for males but the specimens of *C. trutta* were formed of six age-groups (I to VI years) for females and five age-groups for males (Table 2). Of these, IV and V year olds in *C. luteus* and III and IV year olds in *C. trutta* were dominant age groups for both sexes (Fig. 2).

The length of the under researched *C. luteus* individuals varied between 104 and 271mm for females and between 103 and 200 mm for males. For both sexes, the highest range was determined in the 130-159 mm length groups. For *C. trutta*, length of the female samples varied between 130 and 267 mm and the length of the male samples ranged from 135 to 235 mm. In both sexes, the individuals that were between 160-189 mm were dominant (Fig. 2).

The body weight of *C. luteus* individuals ranged between 22 and 354 g for females and between 280 and 182 g for males. The weight of females of *C. trutta* samples varied between 28 and 180 g and between 28 and 212 g for males. For both males and females of both species, 50-99 g weight group was found to be the most (Fig. 2).

Table 1: Monthly physico-chemical properties of water taken from the Tigris River near Bismil Town during the study period.

	Apr. 2012	May	June	July	Aug.	Sept.	October	Nov.	Dec.	Jan. 2013	Feb.	Mart	April	May
Temperature (°C)	13.0	21.0	31.0	27.0	25.8	24.0	18.0	10.0	8.3	9.3	11.0	11.8	13.0	24.0
O ₂ (mg/L)	7.8	4.0	5.7	4.4	2.25	5.6	4.7	5.9	9.4	8.01	7.6	8.79	6.9	4.2
pH	8.1	7.6	7.8	7.7	7.6	7.7	7.1	7.4	8.1	8.0	7.8	8.1	8.0	7.7
Conductivity (µS/cm)	318	382	385	375	383	389	395	448	371	423	432	367	337	364

Table 2. Age distribution of *Carasobarbus luteus* and *Capoeta trutta* according to sexes in the Tigris River during 2012-2013.

	<i>Carasobarbus luteus</i> (N)				<i>Capoeta trutta</i> (N)			
	Female (N)	Female (%)	Male (N)	Male (%)	Female (N)	Female (%)	Male (N)	Male (%)
I	-		-		1	0.3	-	-
II	4	1.3	4	1.3	25	6.3	7	1.8
III	17	5.5	27	8.8	91	23.1	50	12.7
IV	43	14.0	88	28.7	104	26.4	46	11.7
V	48	15.6	43	14.0	39	9.9	21	5.3
VI	17	5.5	7	2.3	9	2.3	1	0.3
VII	2	0.7	-					
VIII	6	2.0	-					
IX	1	0.3	-					
Total	138	44.1	169	55.1	269	68.3	125	31.7

Growth in length

Growth in length (RGL) and the statistical significance of the length differences between the males and females that are in the same age groups are shown in Table 3.

The length between age groups for *C. luteus* is found statistically significant. (ANOVA, $F=121.282$, $p<0.001$ for females and $F=75.308$, $p<0.001$ for males). Furthermore length of the female individuals that are in IV, V, VI, age group was longer than male individuals that are in the same age group. (t-Student $p<0.05$) The highest RGL rate was found between II and III age groups for both sexes.

The length between age groups for *C. trutta* is found statistically significant. (ANOVA, $F=47.28$, $p<0.001$ for females and $F=10.2$, $p<0.001$ for males. However, in terms of the length of male and female individuals in the same age group, statistically there was no difference. ($p>0.05$) For both male and females, RGL rate was between IV and V ages.

Growth in weight

Growth in weight (RGW) and the statistical significance of the length differences between the males and females that are in the same age groups are shown in Table 4.

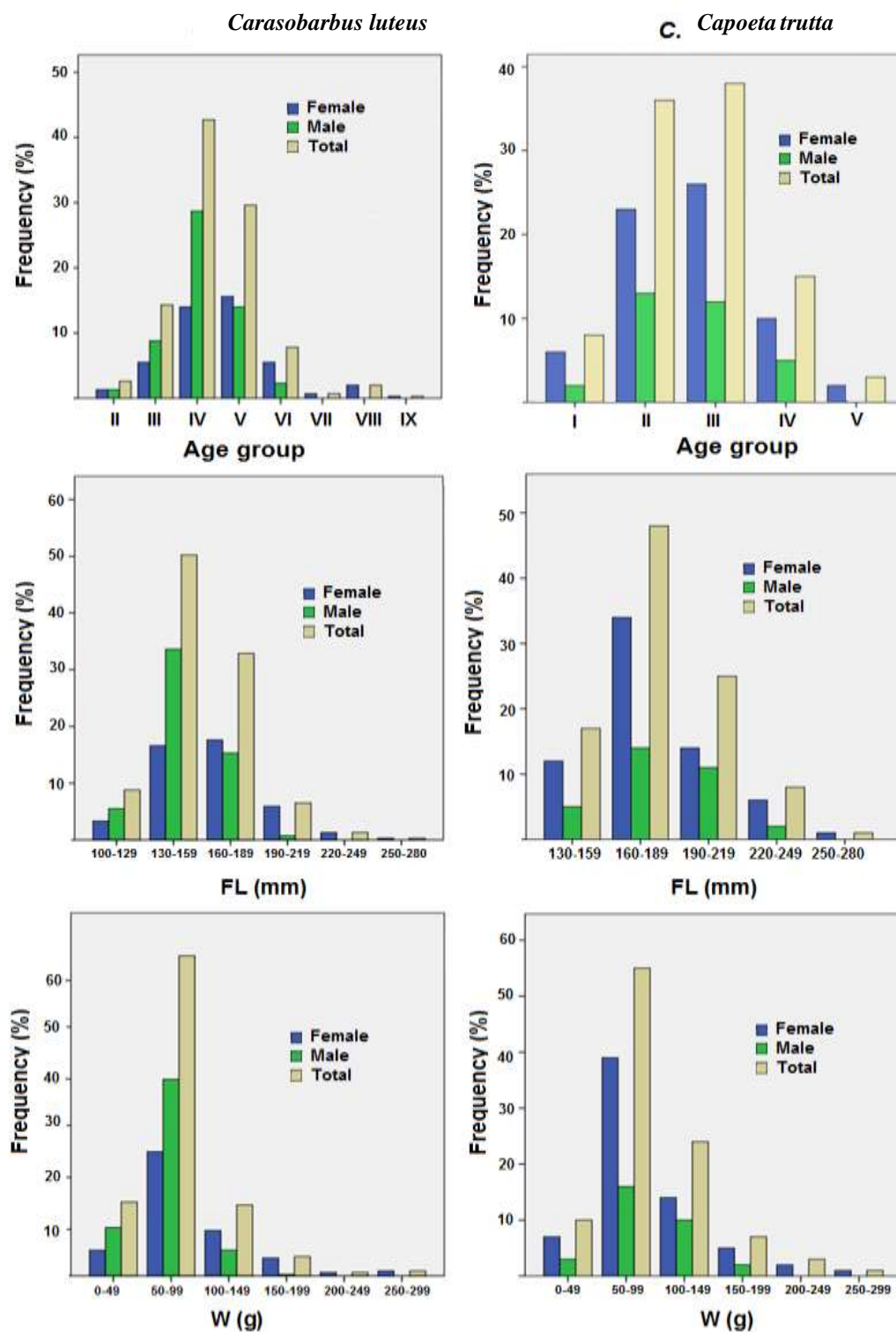


Figure 2: Age, length and weight distribution of *Carasobarbus luteus* and *Capoeta trutta* specimens caught in the Tigris River during 2012-2013.

Table 3: Length and RGL values of of *Carasobarbus luteus* and *Capoeta trutta* according to sexes and age in the Tigris River during 2012-2013.

<i>Carasobarbus luteus</i>								
Age	Female			Male			Statistical differences between sexes	
	N	Average±SD (Min-Max)	RGL	N	Average ±SD (Min-Max)	RGL	Student's <i>t</i> -test	<i>p</i>
II	4	108.75±4.272 (104-114)	-	4	110.00±5.715 (103-116)	-	-0.35036	0.3690
III	17	136.35±9.604 (121-148)	25.3793	27	134.48±11.161 (118-153)	22.2545	0.570508	0.2856
IV	43	150.56±11.335 (110-169)	10.4217	88	146.89±10.630 (123-176)	9.2281	1.890847	0.03045*
V	48	171.08±9.432 (148-202)	13.6291	43	165.14±9.387 (141-186)	12.4242	3.007822	0.0017*
VI	17	196.00±9.533 (180-211)	14.573	7	184.57±9.449 (177-200)	11.7657	2.675936	0.0069*
VII	2	215.00±.000 (215-215)	9.6938	-	-	-	-	-
VIII	6	227.67±18.694 (197-243)	5.893	-	-	-	-	-
IX	1	271.00 (271-271)	19.0319	-	-	-	-	-

<i>Capoeta trutta</i>								
Age	Female			Male			Statistical differences between sexes	
	N	Average ±SD (Min-Max)	RGL	N	Average ±SD (Min-Max)	RGL	Student's <i>t</i> -test	<i>p</i>
I	1	142.00- (142-142)	-	0	-	-	-	-
II	25	152.52±19.58 (127-192)	7.4085	7	159.71±20.34 (135-186)	-	-0.85237	0.200381
III	91	169.84±19.13 (130-232)	11.3526	50	174.18±20.66 (138-222)	9.0572	-1.25415	0.105947
IV	104	187.07±19.97 (143-270)	10.1463	46	185.07±19.84 (154-227)	6.2494	0.567371	0.285661
V	39	210.77±27.34 (155-267)	12.6703	21	202.24±15.25 (165-235)	9.2794	1.320453	0.095935
VI	9	218.22±24.32 (177-245)	3.5361	1	180.00 (180-180)	-10.997	1.491009	0.087148

* Statistically different.

Body weights between age groups of *C. luteus* were statistically significant. (ANOVA, $F=110.718$, $p<0.001$ for females and $F=68.73$, $p<0.001$ for males) The weight of female individuals of IV and V year old age group was more than that of males of the same age group. (t-Student $p<0.05$) The highest RGW rate was between III-IV age groups in both sexes.

The weight differences between the age groups of *C. trutta* were found to be statistically significant. (ANOVA, $F=30.93$, $p<0.001$ for females and

$F=11.36$, $p<0.001$ for males. However, the difference in weight of the male and female individuals was not statistically significant ($p>0.05$). RGW takes place between IV and V ages in female individuals and between III-IV ages in male individuals.

Table 4: Weight and RGW values of of *Carasobarbus luteus* and *Capoeta trutta* according to sexes and age in the Tigris River during 2012-2013.

<i>Carasobarbus luteus</i>								
Age	Female			Male			Statistical differences between sexes	
	N	Average ±SD (Min-Max)	RGW	N	Average ±SD (Min-Max)	RGW	Student's <i>t</i> -test	<i>p</i>
II	4	24.50±3.786 (22-30)		4	23.50±2.517 (20-26)		0,4399	0,3376
III	17	49.76±10.883 (34-70)	103.102	27	48.44±12.665 (30-72)	106.1277	0,3548	0,3622
IV	43	69.35±14.341 (22-90)	39.36897	88	64.11±14.257 (32-102)	32.34929	2,0479	0,0213*
V	48	97.83±19.408 (56-164)	41.06705	43	89.44±15.058 (54-132)	39.51021	2,2849	0,0123*
VI	17	146.82±27.441 (98-190)	50.07666	7	124.29±29.016 (104-182)	38.95	1,5318	0,0699
VII	2	202.00±8.485 (196-208)	37.58343					
VIII	6	230.00±54.126 (138-284)	13.86138					
IX	1	354.00- (354-354)	53.91304					

<i>Capoeta trutta</i>								
Age	Female			Male			Statistical differences between sexes	
	N	Average ±SD (Min-Max)	RGW	N	Average ±SD (Min-Max)	RGW	Student's <i>t</i> -test	<i>p</i>
I	1	44 (44-44)		-	-	-	-	-
II	25	55.6±25.03 (28-106)	26.3636	7	56.57±21.72 (28-92)		-0.09308	0.463229
III	91	74.31±28.62 (30-180)	33.6511	50	78.72±28.46 (38-150)	39.155	-0.87751	0.190862
IV	104	96.06±36.86 (46-230)	29.2693	46	99.7±34.96 (54-212)	26.6514	-0.56605	0.286109
V	39	142±48.28 (42-280)	47.8243	21	123.43±23.76 (72-166)	23.8014	1.653688	0.051797
VI	9	163.56±68.2 (74-272)	15.1831	1	78 (78-78)	-36.806	1.190164	0.13405

* Statistically different.

Age-length relationship

By using *C. luteus* and *C. trutta* samples that are caught in the study field average fork length values

according to the ages, the estimated Von Bertalanffy longitudinal growing equalities for male, female and male+female individuals is shown below:

	<i>Carasobarbus luteus</i>	<i>Capoeta trutta</i>
Female	$L_t=40.09 [1-e^{-0.087036(t+1.55004)}]$	$L_t=35.36 [1-e^{-0.082817(t+4.82738)}]$
Male	$L_t=38.14 [1-e^{-0.080056(t+2.34838)}]$	$L_t=28.82 [1-e^{-0.12380(t+4.40235)}]$

An L_{∞} value of female was estimated higher than those given for male in both species. For *C. luteus*, L_{∞} and optimal product (L_{opt}) that is obtained from Von

Bertalanffy growing parameters were accounted as 40.09 and 24.9 cm for female individuals and 38.14 and 23.8 cm for male respectively. Furthermore,

from these parameters maximum age (t_{max}) is found as 13.4 years for females and 10.1 for males. For *C. trutta*, L_{∞} and optimal product (L_{opt}) were 35.36 and 17.4 cm for female and 28.82 and 15.1 cm for male, respectively. Furthermore, from these parameters

maximum age (t_{max}) is found as 10.1 years for females and 6.9 years for males.

Length-weight relationship

The length-weight relationships are presented in Fig. 3. The resulting equations for females and males are given below:

	<i>Carasobarbus luteus</i>	<i>Capoeta trutta</i>
Female	Log W = -4.7314 + 3.0113 Log FL ($r^2=0.9274$) $p<0.001$	Log W = -4.6845 + 2.9303 Log FL ($r^2=0.9142$) $p<0.001$
Male	Log W = -4.7631 + 3.0263 Log FL ($r^2=0.9390$) $p<0.001$	Log W = -4.7784 + 2.9746 Log FL ($r^2=0.8897$) $p<0.001$

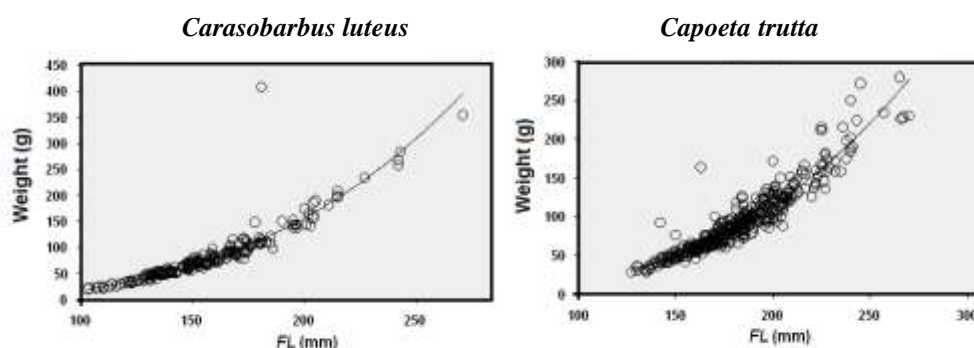


Figure 3: For *Carasobarbus luteus* and *Capoeta trutta* individuals living in Tigris River, fork length change depending on weight.

The length and weight relationship for males and females was found to be not different from each other (ANCOVA, $p>0.05$). The results indicated that the b value of the females and males was not statistically different from 3 in both species, indicating an isometry in the males (t-test, $p>0.05$).

Somatic condition

The somatic condition is calculated according to age groups for *C. luteus*

and *C. trutta* caught in the Tigris River are given in Table 5.

In *C. luteus* the mean somatic condition of females (1.9667 ± 0.1751) was similar to that of males (1.9967 ± 0.4205) and the differences between sexes in same age groups were not statistically significant (Student's t-test, $p>0.05$) except in the ages groups II and VI (Table 4). This has been found to be similar in *C. trutta*.

Table 5: The somatic condition in different age groups of the *Carasobarbus luteus* and *Capoeta trutta* in Tigris River during 2012-2013.

Age	<i>Carasobarbus luteus</i>					<i>Capoeta trutta</i>				
	Female		Male		Student's <i>t</i> -test	Female		Male		Student's <i>t</i> -test
	N	Average±SD (Min-Max)	N	Average±SD (Min-Max)		N	Average±SD (Min-Max)	N	Average±SD (Min-Max)	
I	-	-	-	-	-	1	1.537 (1.537-1.537)	-	-	-
II	4	1.8949±0.11378 (1.80-2.02)	4	1.7661±0.12126 (1.66-1.91)	-9.8411 <i>p</i> =3.17E-05*	25	1.459±0.042 (1.219-2.270)	7	1.334±0.141 (1.137-1.474)	1.457 <i>p</i> =0.078
III	17	1.9354±0.11515 (1.73-2.16)	27	1.9532±0.17674 (1.66-2.37)	0.508789 <i>p</i> =0.306781	91	1.461±0.174 (1.101-2.252)	50	1.439±0.195 (1.140-2.035)	0.687 <i>p</i> =0.247
IV	43	2.0022±0.17594 (1.61-2.38)	88	1.9958±0.18568 (1.53-2.41)	-0.3547 <i>p</i> =0.3616	104	1.417±0.143 (1.095-1.896)	46	1.524±0.194 (1.163-2.150)	-3.799 <i>p</i> =0.0001*
V	48	1.9375±0.22136 (1.52-2.62)	43	1.9725±0.14980 (1.51-2.29)	-1.03588 <i>p</i> =0.151532	39	1.452±0.028 (1.128-1.963)	21	1.488±0.185 (1.021-1.832)	-0.757 <i>p</i> =0.226
VI	17	1.9568±0.16738 (1.70-2.21)	7	1.9492±0.16866 (1.77-2.28)	2.6144 <i>p</i> =0.0079*	9	1.485±0.228 (1.150-1.850)	1	1.337±1.000 (1.337-1.337)	0.612 <i>p</i> =0.279
VII	2	2.0325±0.08538 (1.97-2.09)	-	-	-	-	-	-	-	-
VIII	6	1.9147±0.08835 (1.81-2.00)	-	-	-	-	-	-	-	-
IX	1	1.7787 (1.78-1.78)	-	-	-	-	-	-	-	-

* Difference of the condition factor of male and female individuals that are in the same group is statistically significant.

The mean somatic condition of females and males were estimated as 1.4434 ± 0.1682 and 1.4722 ± 0.1948 respectively and also the differences between sexes in the same age groups were not statistically significant (Student's *t*-test, $p > 0.05$) except in the age group IV (Table 4).

Monthly fluctuations in the somatic condition for males and females of *C. luteus* and *C. trutta* sampled during 14 months in Tigris River are shown in Fig. 4.

In *C. luteus*, the mean values in monthly variations in the somatic condition were high in April, May and October, and lower in June in both sexes. A similar pattern was also seen in *C. trutta* (Fig. 4).

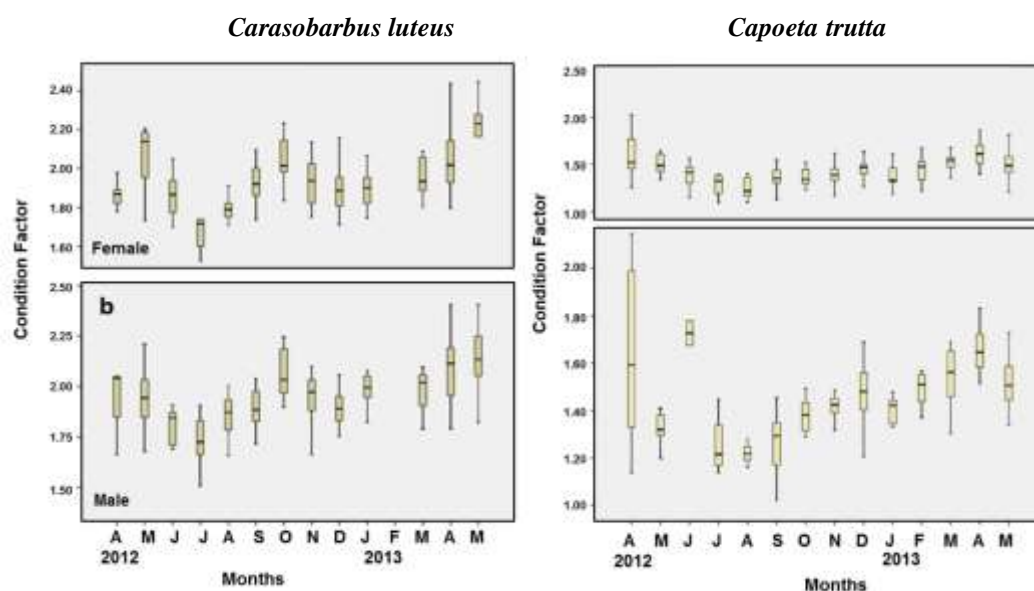


Figure 4: Monthly fluctuations in the somatic condition for males and females of *Carasobarbus luteus* and *Capoeta trutta* sampled in Tigris River during 2012-2013.

Discussion

The obtained 307 (138 females and 169 males) *C. luteus* from Tigris River have ages between 2 and 9 years. The age range of this species was reported to be 1 to 9 years by Gökçek and Akyurt (2008) for Orontes River, 2 to 7 years by Al-Hazzaa (2005) 0 to 6 for Euphrates River and Baboli and Sayahi (2014) for Karkheh River. During this study 394 *C. trutta* (269 females and 125 males) were caught and they were found to be 1+ to 6+ years. According to previous studies, the age range of *C. trutta* was recorded to be 1 to 10 years by Ünlü (1991) for Tigris River, 1 to 9 years by Bozkurt (1998) for Atatürk Dam Lake, 1 to 7 years by Kalkan (2008) for Karakaya Dam Lake, 1 to 8 years by Duman (2004) for Keban Dam Lake, 1 to 9 years by Canpolat and Çalta (2014) for Keban Dam Lake and

1 to 6 years by Patimar and Farzi (2011) for Meymeh River and by Niya *et al.* (2015) for Shour River, Iran. These two species appears to reach about 9 years of age. Age differences between previous studies may be explained by the selectivity of the sampling nets used and high fishing pressure.

The maximum fork length of 271 mm for females at age of 9 and 200 mm for males at age of 7 recorded for *C. luteus* caught in the Tigris River was less than that in other populations. The maximum length for this species was previously given as 444 mm at age 9 from Atatürk dam Lake (Bozkurt, 1998) and 197 mm at age 5 from Orontes River (Yalçın *et al.*, 2004). In this study the maximum fork length of *C. trutta* was found as 245 mm for females at the age of 7 and 180 mm for males at the

same age. Earlier studies indicated that *C. trutta* reaches 270 mm in the Tigris River (Ünlü, 1991) 358 mm in the Karakaya Dam Lake (Kalkan, 2008) and 360 mm in the Meymeh River (Patimar and Farzi, 2011). This may be explained by the selectivity of the sampling nets used, fishing pressure and moreover, ecological differences between lakes and streams.

The L_{∞} values obtained from von Bertalanffy growth equations of *C. luteus* for females and males were 40.09 cm and 38.14 cm, respectively. These values have been stated as 38.77 for females and 40.32 for males in the Asi River (Gökçek ve Akyurtk, 2008) and 28.34 for females and 31.78 for males in Karkheh River (Baboli and Sayahi, 2014). The L_{∞} values for female and male of *C. trutta* were estimated as 35.36 cm and 28.82 cm respectively. According to previous studies, the L_{∞} values of *C. trutta* were stated to be 48.6 cm for females and 46.6 cm for males in the Tigris River (Ünlü, 1991) 89.5 cm for females and 76.4 cm for males in the Karakaya Dam Lake (Kalkan, (2008) and 50.79 cm for females and 45.86 cm for males in the Meymeh River (Patimar and Farzi, 2011). These differences may be due to various factors which can affect fish growth, and can include season, habitat, gonadal maturity, sex, stomach fullness, health and/or preservation techniques (Nikolsky, 1963, Tesch, 1968, Oymak *et al.*, 2008). These differences may also be due to over-exploitation of natural stocks by over-fishing and

deteriorated environmental conditions (Baboli and Sayahi, 2014; Kamangar *et al.*, 2015).

In the present study, the exponent “b” in the length-weight relationship estimated as 3.0113 for males and 3.0263 for females indicated *C. luteus* has an isometric growth. The (b) value from some other studies in *C. luteus* was 3.1202 in Garma marches (Barak and Mohamed, 1983) 2.453 in Diyala River (Biro *et al.*, 1988) and 3.0802 (Başusta ve Çiçek, 2006) and 3.058 and 3.0371 for females and males, respectively (Bozkurt, 1998) in Atatürk Dam Lake, 3.0802 (Yalçın *et al.*, 2004) and 2.986 for females and 3.003 for males (Gökçek and Akyurt, 2008) in Orontes River, 3.18 in Hoor Al-azim wetland of Iran (Eydizadeh *et al.*, 2013), 2.9293 for males and 2.857 for females in Karkheh River (Baboli and Sayahi, 2014). The “b” values for males and females of *C. trutta* were estimated to be 2.9303 for females and 2.9746 for males. Ünlü (1991) reported “b” value to be 2.8603 for females and 2.7584 for males caught from Tigris River. Higher “b” values were observed for *C. trutta* specimens taken from Atatürk Dam lake (Bozkurt, 1998), Karakaya Dam Lake (Kalkan, 2008) and Shour River (Niya *et al.* 2015). Differences in b values can be due to one or more reasons stated by various authors (Ricker, 1968, Baboli and Sayahi 2014) : (i) differences in the number of specimens observed; (ii) range/season effect; (iii) habitat; (iv) degree of stomach fullness; (v) gonad maturity;

(vi) sex; (vii) health and overall fish situation; (viii) preservation methods; and (ix) differences in the observed length ranges of the specimens caught.

The mean somatic condition value of *C. luteus* in the Tigris River was 1.9667 in females and 1.9967 in males which were higher than the values reported by Eydizadeh *et al.* (2014) from Hoor Al-azim wetland with values of 1.44 for females and 1.38 for males, and by Mohamed (2014) with a value of 1.002 in Al-Huwazah Marsh, South Iraq.

In the present study, somatic condition ranged from 1.095 to 2.270 for *C. trutta*. The differences in condition between females and males were statistically significant only at the age of 4; however, they were not significant in the other age groups. The condition factors of *C. trutta* in the present study were similar to results given by Ünlü (1991) and Canpolat and Çalta (2013) higher than those of values reported by Bozkurt (1998) Kalkan (2008). No evidence was found showing a decrease in somatic condition with an advance in age. The measurement of fish condition can be linked to the general health, fat and lipid content prey or food availability, reproductive potential, environmental condition and water level fluctuation. In general, higher condition is associated with higher energy (fat) content, increasing food base, reproduction potential or more favorable environmental condition (Paukert and Rogers, 2004; Awoke *et al.*, 2015).

The condition factor gives a general idea of the body condition, in terms of weight, of the fish along the year. The high amount of the somatic condition of both *C. luteus* and *C. trutta* were observed in spring months and October and decreased after spawning time in June which shows the effect of empty gonad weight and metabolic changes. A similar situation was also noted in many studies (Doddamani *et al.*, 2001; Lizama *et al.*, 2002). The results of the present study are similar to the results given for *C. luteus* population in Atatürk Dam Lake (Bozkurt, 1998) and in Hoor Al-azim wetland (Eydizadeh *et al.*, 2013; Eydizadeh *et al.*, 2014). Baboli and Sayahi (2014) reported highest K value in October and lowest in June samples obtained from the Karkheh River (Iran). These results were compatible to results for *C. trutta* in different populations (Kalkan, 2008).

References

- Ahmed, H.A., Al-Mukhtar, M.A. and Al-Adhub, H.Y., 1984.** The reproductive biology of *Carasobarbus luteus* (Pisces, Cyprinidae) in Al-Hammar Marsh, Iraq. *Cybium*, 18(4), 69-80.
- Al Hazzaa, R. and Hussein, A., 2003.** Initial observations in Himri (*Barbus luteus*, Heckel) propagation. *Turkish Journal of Fisheries and Aquatic Sciences*, 3(1), 41-45.
- Al Hazzaa, R., 2005.** Some biological aspects of the himri barbel, *Barbus luteus*, in the intermediate reaches of

- the Euphrates River. *Turkish Journal of Zoology*, 29(4), 311-315.
- Ali, A.B. and Kadir, B.K.A. 1996.** The reproductive biology of the cyprinid, *Thynnichthys thynnoides* (Bleeker): in the Chenderoh Reservoir - a small tropical reservoir in Malaysia. *Hydrobiologia*, 318(3), 139-151.
- Aral, F., Doğu Z. and Şahinöz, E., 2014.** Comparison of spermatological characteristics in *Carasobarbus luteus* (H., 1843) and *Carassius carassius* (L., 1758) living in Atatürk Dam Lake. *Turkish Journal of Agriculture-Food Science and Technology*, 2(4), 185-189.
- Arslan, M., Yıldırım, A., Bektas, S. and Atasever, A., 2007.** Growth and mortality of the brown trout (*Salmo trutta* L.) population from upper Aksu stream, Northeastern Anatolia, Turkey. *Turkish Journal of Zoology*, 31(4), 337-346
- Awoke, T., Mingist, M. and Getahun, A., 2015.** Some aspects of the biology of dominant fishes in blue Nile River, Ethiopia. *International Journal of Fisheries and Aquatic Studies* 3(1), 62-67.
- Aydın, R., Yüksel, F., Ural, M., Güleç, A.K. and Ural, M.Ş., 2012.** Keban ve Karakaya baraj göllerinde yaşayan *Capoeta trutta* (Heckel, 1843)'nın büyüme parametrelerinin karşılaştırılması. *Journal of Fisheries Sciences.com*, 6(4), 306-320.
- Baboli, M.J. and Sayahi, A., 2014.** Age and growth of *Carasobarbus luteus* (Heckel, 1843) in Karkheh River, Southwestern Iran. *Environmental and Experimental Biology*, 12(3), 107-111.
- Barak, N.A.A. and Mohamed, A.R.M., 1983.** Biological study of the cyprinid fish, *Barbus luteus* (Heckel) in Garma Marshes. *Journal of Biological Sciences Research*, 14(2), 53-70.
- Bartel, R., Bieniarz, K., Epler, P., Kime, D.E., Poppek W. and Sokolowska-Mikolajczyk, M., 1996.** Gonadal development and spawning of *Barbus sharpei*, *Barbus luteus* and *Mugil hishni* in fresh and saltwater lakes in Iraq. *Archives of Polish Fisheries*, 4(1), 113-124.
- Başusta, N. and Cicek, E., 2006.** Length-weight relationships for some teleost fishes caught in Ataturk Dam Lake on southeastern Anatolia, Turkey. *Journal of Applied Ichthyology* 22(4), 279-280. DOI: 10.1111/j.1439-0426.2006.00778.x
- Biria, M., Javadzadeh-Poorshalkoohi, N. and Hosseini, S.A., 2014.** Length-weight relationships *Carsobarbus luteus* (Heckel 1843) from Karoon River, Iran. *Journal of Biodiversity and Environmental Sciences*, 5(1), 140-144.
- Biro, P., Al-Jafery, A.R. and Sadek, S.E., 1988.** On stunted growth of *Barbus luteus* (Heckel) in river Diyala, Iraq. *Journal of Biological Sciences Research, Baghdad*, 19(1),129-147.
- Bozkurt, R., 1998.** The investigations on biological characteristics of

- Acanthobrama marmid* Heckel 1843, *Capoeta trutta* (Heckel, 1843) and *Carasobarbus luteus* (Heckel, 1843) in Atatürk Dam Lake. PhD thesis, Harran University, *Graduate School of Natural and Applied Science*. Şanlıurfa, Turkey. 13P.
- Canpolat, Ö. and Çalta, , 2013.** Reproduction properties of *Capoeta trutta* (Heckel, 1843) from Pertek Region of Keban Dam Lake. *Turkish Journal of Science and Technology*, 8(1), 63-68.
- Canpolat, Ö. and Çalta, M., 2014.** The comparison of reproduction biology of *Capoeta trutta* (Heckel, 1843) populations from Ağın and Örencik Region of Keban Dam Lake. *Turkish Journal of Agriculture-Food Science and Technology*, 2(1), 6-12.
- Coad, B.W., 2010.** Freshwater fishes of Iraq. Pensoft publishers, Sofia and Moscow, 294P.
- Duman, E., 2004.** Reproductive biology of *Capoeta trutta* Heckel, 1843 (Pisces: Cyprinidae) living in Keban Dam Lake. *Firat University Journal of Science*, 16(1), 145-150.
- Doddamani, M., Rameshaand, T.J. and Shanbhogue, S.L., 2001.** Length-weight relationship and condition factor of *Stolephorus bataviensis* from Mangalore area. *Indian Journal of Fisheries*, 48(3), 329-332.
- Düşükcan, M., Çalta, M., 2012.** The Comparison of reproduction periods of *Capoeta trutta* (Heckel, 1843) populations from Keban, Karakaya and Atatürk Dam Lakes. *Firat University Journal of Science*, 24 (2), 57-61.
- Esmaeili, H.R., Gholamifard, A., Vatandoust, S., Sayyadzadeh, G., Zare R. and Babaei, S., 2014.** Length-weight relationships for 37 freshwater fish species of Iran. *Journal of Applied Ichthyology*, 30 (5), 1073-1076. DOI:10.1111/jai.12433.
- Esmaeili H.R., Babai S., Gholamifard A., Pazira A., Gholamhosseini A. and Coad B.W., 2015.** Fishes of the Persis region of Iran: an updated checklist and ichthyogeography. *Iranian Journal of Ichthyology*, 2(3), 201-223.
- Eydizadeh, A., Eskandary, G., Mohammadi, G. and Hashemi, S.A.R., 2013.** Population dynamics and assessment of *Carasobarbus luteus* (Heckel, 1843) Inhooral-Azim Wetland (Khuzestan Province, Iran). *World Journal of Fish and Marine Sciences*, 5(4), 430-436. DOI: 10.5829/idosi.wjfm.2013.05.04.7436
- Eydizadeh, A., 2014.** Some biological aspect of *Carasobarbus luteus* (Heckel, 1843) in Hoor Al-azim Wetland. *Scientific Journal of Biological Sciences* 3(3), 29-36. DOI: 10.14196/sjbs.v3i3.1133.
- Eydizadeh, A., Eskandary, G. and Hashemi, S.A.R., 2014.** Length-weight relationship and fultons condition factor of *Carasobarbus luteus* (Heckel, 1843) in Hoor Al-azim Wetland. *Journal of Ecology*

- and The Natural Environment*, 6(7), 238-243. DOI: 10.5897/JENE2014.0449.
- Gökçek, K. and Akyurt, I., 2008.** Age and growth characteristics of himri barbel (*Barbus luteus* Heckel, 1843) in Orontes River, Turkey. *Turkish Journal of Zoology*, 32(4), 461-467.
- Heckel, J.J., 1843.** Abbildungen und beschreibungen der fische syriens nebst einer neuen classification und charakteristik sämtlicher gattungen der cyprinen. Stuttgart. 109P.
- Kalkan, E., 2008.** Growth and reproduction properties of *Capoeta trutta* (Heckel, 1843) in Karakaya Dam Lake. *Turkish Journal of Zoology*, 32(1), 1-10.
- Kamangar, B., Ghaderi, E. and Hoseinpour, H., 2015.** Growth and reproductive biology of *Capoeta damascina* (Valenciennes, 1842) from a tributary of Tigris. *Iranian Journal of Fisheries Sciences*, 14(4), 956-969.
- Kuru, M., 1979.** The freshwater fish of South-Eastern Turkey-2 (Euphrates-Tigris system). *Hacettepe Bulletin of Natural Sciences and Engineering*, 7-8, 105-114.
- Kuru, M., 1980.** Key to the inland water fishes of Turkey, Part III, *Hacettepe Bulletin of Natural Sciences and Engineering*, 9, 123-133.
- Le Cren E.D., 1951.** The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *The Journal of Animal Ecology*, 20, 201-219.
- Lizama, M.D.L.A.P. and Ambrósio, A.M., 2002.** Condition factor in nine species of fish of the Characidae family in the upper Paraná River floodplain, Brazil. *Brazilian Journal of Biology*, 62 (1), 113-124. DOI: 10.1590/S1519-69842002000100014.
- Mohamed, A.R.M., 2014.** The status of himri fish, *Barbus luteus* (Heckel) population in the Al-Huwazah Marsh, South Iraq. *Journal of Zankoy Sulaimani- Part A*, 16, 303-314.
- Muchlisin, Z.A., 2014.** A general overview on some aspects of fish reproduction. *Aceh International Journal of Science and Technology*, 3(1), 43-52. DOI: 10.13170/AIJST.0301.05.
- Naama, A.K. and Muhsen, K.A., 1986.** Feeding periodicities of the mugilid *Liza abu* (Heckel) and cyprinid *Carasobarbus luteus* (Heckel) from Al-Hammar Marsh, southern Iraq. *Indian Journal Fisheries*, 33(3), 347-350.
- Nikolsky, G.V., 1963.** The ecology of fishes, London Academic Press, 322P.
- Niya, M.T., Baboli, M.J., Roomiani, L., Pazira, A. and Lakzaie, F., 2015.** Study on the growth parameters of *Capoeta trutta* (Heckel, 1843) in Shour River, Iran. *Iranian Journal of Fisheries Sciences*, 14(1), 262-274.
- Oymak, S.A., Musa, D. and Ünlü, E., 2008.** Reproductive biology and histological changes in the gonads of

- barb, *Capoeta trutta* (Heckel, 1843) in Atatürk dam Lake, Turkey. *Istanbul University Journal of Fisheries and Aquatic Sciences*, 23(2), 1-11.
- Özcan, G., 2008.** Length-weight relationships of five freshwater fish species from the Hatay Province, Turkey. *Journal of Fisheries Sciences. Com.*, 2(1), 51-53.
- Patimar, R. and Farzi, S., 2011.** Life history and other biological traits of the trout barb *Capoeta trutta* in the River Meymeh (western Iran). *Folia Zoologica*, 60(2), 153-158.
- Paukert, C. and Rogers, R.S., 2004.** Factors affecting condition of flannelmouth suckers in the Colorado River, Grand Canyon, Arizona. *North American Journal of Fisheries Management*, 24 (2), 648-653. DOI: 10.1577/M03-087.1.
- Pazooki, J. and Masoumian, M., 2012.** Synopsis of the parasites in Iranian freshwater fishes. *Iranian Journal of Fisheries Sciences*, 11(3), 570-589.
- Polat, N., 1987.** Age determination of *Capoeta trutta* (Heckel, 1843) in Keban Dam Lake. *Turkish Journal of Zoology*, 11(3), 155-160.
- Poria, M., Abdoli, A., Kazemian, M., Nouri, F., Ghanbari, K. and Ejraei, F., 2014.** Study of reproductive characteristics of *Capoeta trutta* in Gamasyab River, Kermanshah Province, Iran. *International Journal of Biosciences*, 4(2), 39-46.
- Priyadharsini, S., Manoharan, J., Varadharajan, D. and Subramaniyan, A., 2013.** Reproductive biology and histological study of red lionfish pterois volitans from Cuddalore, south east coast of India. *Journal of Aquaculture Research and Development*, 4(6), 2-9. DOI: 10.4172/2155-9546.1000201
- Rahemo, Z.I. and Al-Shatter, N.M., 2012.** Observations on reproductive organs and tissues of two freshwater Cyprinid fishes. *Trends in Fisheries Research* 1 (2), 42-48.
- Ramin, M., Doustdar, M., Owfi, F. and Lakzaie, F., 2014.** Ichthyofauna of Gahar Lake and Gahar River, Lorestan Province, Iran. *Iranian Journal of Fisheries Sciences*, 13(4), 886-894.
- Ricker, W.E., 1968.** Methods for assessment of fish production in fresh waters. International Biological Programme No. 3, Black-Well Scientific Publications, London. 313P.
- Schlosser, I.J., 1990.** Environmental variation, life history attributes, and community structure in stream fishes: implications for environmental management and assessment. *Environmental Management*, 14 (5), 621-628.
- Tesch, F.W., 1968.** Age and growth in methods for assessment of fishes production. In: W.E. Ricer (Ed.): in methods for assessment of fish production in freshwater, IBP

Handbook, Blackwell Science
Publication, London: pp. 93-123.

Ünlü, E., 1991. A study on the biological characteristics of *Capoeta trutta* (Heckel, 1843) living in the Tigris River, Turkey. *Turkish Journal of Zoology*, 15, 22-38.

Von Bertalanffy, L., 1938. A quantitative theory of organic growth (inquiries on growth laws. II). *Human Biology*, 10 (2), 181-213.

Yalçın-Özdilek Ş., Turan, C., Solak, K. and Akyurt, I., 2004. The growth of *Barbus luteus* (Heckel, 1843) in the River Asi. *Turkish Journal of Aquatic Life*, 2 (3), 168-174.