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Growth and Reproduction Properties of *Capoeta trutta* (Heckel, 1843) in Karakaya Dam Lake

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Abstract: In this study, 510 samples of *Capoeta trutta* living in Karakaya Dam Lake were studied. After determining sex distribution, size (length and weight), growth rates, and growth conditions factors of 210 *C. trutta* specimens were examined. The number of female and male specimens was 104 and 106, respectively. The age of females and males ranged between 1-7 and 0-7 years, respectively. The age-length, age-weight, and length-weight curves were constructed. According to the von Bertalanffy equation, females and males were:

$$L_t = 89.5[1 - e^{-0.0571(t+2.4138)}], W_t = 9627.1[1 - e^{-0.0571(t+2.4238)}]^{3.0325}$$

$$L_t = 76.4[1 - e^{-0.0604(t+2.6514)}], W_t = 5207.2[1 - e^{-0.0604(t+2.6514)}]^{2.9322}, \text{ respectively.}$$

The calculated length-weight relation (W) was $0.0116 L^{3.0325}$ for females and $0.0115 L^{2.9322}$ for males. The average growth condition factor was 1.30 ± 0.06 for females and 1.28 ± 0.05 for males. The reproductive characteristics of *C. trutta* female specimens were investigated. According to gonadosomatic index (I_G) results the development of egg diameter was determined for a spawning period in May and June. It was found that maturity age of the specimens was 2 and 3. The maximum diameter of ripe eggs was 1.04 mm and the maximum number of eggs per gram of gonads was 666.

Key Words: *Capoeta trutta*, Karakaya Dam Lake, growth, reproduction properties

Karakaya Baraj Gölü'nde Yaşayan *Capoeta trutta* (Heckel, 1843)'nın Büyüme ve Üreme Özellikleri

Özet: Bu çalışmada Karakaya Baraj Gölü'nde yaşayan toplam 510 *Capoeta trutta* örneği incelenmiştir. Bunlardan 210 tanesinde (104 dişi, 106 erkek) eşey dağılımı, boy ve ağırlık gelişimi, gelişme oranları ve kondüsyon faktörü incelenmiştir. Dişi ve erkeklerin yaş dizilimleri ise sırasıyla 1-7 ve 0-7 yaş grupları arasındadır. Yaş-boy, yaş-ağırlık ve boy-ağırlık grafikleri oluşturuldu. Von Bertalanffy büyüme denkleminde uygulanan yaş-boy, yaş-ağırlık ilişkileri dişilerde ve erkeklerde sırasıyla:

$$L_t = 89.5[1 - e^{-0.0571(t+2.4138)}], W_t = 9627.1[1 - e^{-0.0571(t+2.4238)}]^{3.0325}$$

$$L_t = 76.4[1 - e^{-0.0604(t+2.6514)}], W_t = 5207.2[1 - e^{-0.0604(t+2.6514)}]^{2.9322} \text{ olarak bulunmuştur.}$$

Dişiler için uzunluk ve ağırlık arasındaki ilişki (W) $0.0116 L^{3.0325}$, erkekler için ise $0.0115 L^{2.9322}$ olarak hesaplanmıştır. Ortalama kondüsyon faktörü dişiler için 1.30 ± 0.06 , erkekler için ise 1.28 ± 0.05 dir. 300 dişi *C. trutta* örneğinin üreme karakteristiği incelenmiş, yumurta çapının gelişimi ve gonadosomatik indekse göre yumurtlama periyodunun Mayıs ve Haziran olduğu belirlenmiştir. Olgunluk yaşı ikinci ve üçüncü yaşlar olarak bulunmuş olup, olgun yumurtaların maksimum çapı 1.04 mm, gonadların her bir gramındaki maksimum yumurta sayısı ise 666'dır.

Anahtar Sözcükler: *Capoeta trutta*, Karakaya Baraj Gölü, büyüme ve üreme özellikleri

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Introduction

Capoeta trutta (Heckel,1843) is one of the most common and widely distributed Cyprinid species in the Euphrates and Tigris River systems. Many investigations have been made to determine various biological properties of *C. trutta* (Özdemir, 1983; Polat, 1987; Ünlü, 1991; Gül et al., 1996). Determination of growth and reproductive features of fish stocks living in seas and fresh waters are important for economical utilisation of this natural resource. Climate and geographic and ecological conditions affect the growth and reproductive features of living organisms differently. Karakaya Dam Lake contains fish that provide a large proportion of the protein need for the people living in the region. However, there is almost no information regarding this fish species living in this reservoir. Differences are known to occur in growth and reproductive features between the populations of same species living in different regions. Therefore, this study was carried out to determine the biological characteristics of sex distribution, growth and growth rates, growth condition factors, fish maturity age, spawning period, egg-number and egg-diameter in ovarium, and fecundity of the *C. trutta* population habitating the Karakaya reservoir.

Materials and Methods

This study was carried out on *C. trutta* from Karakaya reservoir, located in the eastern region of Anatolia (Figure 1). Karakaya Dam Lake was constructed for both electricity and irrigation purposes. It is located in a distance of 17 km from Malatya city centre. In terms of lake surface area, it is the third biggest dam lake, after Keban Dam Lake, constructed on Fırat River. Its maximum depth is 693 m and the surface area and water storage volume of the Dam are 298 ha and $9.58 \times 10^6 \text{ m}^3$, respectively. Water temperature ranges between 11 and 25 °C during an annual period. Maximum depth of the lake from the sea level is 935 m (Anonymous, 1991).

A total of 510 *C. trutta* specimens were caught in Karakaya Dam Lake out of the reproduction period to determine growth features. Also specimens were collected for their reproductive features in the reproduction period. The sampling was performed using gill-nets with various mesh-sizes (12 × 12, 18 × 18, 24 × 24, and 32 × 32 mm). The samples were brought to the laboratory and their fork lengths (L_f) and weights (W) were measured at a sensitivity of 1.0 mm and 0.1 g, respectively. For age determination, scales were taken from between anterior of dorsal fin lateral line (L. lat.)

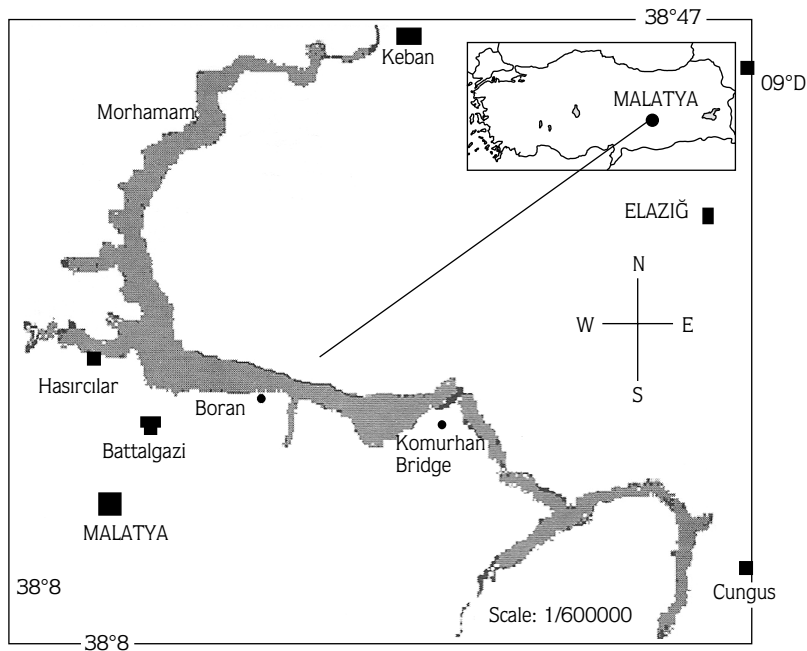


Figure 1. Map of the Karakaya Dam Lake.

region. The scales were kept in 5% KOH for 24 h and then 10 scales from each fish were transferred into 70% ethyl alcohol for 3 min and age determination was carried out under a binocular microscope (Polat, 1987).

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

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

Age-length, age-weight, and length-weight relationships were calculated according to the age groups. Von Bertalanffy formulas, $L_t = L_\infty [1 - e^{-k(t-t_0)}]$ and $W_t = W_\infty [1 - e^{-k(t-t_0)}]^n$, were used to determine the relationships between age-length and age-weight (Bertalanffy, 1938; Le Cren, 1951; Simpson, 1960; Lagler, 1977). The growth parameters k , L_∞ and t_0 were estimated by the Ford-Walford method (Chugunova, 1959; Nikolsky, 1963; Laevastu, 1965; Hanumara, 1981). To calculate length-weight relationships, $W = a.L^n$ equation of Le Cren was used (Le Cren, 1951). Relation diagrams obtained from this equation were used for calculations (Bertalanffy, 1938; Ratkowsky, 1986). The growth condition factors were determined using the formula $K = W/L^n \times 100$ (Chugunova, 1959). Growth characteristics (GC) were estimated using the following formula given by Chugunova (1959):

$$GC = \frac{\text{Log}L_n - \text{Log}L_{n-1}}{0.4343[n - (n-1)]}$$

Three hundred *C. trutta* females were obtained by weekly collections during the prereproductive and reproductive period (March-July). Furthermore, specimens were collected monthly during the rest of the year. Their sex was determined by macroscopic observation of the gonads. The overall sex ratio and stages of sexual maturity age were also determined (Erdem, 1988). The gonads were removed and weighed to the nearest 0.01 g. The spawning period was determined by means of monthly changes in the gonadosomatic index (I_G), ovarium weight, egg diameter, and egg numbers per gram ovarium. I_G was calculated using the following equation:

$$I_G = \frac{\text{Gonad weight (g)}}{\text{Total living weight (g)}}$$

The number of eggs was estimated by the gravimetric method using ovaries preserved in 4% formalin solution (Erdem, 1988) in order to enumerate the total number of eggs in the particular ovary. Twenty ova selected at random from each ovary were measured by means of a micrometer eyepiece. The relationship between the body weight and the gonad weight was calculated by linear regression. Egg diameter was measured under a microscope ocular and a stereomicroscope using an eyepiece graticule.

Statistically significant differences between sexual and age groups were tested with Student t-test (Bertalanffy, 1938; Ratkowsky, 1986; Anonymous, 1986).

Results

Sex Ratio and Age Composition

Age composition of the fish samples, caught in Karakaya Dam Lake, was between 0 and 7. The obtained sex ratio and age composition of the fish samples are given in Table 1. Males were more abundant than females; the observed male:female ratio was 1.02:1. Age groups IV and VI were mostly composed of females, whereas the age group III was mostly male.

Relative Growth in Length

To determine the growth rate of the age groups in Karakaya Dam Lake *C. trutta* species, the increase in length between the age groups and the increase rate and growth characteristics were calculated as shown in Table 2. Table 2 shows that maximum annual increase is between the years 1 and 2.

Growth in Length and Age-Length Relationship

The mean length (cm) with the minimum (Min) and maximum (Max) lengths, standard deviation, standard error, calculated length, and the significance level of differences between females and males in the same age group of *C. trutta* are given in Table 3. Age-length relationship is also given in Figure 2. Age-length relationship of the species was calculated as

$$L_t = 89.5[1 - e^{-0.0571[t+2.4138]}]$$

$L_t = 76.4[1 - e^{-0.0604[t+2.6514]}]$ for females and males, respectively.

Table 1. Sex ratio and age composition of *C. trutta* samples from Karakaya Dam Lake.

Age Groups	Female (♀)		Male (♂)		Female+Male (♀ + ♂)	
	N	%N	N	%N	N	%N
0	-	-	4	1.89	4	1.89
I	9	4.32	6	2.84	15	7.16
II	17	8.17	19	8.96	36	17.13
III	11	5.28	31	14.63	42	19.91
IV	26	12.50	26	12.26	52	24.76
V	13	6.25	7	3.30	20	9.55
VI	26	12.50	10	4.72	36	17.22
VII	2	0.96	3	1.42	5	2.38
Total	104	49.98	106	50.02	210	100

Table 2. The relative growth in length and growth characteristics at different age groups of *C. trutta* from Karakaya Dam Lake.

Age Groups	Mean Length ± SD (cm)	SE	Yearly Increase	RGL (%)	Growth Characteristics
0	13.13 ± 0.15	0.08	1.88	14.70	1.80
I	15.01 ± 1.05	0.35	4.82	31.67	4.14
II	19.83 ± 1.65	0.26	2.79	18.96	3.44
III	22.62 ± 1.34	0.24	4.28	15.77	3.62
IV	26.90 ± 0.93	0.18	2.71	9.76	2.29
V	29.61 ± 0.52	0.22	4.61	8.75	2.77
VI	34.22 ± 1.04	0.37	1.67	8.90	2.78
VII	35.89 ± 1.50	0.57			

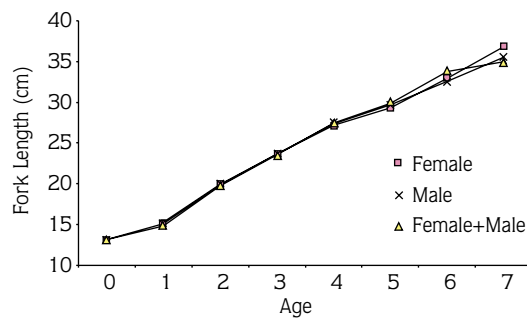


Figure 2. Age-length relationship of *C. trutta* population from Karakaya Dam Lake.

Table 3. The length and absolute growth of *C. trutta* samples from Karakaya Dam Lake (N : number of samples; FL.: fork length; SD: standard deviation; SE: standard error).

Age Groups	Sex	N	FL± SD(Min- Max) (cm)	SE	Absolute Length	Differences
0	♀	-	-	-	-	-
	♂	4	13.13 ± 0.15 (11.0-13.5)	0.08	11.30	-1.83
I	♀	9	15.26 ± 1.05 (14.0-16.7)	0.35	15.85	0.59
	♂	6	14.77 ± 1.44 (13.8-17.51)	0.59	15.11	0.34
II	♀	17	19.91 ± 1.65 (17.4-21.8)	0.26	19.94	0.03
	♂	19	19.74 ± 0.94 (17.8-21.0)	0.22	18.70	-1.04
III	♀	11	23.74 ± 1.34 (22.5-25.6)	0.24	23.79	0.05
	♂	31	22.51 ± 1.91 (21.0-26.1)	0.58	21.08	1.43
IV	♀	26	27.32 ± 1.06 (25.6-29.0)	0.20	27.45	0.13
	♂	26	26.47 ± 0.93 (25.7-29.7)	0.18	25.76	-0.71
V	♀	13	29.34 ± 0.52 (28.8-30.3)	0.20	30.88	1.54
	♂	7	29.89 ± 0.80 (28.7-31.1)	0.22	29.86	-0.03
VI	♀	26	35.96 ± 1.04 (31.3-36.2)	0.37	34.14	-1.82
	♂	10	32.49 ± 1.03 (30.9-34.5)	0.20	31.08	-1.41
VII	♀	2	36.83 ± 1.50 (35.1-37.7)	0.87	37.21	0.38
	♂	3	34.95 ± 0.07 (33.9- 35.1)	0.05	33.73	-1.22

Growth in Weight and Age-Weight Relationship

The mean weight, minimum and maximum values, standard deviation, standard error, absolute growth in weight for females and males of different age groups, and the significance level of differences between females and males of the same age group of *C. trutta* are given in Table 4. Age-weight relationship is also presented in

Figure 3. Mean weight value in Table 5 was calculated according to Bertalanffy's growth equation (Bertalanffy, 1938) as:

$$W_t = 9627.1 [1 - e^{-0.0571[t+2.4138]}]^{-3.0325} \text{ and}$$

$W_t = 5207.2 [1 - e^{-0.0604[t+2.6514]}]^{-2.9322}$ for females and males, respectively.

Table 4. The weight and absolute growth in weight of *C. trutta* from Karakaya Dam lake (N: Number of samples; W: Weight; SD: Standard deviation; SE: Standard error).

Age Groups	Sex	N	W ± SD(Min- Max) (g)	SE	Absolute Length	Differences
0	♀	-	-	-	-	-
	♂	4	19.78 ± 1.45 (17.80-31.28)	0.72	19.22	-0.56
I	♀	9	43.41 ± 9.82 (31.54-54.97)	3.27	53.10	9.69
	♂	6	42.06 ± 9.18 (32.60-58.98)	3.75	45.05	2.99
II	♀	17	102.7 ± 11.44 (76.75-116.86)	2.78	97.52	-5.18
	♂	19	97.42 ± 12.89 (70.00-114.92)	2.96	84.16	-13.26
III	♀	11	172.0 ± 35.56 (116.9-232.32)	6.39	161.96	-10.04
	♂	31	164.16 ± 41.76 (117.18-245.45)	12.59	157.03	-7.13
IV	♀	26	272.8 ± 37.92 (216.6-321.28)	7.04	276.09	3.29
	♂	26	258.72 ± 26.54 (220.94-342.97)	5.21	253.22	-5.50
V	♀	13	362.7 ± 42.75 (273.9-376.41)	16.16	398.92	36.22
	♂	7	345.04 ± 38.19 (292.31-379.48)	10.59	382.43	37.39
VI	♀	26	492.2 ± 54.28 (362.9-519.79)	19.19	511.91	19.71
	♂	10	472.58 ± 46.15 (360.05-551.96)	9.05	473.19	0.61
VII	♀	2	613.0 ± 79.97 (521.4-664.09)	16.17	633.42	20.42
	♂	3	549.68 ± 17.23 (537.5-561.86)	12.18	574.37	24.69

Relative growth in weight

Relative growth of all age groups is shown in Table 5. The highest increase in relative weight was between the age groups I and II. The relative growth in weight, however, decreased with age except the ages IV and V.

Length–weight relationship

Length–weight relationships were calculated with the Le Cren equation (Le Cren, 1951) using the length and weight of the samples and the equations for females and males are given as:

$$\text{Female (♀): } W = 0.0116.L^{3.0325}$$

$$\text{Male (♂): } W = 0.0115.L^{2.9322}$$

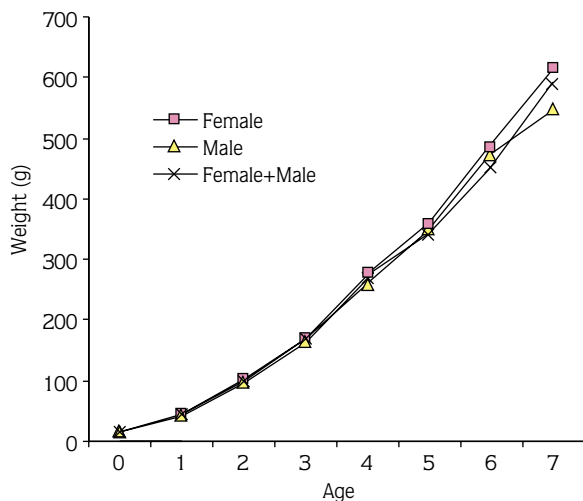


Figure 3. Age-weight diagram of female and male individuals of *C. trutta* population from Karakaya Dam Lake.

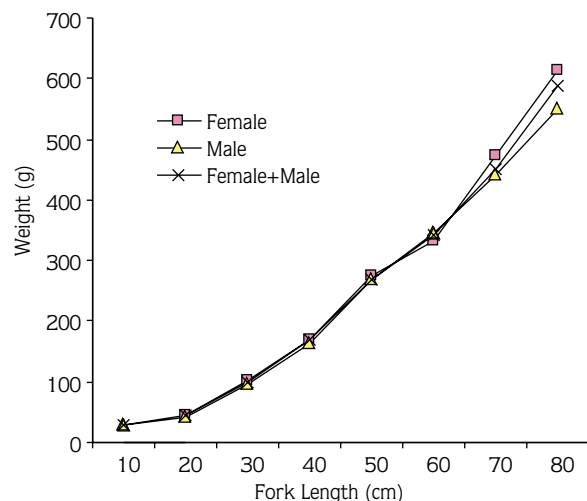


Figure 4. Length-weight relationship of *C. trutta* from Karakaya Dam Lake.

Table 5. Percentage weight growth of female and male *C. trutta* individuals (A.W.: Average Weight; Y.W.I.: Yearly Weight Increase, P.W.I.: Percentage Weight Increase).

Age Gr.	Female (♀)			Male (♂)			Female + Male (♀ + ♂)		
	AW	YWI	%PWI	AW	YWI	%PWI	AW	YWI	%PWI
0	-	-	-	19.78	22.28	43.82	19.78	22.95	45.13
I	43.41	59.29	138.70	42.06	55.36	127.46	42.73	57.33	132.89
II	102.70	69.30	63.46	97.42	66.74	68.51	100.06	68.02	68.93
III	172.00	100.80	62.43	164.16	94.56	63.67	168.08	97.68	58.91
IV	272.80	89.90	20.70	258.72	86.32	28.41	265.76	88.11	26.36
V	362.70	129.50	41.93	345.04	127.54	28.28	353.87	128.52	32.32
VI	492.20	120.80	29.95	472.58	77.10	24.20	482.39	98.95	30.44
VII	613.00			549.68			581.34		

The curves of the length-weight relationships obtained from these equations are shown in Table 6. Logarithmic regression curve is presented in Figure 4. Length and weight differences between females and males were statistically significant ($P < 0.05$). Length-weight relation according to the age groups is given in Table 7.

Growth Condition Factor

Growth condition factor for *C. trutta* population with respect to their age and sex are presented in Table 8. The mean growth condition factor was calculated as 1.30 and 1.28 for females and males, respectively. Average condition factor (C) differences were statistically

Table 6. Length-weight relationship equations of *C. trutta* from Karakaya Dam Lake.

Sex	Equations
Female (♀)	$\text{Log}W = -1.936 + 3.0325 \cdot \text{Log}L$
Male (♂)	$\text{Log}W = -1.804 + 2.9320 \cdot \text{Log}L$
Female+Male (♀ + ♂)	$\text{Log}W = -1.907 + 3.0155 \cdot \text{Log}L$

significant between females and males in the same and consecutive age groups ($P > 0.05$). The mean growth condition factor, however, changed with time.

Table 7. The Formation of weight values of *C. trutta* calculated from length-weight relation according to age groups.

Age Gr.	Female (♀)		Male (♂)		Female + Male (♀ + ♂)	
	L(cm)	W(g)	L(cm)	W(g)	L(cm)	W(g)
0	-	-	13.13	19.78	13.13	19.78
I	15.26	43.41	14.77	42.06	15.01	42.73
II	19.91	102.70	19.74	97.42	19.83	100.06
III	23.74	172.00	21.51	164.16	22.62	168.08
IV	27.32	272.80	26.47	258.72	26.90	265.76
V	29.34	362.70	29.89	345.04	29.61	353.87
VI	35.96	492.20	32.49	472.58	34.22	482.39
VII	36.83	613.00	34.95	549.68	35.89	581.34

Table 8: The condition factors of different age groups of *C. trutta* from Karakaya Dam Lake.

Age Groups	Condition Factor		
	Female (♀)	Male (♂)	Female + Male (♀ + ♂)
0	-	1.32	1.32
I	1.22	1.33	1.27
II	1.31	1.27	1.29
III	1.29	1.26	1.26
IV	1.38	1.30	1.32
V	1.32	1.29	1.30
VI	1.32	1.15	1.30
VII	1.23	1.29	1.31
Mean	1.30 ± 0.06	1.28 ± 0.05	1.30 ± 0.02

Reproduction

The Age of Sexual Maturity

The maturity of 300 female specimens in reproduction period was determined by direct observation of gonads and the results are shown in Tables 9 and 10. It was determined that females reached maturity at age 3 and males at age 2. Specimens attained sexual maturity at age 2 and 3 (Tables 2 and 5).

Reproduction Period and Spawning

Gonadosomatic index (I_G), used to determine the reproductive period, was calculated from ovarium samples taken monthly (Table 9). It was determined that the spawning period of *C. trutta* occurs in May and June,

with reproduction period occurring in March-July (Table 9). Maximum I_G value was calculated as 7.91 for females in May (Figure 5). The I_G value decreased in July because all samples had dispensed their eggs by then. After August, the gonads began to develop and the values of I_G again started to increase gradually until December, suggesting a reproduction period of this species between March and July (Table 9).

Ovarium Weight and Egg Diameter

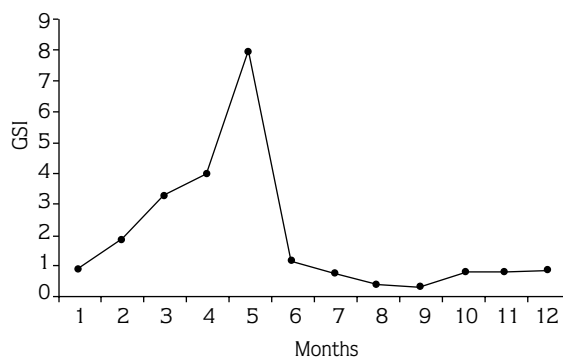
The values of the ovarium weight, egg diameter, number of eggs per gram of gonads and the monthly changes (April-July) of these values are shown in Table 10. Mean ovarium weight was maximum in May (72.5 g) and minimum in July (20.41 g).

Table 9. Monthly changes in the values of gonadosomatic index of female *C. trutta* Samples from Karakaya Dam Lake.

Months	January	February	March	April	May	June	July	August	September	October	November	December
GSI	0.91	1.84	3.25	4.02	7.91	1.10	0.76	0.38	0.29	0.79	0.80	0.88

Table 10. The monthly changes of the gonadal values of *C. trutta* samples (OW: ovarium weight; r: egg diameter; N: mean number of eggs per gram of gonads).

Months	OW (g)	r (mm)	N
April	22.3 (10.64-38.05)	0.48 (0.37-0.57)	-
May	72.5 (10.8-178.86)	0.64 (0.58-0.88)	393.6 (314-486)
June	29.2 (8.02-112.2)	0.84 (0.82-0.89)	340.2 (256-362)
July	20.41 (15.31-40.95)	0.87 (0.57-1.04)	410 (196-666)

Figure 5. Monthly gonadosomatic index (I_G) values of female *C. trutta* samples from Karakaya Dam Lake.

Discussion and Conclusion

C. trutta is more common than other fish inhabiting the Euphrates River. One hundred and four female fish specimens were captured from Karakaya Dame Lake. This represents a female:male ratio of 0.98:1. Nikolsky (1963) indicated different sexual dispersion of same species in different population and found that sex ratio in many varieties is close to 1:1. While Özdemir and Kabukçu (1983) reported that Keban Dam Lake population contain 52% female and 48% male *C. trutta*, Polat (1987) reported 64.69% female and 36.11% male. Tigris (Dicle) River has been reported to contain 58.74% female and 41.26% male (Ünlü, 1991) and Euphrates River 53.3% female and 46.7% male (Gül et al., 1996). Age composition of *C. trutta* population (0-7) in the present study agrees with Polat (1987) (1-8) and is slightly different from that of Ünlü (1991) (1-10) and Gül et al. (1996).

Determination of growth and reproduction properties of fish stocks is necessary for economical use of this natural wealth. Minimum 11.0 cm and maximum 37.7 cm lengths were obtained from the age groups 0 to VII (Table 3). Polat (1987) found 10.84 cm (age group I)

and 34.61 cm (age group VIII) and Gül et al. (1996) found 11.2cm (age group I) and 36.6cm (age group VII). Dominant age groups were III and IV in females and III in males (Table 1). The decrease in absolute and relative growth in length can be explained by the changes in activity as a result of sexual maturity. The increase in relative length and maximum growth was between the age groups I and II. Relative length growth was 31.67 and the growth characteristic value was 4.14. Relative increase in length of *C. trutta* population in Karakaya Dam Lake indicates a good growing performance. Growth parameters showed differences in terms of species, population, and age groups (Table 2).

The mean weights of *C. trutta* in Karakaya Dam Lake were 19.78 g (for the age group 0) and 613.0 g (for the age group VII) (Table 5). In other studies on the same species, it is 24 g (for the age group 1) and 537 g (for the age group IX) (Gül et al., 1996) and 74.07 g (for the age group I) and 666.0 g (for the age group VII) in Keban Dam Lake (Polat, 1987), and 28 g (for the age group 0) and 422 g (for the age group VI) in Tigris River (Ünlü, 1991). The ultimate length (L_{∞}) and weight (W_{∞}) obtained by the Bertalanffy growth equation for females is greater than those of males. On the other hand, many

factors, such as physicochemical and biological factors, may have an effect on the growth-rate in length and weight of fish directly or indirectly. The annual mean condition factors calculated for females and males were 1.30 ± 0.06 and 1.28 ± 0.05 , respectively (Table 8). The growth condition factor value of the same species was 0.81 for females and 1.02 for males in Tödürge Lake (Erdem, 1988).

The samples, taken between March 1998 and June 1999, reached sexual maturity in age 2 or 3. Previous studies support this finding (Özdemir and Kabukçu, 1983; Polat, 1987; Erdem, 1988; Ünlü, 1991; Gül et al., 1996). The spawning period of *C. trutta* occurs in May and June. The gonadosomatic index (I_G) reached the highest value (7.91) in May and the reproduction period of this species occurred in March-July (Table 9). In previous studies, it was May-July (Gül et al., 1996), May-

September (Özdemir and Kabukçu, 1983), April-June (Polat, 1987), and May-June (Ünlü, 1991). Egg diameter gave the highest value (1.04 mm) in July and the smallest value (0.37 mm) in April (Table 10). Previous studies reported it as 0.78-1.20 mm (Gül et al., 1996), 0.46-1.04 mm (Özdemir and Kabukçu, 1983), 0.43-1.03 mm (Polat, 1987), and 0.55-1.38 mm (Ünlü, 1991).

The maintenance of species and the balance of population density are of importance in terms of economical fishing of this species in the region. Therefore the prohibition of fishing during March-August period can be advised. In addition, the fish under the age of 3 and below the average length of 22.62 cm should not be caught during the fishing period. This will lead to an improvement in the productivity of both population and fishing as was determined by previous studies (Şen, 1988; Ünlü, 1991; Gül et al., 1996).

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