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Population Structure, Growth and Reproduction Properties of *Capoeta capoeta* (Guldenstaedt, 1772) Living in Cigli (Zapbasi) Stream, Van, Turkey

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Abstract: This study was carried out in Cigli stream between March 2007 and July 2009 on 553 *Capoeta capoeta*. Maximum age, fork length and total weight of samples was found as VII, 33.2 cm and 432.3 g, respectively. Length-weight relationship was calculated as $W = 0.01702 \times L^{2.887}$. Average condition factor were calculated as 1.280±0.006 in overall samples. The male:female ratio was established as 1.296:1. It was established that males and females attained sexual maturity when they reached to 2nd age and 10 cm and 4th age and 18 cm, respectively and spawning was observed from last week of May to 2nd week of July.

Key words: *Capoeta capoeta*, Cigli stream, growth, reproduction, Zab river

INTRODUCTION

Five of seven species of *Capoeta* have been presented in Anatolia. *Capoeta capoeta* is widely distributed in a large area from Afghanistan to Aegean coastal regions in Turkey. It has 11 subspecies, six of them live in inlands of Turkey. The species fairly adapts to changeable life condition. In Cigli stream, any study was conducted except a taxonomic study. Various studies related with *C. capoeta* and its subspecies were made in Lake Van Basin (Elp and Karabatak, 2007; Kankya *et al*., 2008; Sen and Elp, 2009).

For sustainable fisheries, natural resources shall be protected. Therefore, the resources shall be investigated and managed based on scientific foundation. An investigation in the Cigli stream was not carried out before. It is hoped that this study can make a contribution to knowledge of population structure, growth, reproduction of this population.

MATERIALS AND METHODS

This study was carried out in Cigli stream and its branch from March, 2007 to July, 2009. Cigli stream is also known as Zapbasi stream. The altitude of study areas are about between 1950 and 2100 m. Cigli stream is a branch of Zab river that is a main branch of Tigris (Fig. 1). The sources of the stream are on Mengene Mountains in Baskale-Van and Haravil (Yigit) Mountains near the Turkey and Iran borderer. Cigli stream constitute Zab river joining with Nehil stream near Yuksekova-Hakkari and leaves Turkey from Cukurca. The length in Turkey is 189 km and it flows into Tigris about 40 km to Southern

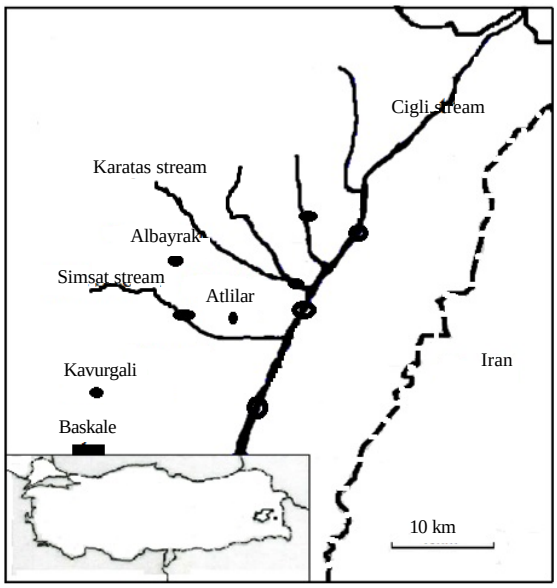

Fig. 1: Cigli stream and sampling areas

Musul (Bakis and Tip, 2007). On the Cigli stream, Yavuzlar, Baskale and Caldiran dams are planned and Yavuzlar dam construction has begun. Except those dams, there are historical constructions on the Cigli stream and its branch. They are Gelincik, Yukari Embi, Aþagi Embi Dams and Cuh, Cimlik, Duztepe, Mercimek, Kurugol, Buklumdere and Kurbagali Embankments and Mengene and Pestekan Canals that constituted at VII-VIII century B.C. by Urartian.

The species, belonging to Cyprinidae family is known as "siraz or in baligi" in Turkey. Fish samples caught

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monthly with electroshock and hand nets in the stream and the branches. Totally 553 fish were sampled, sex was determined in 506 individuals and age was determined in 521 fish. Sex could not be determined on 47 samples because of the crushing during transporting of fish. In the measurement of length, Fork Length (FL) was used. Total (W) and Gonad (G_w) weights measurements were carried out fresh caught fish. Samples were weighted as soon as they were taken from the water. The age, length and weight composition of the population was determined. In estimation the length-weight relationship, the formula of $W = a \times FL^b$ was used. The formula $CF = (W/FL^3) \times 100$ was used in calculating the Condition Factor (CF). Age determination was made using scales (Turkmen *et al*., 2005). Sex was determined by examining the gonads. First spawning age, length and weight of samples were determined according to gonad maturity of their gonads. Spawning season was tried to determine by field observations and Gonad somatic index ($GSI = G_w/W \times 100$) values (Karatas *et al*., 2005).

Population parameters in this study that mean, standard error mean and other estimations were made by common statistical methods. In the estimations, common PC programs were used.

RESULTS

Population structure: Age was determined at 521 samples caught from Cigli stream. Age of the samples was found between 0-VII. While maximum age of males was VII in the females, it was found as VII. Male and females at 0+ages could not catch. According to age groups, all samples, males and females were concentrated in II (43.57, 25.53 and 14.59%) and III (29.39, 15.74 and 12.28%) ages.

According to 2 cm length groups, all samples, males and females were accumulated in 11.0-12.9 cm group (24.41, 13.93 and 9.22%), in 13.0-14.9 cm group (27.13, 16.09 and 9.76%) and in 15.0-16.9 cm group (13.56, 8.14 and 4.88%).

According to 20 g weight groups while the relative frequency of all samples was concentrated in 0.0-19.9 g group (22.24%), 20.0-39.9 g group (45.03%) and 40.0-59.9 g group (16.64%), in males and females, it was accumulated in 20.0-39.9 g group (26.76 and 15.91%) and 40.0-59.9 g group (10.31 and 5.61%).

Distribution of individuals in the population observed and it was showed that the samples were consisted of small individuals. While between 0-III ages samples were 88.67%, older than III ages samples were found as 11.33%. In the same way, individuals smaller than 17 cm was 83.54% and 17 cm and larger samples was found as 16.46%. Also, 60 g and lighter samples of *C. capoeta* in Cigli stream was calculated as 83.91% and heavier than 60 g samples was found as 16.09%.

Growth: Fork length and total weight values of samples were determined according to age and sex; sampled the smallest individual was found as 3.8 cm and 0.8 g and the largest individual was found as 33.2 cm and 432.3 g (Table 1 and 2).

Table 1: Fork Lengths (FL) (cm) of *C. capoeta* according to age and sex in Cigli stream

Age groups	n	Male FL±SE (min.-max.)	n	Female FL±SE (min.-max.)	n	Juvenile FL±SE (min.-max.)	n	Total FL±SE (min.-max.)
0	-	-	-	-	14	5.49±0.34 (3.8-7.9)	14	5.49±0.34 (3.8-7.9)
I	7	10.34±0.38 (9.2-11.9)	6	11.47±0.39 (9.9-12.6)	46	8.38±0.17 (7.0-12.4)	68	8.93±0.17 (7.0-12.6)
II	133	13.12±0.12 (9.8-17.7)	76	12.82±0.15 (9.6-17.1)	13	11.52±0.43 (9.5-14.0)	227	12.87±0.09 (8.5-17.7)
III	82	15.25±0.22 (11.5-20.6)	64	15.98±0.29 (12.3-21.4)	6	12.87±0.90 (10.1-15.2)	153	15.46±0.18 (10.1-21.4)
IV	15	20.09±0.47 (16.8-23.6)	22	22.01±0.53 (16.8-26.0)	-	-	37	21.24±0.40 (16.8-26.0)
V	1	25.30	12	24.97±0.82 (20.5-28.0)	-	-	13	24.99±0.75 (20.5-28.0)
VI	2	28.70±3.20 (25.5-31.9)	5	28.46±1.62 (24.6-32.8)	-	-	7	28.53±1.32 (24.6-32.8)
VII	-	-	2	32.10±1.10 (31.0-33.2)	-	-	2	32.1±1.10 (31.0-33.2)
Total	240	9.2-31.9	187	9.6-33.2	79	3.8-15.2	521	3.8-33.2

Table 2: Total Weights (W) (g) of *C. capoeta* according to age and sex in Cigli stream

Age groups	n	Male W±SE (min.-max.)	n	Female W±SE (min.-max.)	n	Juvenile W±SE (min.-max.)	n	Total W±SE (min.-max.)
0	-	-	-	-	14	2.44±0.40 (0.8-5.6)	14	2.44±0.40 (0.8-5.6)
I	7	15.87±1.65 (11.1-23.3)	6	18.68±1.59 (12.7-24.6)	46	8.19±0.57 (4.5-25.7)	68	10.13±0.62 (4.5-25.7)
II	133	30.24±0.84 (11.9-74.1)	76	27.45±0.90 (11.2-54.1)	13	20.77±2.01 (11.2-33.6)	227	28.50±0.63 (8.0-74.1)
III	82	46.77±2.24 (20.4-116.7)	64	51.62±2.58 (20.2-105.4)	6	26.77±5.52 (13.0-43.7)	153	48.03±1.67 (13.0-116.7)
IV	15	98.95±8.79 (50.0-162.4)	22	130.10±9.29 (46.7-214.2)	-	-	37	117.47±6.97 (46.7-214.2)
V	1	189.90	12	201.25±20.06 (84.5-286.9)	-	-	13	200.38±18.47 (84.5-286.9)
VI	2	295.90±74.80 (221.1-370.7)	5	291.92±50.57 (158.8-430.1)	-	-	7	293.06±38.53 (158.8-430.1)
VII	-	-	2	400.3±32.00 (368.3-432.3)	-	-	2	400.30±32.00 (368.3-432.3)
Total	240	11.1-370.7	187	11.2-432.3	79	0.8-43.7	521	0.8-432.3

Table 3: Length-weight relationship of *C. capoeta* living in Cigli stream

Sex	n	r^2	Equations
Male	254	0.946	$W = 0.02323 \times L^{2.776}$ (LogW = -1.634+2.776×LogL)
Female	196	0.981	$W = 0.01694 \times L^{2.884}$ (LogW = -1.771+2.884×LogL)
Juvenile	85	0.984	$W = 0.01644 \times L^{2.890}$ (LogW = -1.784+2.890×LogL)
Total	553	0.985	$W = 0.01702 \times L^{2.887}$ (LogW = -1.769+2.887×LogL)

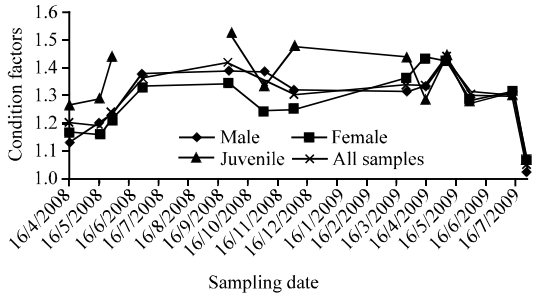

Fig. 2: Condition factor values of *C. capoeta* living in Cigli stream

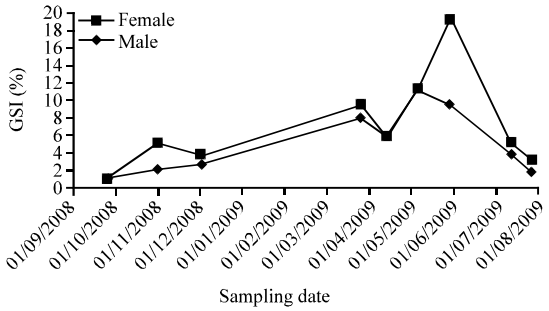

Fig. 3: Changes in GSI values of *C. capoeta* in Cigli stream

Length weight relationships was calculated as $W = 0.02323 \times L^{2.776}$ in males as $W = 0.01694 \times L^{2.884}$ in females and as $W = 0.01702 \times L^{2.887}$ in all samples (Table 3). Condition factor values were calculated on 553 samples according to sampling date and sex (Fig. 2). In the overall samples, it was calculated as 1.280±0.006, 1.294±0.010 in males, 1.241±0.010 in females and 1.310±0.016 in juveniles.

Reproduction: Sex determination was made on 535 individuals. The 254 samples (47.48%) were male, 196 individuals (36.63%) were female and also 85 fish captured (15.89%) were juvenile. The male:female ratio was calculated as 1.296:1.

Sexual maturity of *C. capoeta* sampled from Cigli stream was observed according age, fork length and total weight of samples. According age, matured males was firstly in II age group (71.43%) and matured females was in IV age group (81.82%) with regard to 2 cm fork length, matured males was firstly in 10.0-11.9 cm group (51.61%) and matured females was in 18.0-19.9 cm group (76.92%) and in accordance with 10 g total weight, matured males was firstly in 10.0-19.9 g group (55.56%) and matured females was in 60.0-69.9 g group (57.14%). Reproduction tubercles were observed on head, anal fin and tail stalk region of matured males from the beginning of April to until the middle of June.

The GSI values calculated as maximum in the 1st week of May in males (11.33±0.96) and in the last week of May in females (9.83±1.13) and declined rapidly thereafter, calculated as minimum in the 2nd week of July in females (1.33±0.00) and in the last week of July in males (1.66±0.21). The findings and field observations showed that spawning took place intensively from last week of May to the 2nd week of July (Fig. 3).

DISCUSSION

The study area has an important place in Turkey in terms of the presence of water. Cigli stream is one of the main branches of the Tigris which is one of Turkey's largest rivers and it has a very high potential for electricity generation (Bakis and Tip, 2007) and also for fisheries. It was also recognized the potential by Urartian 3000 years ago and they have made many channels and dams for drinking and irrigation on Cigli stream and its branches. It was showed that the majority of the samples were consisted of small individuals (about 85% of all samples). The reason for this may be those the stream has fast flowing, there is no meander for taking cover of fish and nutrient is very poor. Also, intensive fishing was showed with nets on sampling areas. Age determination must be made correctly because of the main criteria in the determination of growth. Age of *C. capoeta* in Cigli stream was identified between 0-VII. Age of *C. capoeta* in Karasu and Bendimahi streams and Dgnerdere dam were reported higher than Cigli stream; on the contrary, it was reported similar in KoCkopru and Zernek Dam lakes and Karasu stream (Elp and Karabatak, 2007; Kankaya *et al*., 2008; Sen and Elp, 2009). Maximum fork lengths and total weights of *C. capoeta* in Lake Van Basin were reported as 47.0 cm and 1250.0 g in Donerdere reservoir as 48.3 cm and 1379.5 g in Nazik lake as 39.8 cm and 755.6 g in KoCkopru Dam lake (Elp an Karabatak, 2007) as 41.0 cm and 1060.4 g in Zernek Dam lake (Kankaya *et al*., 2008) as 37.5 cm and 676.2 g in Karasu stream (Sen and Elp, 2009). In this study, maximum length and total weight (33.2 cm and 432.3 g) were smaller than studies in Lake Van Basin.

The b value was reported as 2.970 in Karasu stream as 2.960 in Nazik lake as 2.999 in KoCkopru dam lake (Elp and Karabatak, 2007) as 2.992 in Zernek dam lake

(Kankaya *et al*., 2008) as 3.039 in Karasu stream (Sen and Elp, 2009). In this study, it was calculated as 2.887 and the value is lower than in the value of Van lake basin. The b value may be used as an indicator of food intake and growth regime and many differ according to some biotic and abiotic factors like water temperature, food availability and habitat type (Wootton, 1992).

Condition coefficient of *C. capoeta* living in Cigli stream was calculated as 1.280 and the values changed between 0.665 and 1.866. Variations in the coefficient may change within same species, age, season, sexual maturity, spawning season, feeding condition and environment. In the basin, condition coefficient was reported as 1.461 in Donerdere reservoir as 1.234 in Nazik lake as 1.275 in KoCkopru Dam lake (Elp an Karabatak, 2007) as 1.339 in Zernek (Kankaya *et al*., 2008) and as 1.452 in Karasu stream (Sen and Elp, 2009). Sex determination was made on 535 individuals. The 254 samples (47.48%) were male, 196 individuals (36.63%) were female and also 85 fish captured in Cigli stream (15.89%) were juvenile. The male:female ratio was calculated as 1.296:1. The male was found dominant. In most species, sex ratio is close to 1:1 but this situation may vary from species to species. It also may differ from one population to another in same species.

It also may change from year to year in the same population (Nikolskij, 1963). It was reported that male was dominant in Nazik lake and in Karasu stream (Sen and Elp, 2009) and the female was dominant in KoCkopru dam lake (Elp and Karabatak, 2007) and in Zernek dam lake (Kankaya *et al*., 2008).

Sexual maturation was happened at 2nd age and in 10.0-11.9 cm group in males and at 4th age and in 18.0-19.9 cm group in females in this study. It was reported as 3rd age, 15 cm in males; 4th age, 22 cm in females from Nazik lake as 3rd age, 23 cm in males; 4th age, 33 cm in females from KoCkopru dam lake (Elp and Karabatak, 2007) as 2nd age, 14 cm in males; 4th age, 22 cm in females from Zernek dam lake (Kankaya *et al*., 2008) and as first age, 11 cm in males and 4th age, 23 cm in females from Karasu stream (Sen and Elp, 2009). Females of *C. capoeta* in all resources in Lake Van Basin have matured similar age and similar length but matured males of Cigli and Karasu streams was found smaller than the others.

In some *Cyprididae* species, reproduction tubercles may see different region on their body. Also, in this study, it was observed on head, anal fin and tail stalk region of matured males from the beginning of April to until the middle of June. Tubercles on different parts of *C. capoeta*'s body were reported in Nazik lake, in KoCkopru Dam lake (Elp and Karabatak, 2007), in Zernek dam lake (Kankaya *et al*., 2008) and in Karasu stream (Sen and Elp, 2009). Spawning took place intensively from last week of May to the 2nd week of July in this study. It was reported that spawning season of *C. capoeta* between May and July in Nazik lake, May and June in KoCkopru dam lake (Elp and Karabatak, 2007) and June and July in Zernek dam lake (Kankaya *et al*., 2008).

CONCLUSION

As a result, *C. capoeta* has not a good growth performance in Cigli stream because of fishing pressure, fast flowing and no meander for taking cover of fish. So, *C. capoeta* in the stream could be endangered. Therefore, fishing shall be prohibited between April and August and minimum fishing size shall be 22 cm fork length and 80 g total weight.

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