

A Study on *Capoeta capoeta* (Guldenstaedt, 1772) Population Living in Kockopru Dam Lake; Van-TURKEY*

Mahmut ELP¹

Mustafa KARABATAK²

¹ Dept. of Fisheries , Faculty of Agriculture, Yuzuncu Yil University, 65080 Kampus-Van/ TURKEY

² Faculty of Fisheries Istanbul University Ordu Cad. No: 200 Laleli-Istanbul/TURKEY

Corresponding Author
e-mail: mahmutelp@yyu.edu.tr

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Abstract

The aim of this study is aiming to determine the growth and reproduction of *C. capoeta* (Guldenstaedt, 1772) population living in Kockopru Dam Lake, Van-Turkey and to arrange the fishing on the scientific base. The study was carried out from December 1998 to October 2001. The ages, lengths, and weights of the investigated *C. capoeta* individuals varied from I to VI year, 3.2 to 39.8 cm, and 0.4 g to 755.6 g, respectively. Length-weight and age-length relationships were determined as $\log W = -1.899 + 2.999 \times \log FL$, $FL_t = 58.24[1 - e^{-0.152 \times (t-0.376)}]$, respectively. The mean condition factor was determined as 1.275 ± 0.004 . It was established that males and females attained sexual maturity when they reached to 23 cm and 33 cm in length, respectively; and spawning was observed from May 15th to June 15th. The male: female ratio was found as 1:1.43. It was observed that *C. capoeta* entered to streams in May and stayed there until the end of September. It was also noticed that *C. capoeta* to be caught before they had not reproduced. It will be appropriate to ban commercial fishing in Kockopru Dam Lake from May 1st to July 1st and to set minimum length for fishing as 34 cm. With this application, population sustainability will be attained, and the maximum sustainable yield will be gained.

Key words: Siraz, growth, reproduction, fishing, Van Lake Basin

INTRODUCTION

C. capoeta is widely distributed in a large area from Afghanistan to Aegean costal regions in Asia. It has 11 subspecies, 6 of them live in inlands of Turkey [1]. Various studies related with *C. capoeta* and its subspecies were made not only in Van Lake Basin [2, 3], but also other basins in Turkey [4, 5, 6, 7]. In the studies it was informed that the populations maximum age was XIV, length and weight were determined bigger then 50 cm and 1.5 kg. It was reported that populations reproduced between May- August.

The Kockopru Dam Lake (KDL) was constructed on the Zilan Stream in the Lake Van Basin in 1992. Native fish species of Zilan Stream were *Capoeta capoeta*, *Barbus plebejus ercisianus*, *Nemacheilus tigris*, *Chalcalburnus tarichi*. General Directorate of State Hydraulic Works (DSI) introduced *Cyprinus carpio* and *Oncorhynchus mykiss* to the KDL in 1992. Commercial fishing has been done in KDL since 1994. Commercial fishing main species were *Capoeta capoeta* and *Cyprinus carpio*.

Population sustainability must be maintained in natural sources. Therefore, management of natural sources based on the scientific foundation is a necessity. The present study is aiming to determine the growth and reproductive aspects of *C. capoeta* population living in KDL and arrange the fishing on the scientific basis.

MATERIALS AND METHODS

This study was carried out in the KDL and its inlets from December 1998 to October 2001. The KDL was built on the Zilan Stream in the Lake Van Basin, the Eastern Anatolia, Turkey. It was built for irrigation and electricity production purpose, but commercial fishing is also being carried out there. The dam has an estimated surface area of 6.15 km² when it is full, a storage capacity of 86 hm³. It is 48.5 m in deep at its deepest point. Altitude is 1778.50 m at maximum water level. It is fed by the Zilan (Hacidiri Suyu), Ilica (Incesu), Komurcu and Kunduk streams, and by rainwater and snowmelt.

Fish samples were caught from the Dam Lake and streams (Figure 1). Totally 2457 fish were sampled. sex was determined in 1518 fish, age was determined in 703 fish. The species, belonging to *Cyprinidae* family, is known as siraz or in baligi in Turkey.

Sampling was carried out monthly using hand nets and electroshock equipment in running water, and polyfilament trammel nets and beach seine nets in the Dam Lake. In the measurement of length, fork length was used. Weight measurements were carried out fresh caught fish. Samples were weighted as soon as they were taken from the water [8]. Age determination was made using scales [9]. In estimation the length-weight and age-length relationships, the formulas of $\log W = \log a + b \log L$ and $FL_t = FL_{\infty} [1 - e^{-K(t-t_0)}]$ were used. The formula $K = (W/L^3) \times 100$ was used in calculating the condition factor [8]. Gonadosomatic index values were calculated by using the formula $GSI = (G_w/W)100$. The eggs were counted by the gravimetric method. Sex was determined by examining

the gonads [10]. Statistical analyses were made by common statistical methods [11].

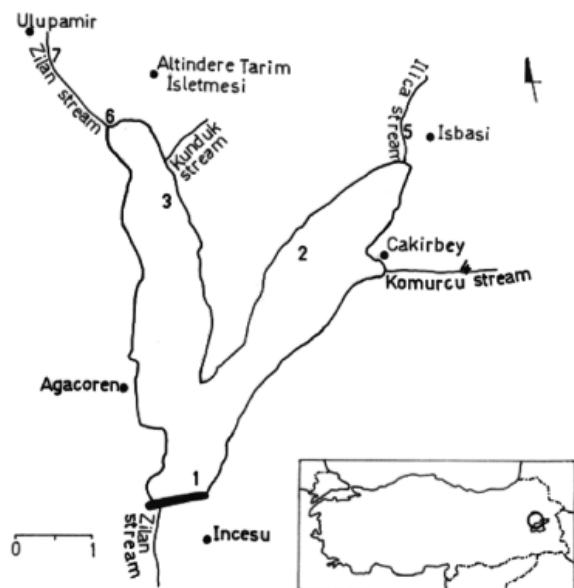


Figure 1. Kockopru Dam Lake, its inlets and sampling points

RESULTS

Age was determined in the 703 of *C. capoeta* individuals. Age of the samples were found between I-VI. Fork length values were examined in relation to age and sexes separately. Growth differences were determined in some age groups. It was calculated that II and IV age groups and when omitted age the growth differences was statistically significant ($p < 0.05$) in favor of females (Table 1).

When weight was examined in relation to sex and age, it was determined that IV and VI age group females were heavier than the males ($p < 0.05$). In analysis of the samples overall, it was observed that females were heavier than the males ($p < 0.05$) (Table 2).

Length-weight relation was analyzed depending on sex, and it was found that males had $\log W = -1.712 + 2.866 \log FL$ ($r = 0.988$), females had $\log W = -1.755 + 2.896 \log FL$ ($r = 0.990$), and total samples had $\log W = -1.899 + 2.999 \log FL$ ($r = 0.998$). Von Bertalanffy growth formula was found as $FL_t = 58.24 [1 - e^{-0.152(t-0.376)}]$ in the sample overall (Figure 2).

Condition factor in the overall samples was calculated as 1.275 ± 0.004 , 1.279 ± 0.006 in males, 1.258 ± 0.004 in females, 1.313 ± 0.015 in juveniles. Condition factor declined to its lowest point (1.078 ± 0.014) in spring 2000 and reached to a peak (1.434 ± 0.010) in autumn 2000.

Condition factor was analyzed depending on age and sex. The highest value was calculated in III age group (1.249 ± 0.009). The condition factor difference between the III and IV ages were found to be significant ($p < 0.05$) between males and females.

The male: female ratio was determined as 1:1.43 (male: 507, female: 727). The difference was found to be statistically significant ($p < 0.05$). In the samples, females were found to be dominant. Male: female ratio analyzed depending on age and found that the ratio was equal at II and III ages groups, and then female ratio was found to be bigger than male ($p < 0.05$) in other ages.

It was observed that the 55.1 % of males in the III age group were sexually mature, and more than 51.6% of females in IV age group were sexually mature. It was observed that the 68.5% of males in 23-24.9 cm length group were sexually mature, more than 72.5% of females in 33-34.9 cm length group were sexually mature

The GSI values reached a maximum in May (6.866 ± 0.531 in males, and 9.433 ± 0.881 in females), and declined rapidly thereafter, falling a minimum in June in females (1.385) and in July in males (0.567 ± 0.097). This finding showed that spawning took place intensively from 15th May to 15th June (Figure 3)

It was observed that reproduction tubercles formed on head and anal fin of matured male individuals in April and these tubercles spread to tail stalk region on the second half of May. Reproduction tubercles were last observed in the middle of June.

Table 1. Fork length values (cm) of *C. capoeta* in relation to age and sex in KDL and its inlets

Age Group	Male		Female		p=0.05	Juvenile		General	
	n	FL± SE (min-max)	n	FL± SE (min-max)		n	FL± SE (min-max)	N	FL± SE (min-max)
I						9	4.3±0.2 (3.4-5.0)	9	4.3±0.2 (3.4-5.0)
II	15	14.3±0.8 (9.5-18.8)	15	15.3±0.5 (12.5-17.7)	p<0.05	16	12.5±0.8 (4.7-17.1)	49	13.9±0.4 (4.7-18.8)
III	98	24.5±0.3 (17.7-29.1)	82	24.5±0.3 (17.8-29.1)	p>0.05	4	19.0±0.6 (17.8-20.0)	184	24.4±0.2 (17.7-29.1)
IV	115	27.6±0.3 (22.0-35.1)	282	29.7±0.2 (21.0-35.3)	p<0.05			397	29.1±0.2 (21.0-35.3)
V	1	32.1	31	31.1±0.3 (28.1-34.7)	p>0.05			32	31.1±0.3 (28.1-34.7)
VI	1	36.5	5	36.5±1.9 (29.4-39.8)	p>0.05			6	36.5±1.5 (29.4-39.8)
Total	230	25.5±0.3 (9.5-36.5)	415	28.3±0.2 (12.5-39.8)	p<0.05	29	10.8±1.0 (3.4-20.0)	677	26.6±0.2 (3.4-39.8)

It was determined that average individual fecundities of 21 mature female *C. capoeta* were 9452±968 egg per female. The relative fecundity was calculated as either $RF_{F(L(cm))} = 296 \pm 28$ eggs/cm fork length or $RF_{W(g)} = 23.72 \pm 1.96$ eggs/g body weight. The average diameter of egg was determined as 1.852±0.029 mm (n= 21).

The fork lengths and weights of total 549 *C. capoeta* samples caught with commercial fishery equipment ranged from 12.4-39.4 cm (average 28.0±0.2 cm) and from 25.1-755.6 g, (average 279.3±4.4 g). It was determined that the caught females by fishermen generally did not reach to sexual maturity (68 %).

DISCUSSION

Age is the main criteria in the determination of growth, therefore, it must be determined correctly [4]. It was reported that *C. capoeta* was at IX, XIII, VIII, VII, and XI old age in Kockopru Dam Lake, Donerdere Dam, Bendimahi Stream, Karasu Stream, and Nazik Lake, respectively in the basin [2, 3]. In this study it was determined that, the age of *C. capoeta* ranged from I to VI. It is understood from other literature, the biological lifespan of this species is longer then that we determined [2, 3].

Table 2. Weight (g) of *C. capoeta* samples in relation to sex and age in KDL and its inlets.

Age Group	Male		Female		p=0.05	Juvenile		General	
	n	W±SE (min-max)	n	W± SE (min-max)		n	W± SE (min-max)	N	W± SE (min-max)
I						33	1.0±0.1 (0.4-2.2)	33	1.0±0.1 (0.4-2.2)
II	15	41.4±6.2 (10.9-85.6)	15	45.1±4.1 (22.6-67.7)	p>0.05	18	25.5±3.8 (1.4-61.2)	48	36.6±3.0 (1.4-85.6)
III	97	188.4 ± 6.3 (70.8-315.7)	80	194.1 ± 7.0 (63.1-333.6)	p>0.05	4	82.0 ± 7.5 (64.0-98.8)	181	188.6 ± 4.8 (63.1-333.6)
IV	115	265.8 ± 8.0 (135.9-550.5)	280	331.0 ± 5.3 (106.3-580.7)	p<0.05			395	312.1 ± 4.7 (106.3-580.7)
V	1	390.4	31	371.4 ± 11.7 (247.0-539.9)	p>0.05			32	372.0 ± 11.4 (247.0-539.9)
VI	1	392.2	5	596.7 ± 69.0 (354.2-755.6)	p<0.05			6	562.6 ± 65.9 (354.2-755.6)
Total	229	219.4 ± 6.3 (10.9-550.5)	411	300.2 ± 5.7 (22.6-755.6)	p<0.05	55	14.9 ± 3.3 (0.4-98.8)	695	251.0 ± 5.0 (0.4-755.6)

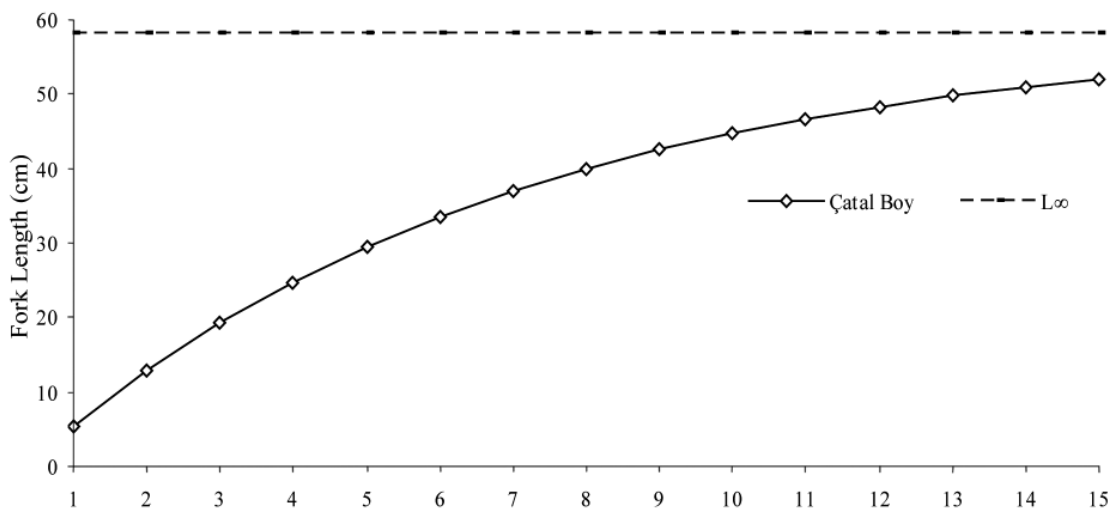


Figure 2. Age-length relationship of *C. capoeta* samples in KDL and its inlets.

Maximum fork lengths of *C. capoeta* in Kockopru Dam Lake, Donerdere Dam, Bendimahi Stream, Karasu Stream, and Nazik Lake were reported as 40, 47, 32, 32, and 48.3 cm, respectively [2, 3]. In this study, the maximum fork length was found as 39.8 cm. This finding is close to the previous report (40 cm) of Evci [2].

Although the maximum weight of *C. capoeta* of KDL was reported as 1250 g [2], the value obtained in our study was 756 g. The big difference between this two studies suggests that there has been rapid variation in the population structure. Moreover, the samples of the other study [2] were solely come from the commercial fishing; therefore, samples were bigger.

The analyses done *C. capoeta* in various environments showed that the females at the same age had significantly longer than males [12, 13, 14]. In this study it was determined that females at II and III ages were longer than the males at the same age. This was because similar to the other environments, females in KDL reach to sexual maturity later than males.

In this study, it was determined that there were significant ($p < 0.05$) growth differences at IV and VI aged *C. capoeta* in KDL; females developed faster than males. This weight difference lie as length difference was thought to be a consequence of early sexual maturation of females.

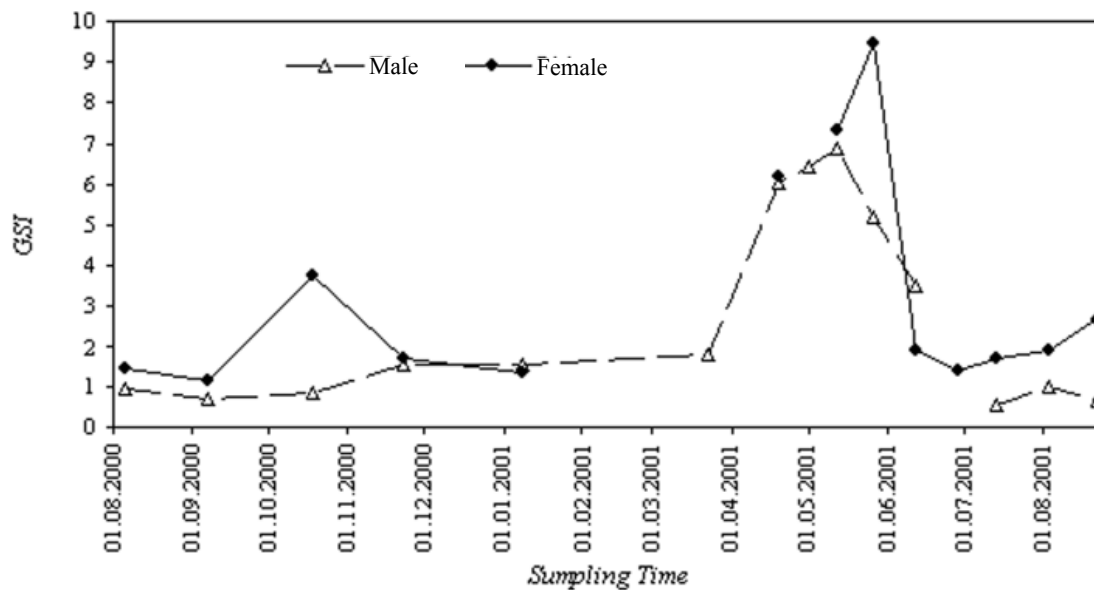


Figure 3. Changes in GSI value of *C. capoeta* depending on sex and sampling time.

The age-length relationship was found as $L_t = 58.240 \times [1 - e^{-0.152(t+0.376)}]$. K value which is a linear parameter showing (how fast) fish reach to L_∞ value, is near to 1 in short living fish and is near to 0 in long living fish [8]. In this study, K value was calculated as 0.152. These shows that *C. capoeta* is a long living species.

Condition factor of *C. capoeta* was calculated in KDL as 1.414, (1.437 in males, 1.437 in females, 1.321 in juveniles), in Donerdere Dam Lake as 1.447, in Bendimahi Stream as 1.405, in Karasu Stream as 1.356 [2], and in Nazik Lake as 1.234 ± 0.005 [3]. In this study, condition factor of *C. capoeta* in KDL was determined as 1.275 ± 0.004 , 1.279 ± 0.006 , 1.258 ± 0.004 , and 1.313 ± 0.015 for general sample, males, females, and juveniles, respectively. These values were similar to the result of Nazik Lake, but lower than those of Donerdere, Bendimahi, and Karasu studies which were conducted in Lake Van Basin [2, 3]. Condition factor in Nazik Lake was the lowest (1.108 ± 0.017) in July, but highest (1.379 ± 0.020) in November [3]; In the present study conducted in KDL, the highest (1.434 ± 0.010) and lowest (1.188 ± 0.009) condition factor were determined in Autumn and Winter seasons. The lowest condition factor in Winter season was observed due to the lack of feeding.

It was reported that the males and females of *C. capoeta* in Nazik Lake reached to sexual maturation at III and IV ages respectively [3]. In the present study, it was determined that evaluated males and females reached to sexual maturation at III and V year old, respectively. These findings are in line with the Nazik Lake.

It was reported that males and females of *C. capoeta* population started to reproduction when they reached to 15 cm and 22 cm fork lengths, respectively [3]. Sexual maturation in males and females in Cildir Lake were observed when they reached to 26.9 cm and 30.4 cm fork lengths, respectively [15]. In this study, males and females were sexually matured when they reached to 23–24.9 cm and 33–34.9 cm fork lengths, respectively. These values were close to the values reported for Lake Cildir [15], but higher than Nazik Lake [3].

It was reported that the male: female ratio of *C. capoeta* in KDL was 1: 1.07 [2] and 1.3:1 in Nazik Lake which was significantly different and increased to 1.7:1 in reproduction period [3]. In the present study, the sex ratio was significantly in favor of females as 1:1.43. In the sex ratio analyses, it was determined that the female ratio increased by age. In the seasonally sex ratio, the male ratio was significantly ($p < 0.05$) higher than females in the spring 2000, but lower in winter 1998,

Summer 2000, Spring 2001, and Summer 2001. The differences in other seasons was insignificant ($p > 0.05$).

It was reported that GSI value of *C. capoeta* population in Nazik Lake was the highest (M:8.38; F:10.10) in May and the lowest (M: 1.05; F:1.34) in August [3]. In the present study, the highest GSI values in males (6.866 ± 0.531) and females (9.433 ± 0.881) were determined on May 12th and May 26th sampling dates. The GSI value dropped fast and the lowest GSI values in males (0.619 ± 0.045) and females (1.126 ± 0.327) were determined on August 22nd and September 7th.

In sexually matured males of *C. capoeta* were there some signs; tubercles on head, body, and anal fin of males in Nazik Lake from June to August [3]. In the present study, it was observed that tubercles formed on head and anal fin of matured male individuals in April and these tubercles spread to tail stalk region on the second half of May. Reproduction tubercles were last observed in the middle of June.

It was reported that *C. capoeta* population reproduced at different periods in various regions; from June to July in Nazik Lake [3], *C. c. capoeta* reproduction was from May to June in Aras [5]. In the present study, the reproduction of *C. capoeta* realized in 15 May to 15 June.

It was reported that in the reproductive period of *C. capoeta* in Nazik Lake mean individual fecundity was calculated as 1809-46000 per female and relative fecundity was calculated as 30341 ± 1330 per kg of female [3]. In the present study, the individual fecundity was determined as 9452 ± 968 per female. Relative fecundities based on fork length and weight were as $RF_{cm} = 296 \pm 28$, $RF_{w(g)} = 23.72 \pm 1.96$.

It was reported that the egg diameters of *C. capoeta* in Nazik Lake was 1.82 mm [3]. In the present study, the average diameter of *C. capoeta* in the reproduction season was determined as 1.852 ± 0.029 mm.

It was reported that *C. c. bergamae* migrated in big schools to the source of the Western Anatolia rivers in order to reproduce [7]. *C. capoeta* start to enter from KDL to the streams in April and spreads intensively there from the middle of May to September, and re-migrated to KDL in October. Ground structure of streams where *C. capoeta* spreads has rocks, pebble- sand, and current rate is high.

It was determined that fork lengths and weight of *C. capoeta* caught with commercial fishing equipment were 28.0 ± 0.2 cm (12.4-39.4) and 279.3 ± 4.4 g (25.1-755.6). When considering the mature weight of *C. capoeta*, this applied fishing is an extent endangering the continuity of the population.

As a result, *C. capoeta* has a good growth performance in KDL. However, if individuals which are not reach the sexual maturity are captured, the future generation of the population could be endangered.

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