Turkish Journal of Zoology

Volume 24 | Number 1 Article 11

1-1-2000

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AYHAN YILDIRIM

M. SITKI ARAS

Turk J Zool
24 (2000) 95–101

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Ayhan YILDIRIM
Department of Fisheries, Vocational School of Hamza Polat, Atatürk University, İspir, Erzurum-TURKEY

M. Sıtkı ARAS
Department of Fisheries, Faculty of Agriculture, Atatürk University, Erzurum-TURKEY

Received: 13.10.1998

Abstract: 913 specimens of *Capoeta tinca* (Heckel, 1843) were analysed in Oltu Stream-Çoruh Basin from August, 1994 to July, 1996.

It was determined that the age distribution in the population varied between I and XII, but age group III was dominant in number. The sexual maturity of specimens in the population were complete at the age of II in males and III in females, and they spawned between May and July when water temperature was 16°C. Fecundity was on average 5561±833 eggs/female and was related to fork length, total weight, age and gonad weight.

Key Words: *Capoeta tinca,* Oltu Stream, maturity, fecundity, spawning period

Çoruh Havzası Oltu Çayı'nda Yaşayan *Capoeta tinca* (Heckel, 1843)'nın Bazı Üreme Özellikleri

Özet: Çoruh Havzası Oltu Çayı'nda Ağustos-1994 ile Temmuz-1996 tarihleri arasında yürütülen bu çalışmada toplam 913 adet *Capoeta tinca* (Heckel, 1843) incelenmiştir. Populasyonda yaş dağılımı I-XII arasında dağılım göstermiş olup, III+ yaş grubunun birey sayısı bakımından dominant olduğu belirlenmiştir. Cinsi olgunluğa ulaşma yaşının erkeklerde II, dişilerde III olduğu ve üreme mevsiminin su sıcaklığının 16°C'ye ulaştığı Mayıs-Temmuz ayları arasında gerçekleştiği tespit edilmiştir. Yumurta verimi 5561±833 adet/birey olduğu ve yumurta verimi ile çatal boy, toplam ağırlık, yaş ve gonad ağırlığı arasında ilişkiler olduğu saptanmıştır.

Anahtar Sözcükler: *Capoeta tinca,* Oltu Çayı, eşeysel olgunluk, yumurta verimi, üreme mevsimi

Introduction

Capoeta tinca (Heckel, 1843) is a species of the genus *Capoeta* of the Cyprinidae and has a wide distribution in Western Asia. In Turkish waters, there are six species and six subspecies of *Capoeta* (1, 2). Earlier studies on this genus were on distribution and taxonomy. They were carried out by Slastenenko (3), Karaman (4), Kuru (5, 6), Balık (7) and Solak (8). There is much information on the age, growth and reproduction of different species and subspecies of the genus *Capoeta* inhabiting Turkish waters (9-27), but there is little information on the age and reproduction characteristics of *Capoeta tinca* (12, 13, 19, 21, 23, 27). Since species inhabiting Çoruh Basin are captured and eaten by native people, it has economic importance.

The aim of this study was to contribute information on the age of first spawning, reproduction period, fecundity, to determine correlation fecundity with fork length, total weight, age and gonad weight of Siraz (*Capoate tinca*) in the Oltu stream in the Çoruh basin.

Study Area, Material and Methods

The study area is on Oltu stream of the Çoruh Basin Stream (41°41'49" E-40°46'51" N) (Figure 1). Specimens were collected with nets (12-12 mm) once a month in the period from August, 1994, to July 1996. The fishes were frozen immediately and transported to the laboratory. Once they were thawed, their size (fork length, FL, ±1 mm), weight, gonad wight (±0.01 g) and sex (male, female) were recorded (28).

Ten to fifteen scales were removed from the left side of the body between the lateral line and dorsal fin and mounted under binocular microscope for age determination (29). Determination of sex was accomplished by macroscopic and microscopic

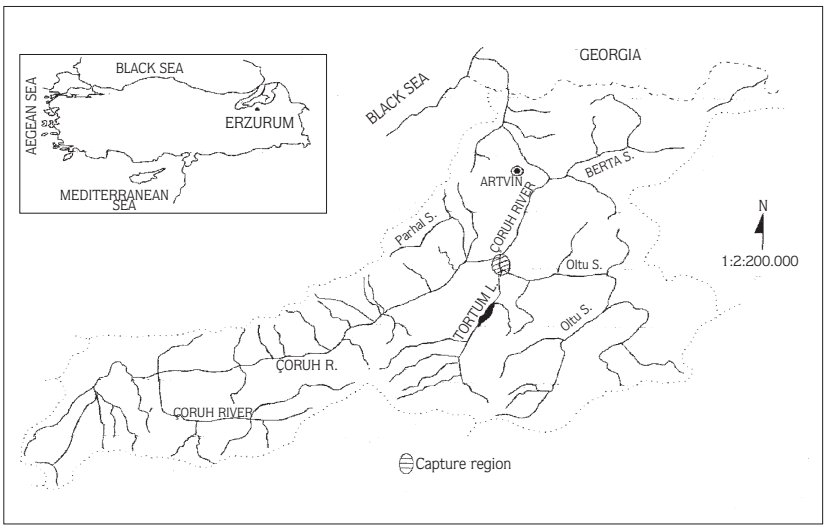

Figure 1. Map of study area.

examination of gonads. Sexual maturity was determined by observation of the stages of maturation of gonads. Spawning period was etablished with monthly variations by the gonadosomatic index (GSI). The gonadosomatic index (GSI) was calculated as follows: GSI=(gonad weight) (g)/total weight (g))x100. Fecundity was estimated in 25 females captured just prior to spawning. Fecundity was calculated by gravimetric methods (28, 30).

Results

Sex Ratio and Age Composition

The sex ratio and age composition of the fish samples are given in Table 1.

Age at First Spawning

The ages of these specimens were determined and summarized in Table 2.

Gonad Development and Spawning Period

The gonad cycle was analyzed by the gonadosomatic index (GSI). Monthly variation of the gonadosomatic index is presented in figure 2. Spawning occurred between June and July when water temperature was between 16 and 18˚C in the first year. In the second year, however, spawning occurred between May and July when water temperature was between 16 and 17˚C (Figure 2).

Table 1. Sex ratio and age composition of *Capoeta tinca* samples.

Age	Population		Male		Female		
Groups	N	%	N	%	N	%	p=0.05
I	159	17.41	89	9.74	70	7.67	p<0.05
II	236	25.85	136	14.89	100	10.95	p<0.05
III	336	36.80	208	22.78	128	14.02	p<0.05
IV	115	12.60	61	6.68	54	5.92	p>0.05
V	27	2.95	11	1.20	16	1.75	p>0.05
VI	16	1.75	1	0.11	15	1.64	p<0.05
VII	15	1.64	1	0.11	14	1.53	p<0.05
VIII	4	0.44	-	-	4	0.44	-
IX	2	0.22	1	0.11	1	0.11	-
X	1	0.11	1	0.11	-	-	-
XI	1	0.11	-	-	1	0.11	-
XII	1	0.11	-	-	1	0.11	-
Total	913	100	509	55.75	404	44.25	p<0.05

Table 2. Maturity according to age.

Age Groups	Male		Female		
	Mature	Immature	Mature	Immature	Total
I	40	49	-	70	159
II	100	36	55	45	236
III	203	5	100	28	336
IV	61	-	54	-	115
V	11	-	16	-	27
VI	1	-	15	-	16
VII	1	-	14	-	15
VIII	-	-	4	-	4
IX	1	-	1	-	2
X	1	-	-	-	1
XI	-	-	1	-	1
XII	-	-	1	-	1

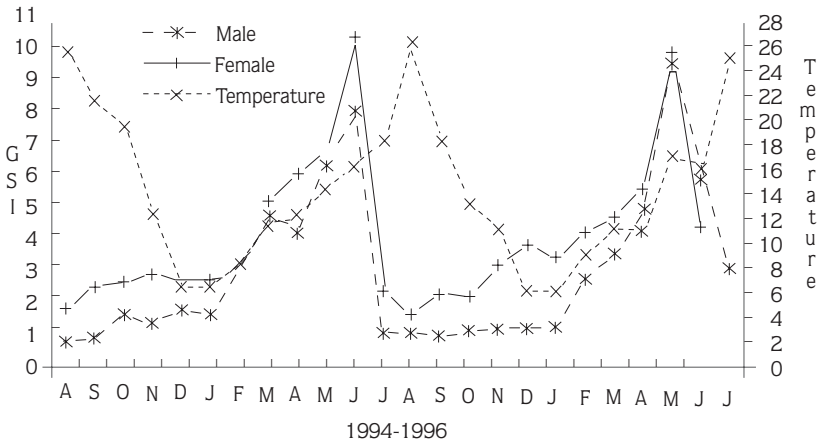

Figure 2. Monthly changes in temperature of water and GSI of males & females

Fecundity

Fecundity was estimated in 25 females captured just prior to spawning (April and May) (Table 3). Because 80.08% of the population was at the age of III and younger, the number of females caught in spawning period with eggs was low. Equations were used for calculating fish weight (Figure 3), fish age (Figure 4), fish length (Figure 5), and gonad weight (Figure 6) in relation to fecundity (F as; $F=147.35xW^{0.725}$ (N=25, r=0.91), $F=354.88xt^{1.770}$ (N=25, r=0.80), $F=11.84xFL^{1.979}$ (N=25, r=0.86) and $F=879.55xW^{0.974}$ (N=25, r=0.94) respectively).

Table 3. Mean fork length ($\overline{FL}$), total weight (W), and fecundity (F) according to age group.

Age Groups	N	Fork Length ($\overline{FL}$) (cm)	Total Weight (W) (g)	Fecundity (F)
III	6	16.30±1.18	56.40±14.96	1768±45
IV	8	19.52±0.44	94.85±7.33	3046±208
V	5	24.21±1.08	203.85±35.90	7461±1755
VI	4	25.85±0.76	244±32.51	9239±624
VII	1	26.50	259	9975
XII	1	40	838	29120
Mean	25	22.05±1.11	170.30±31.20	5561±833

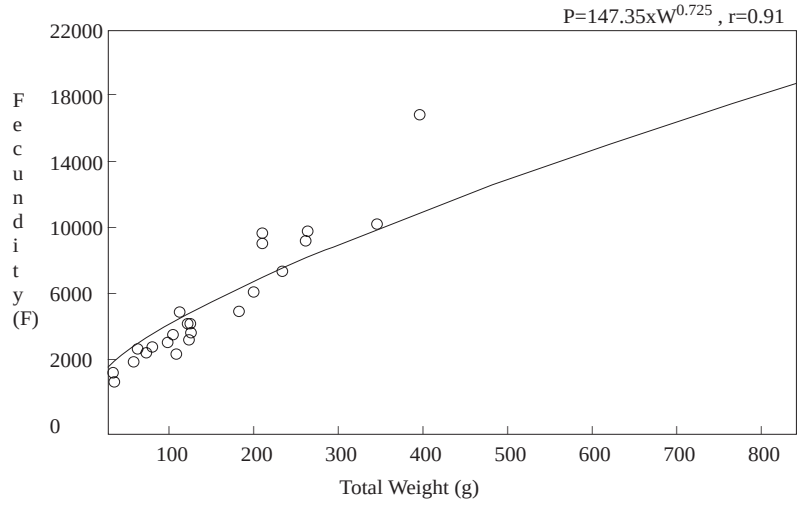

Figure 3. Fecundity-total weight relation

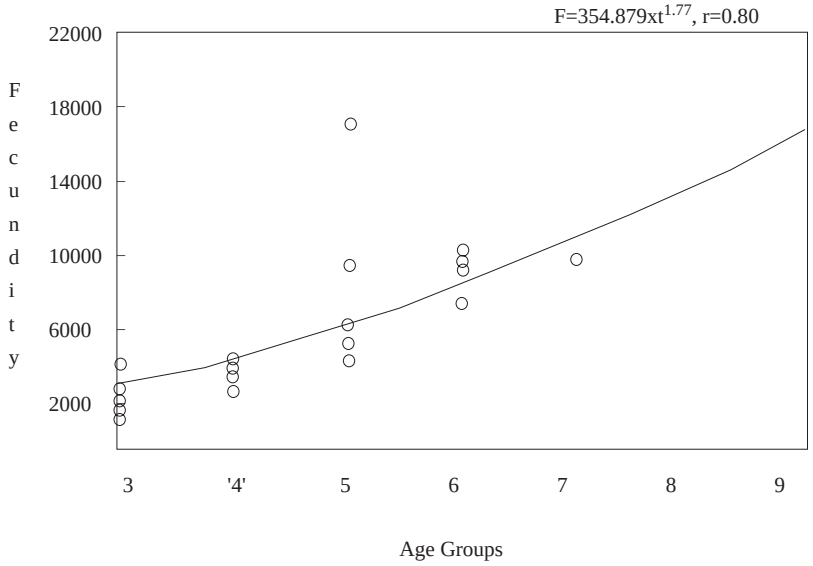

Figure 4. Fecundity-age groups relation

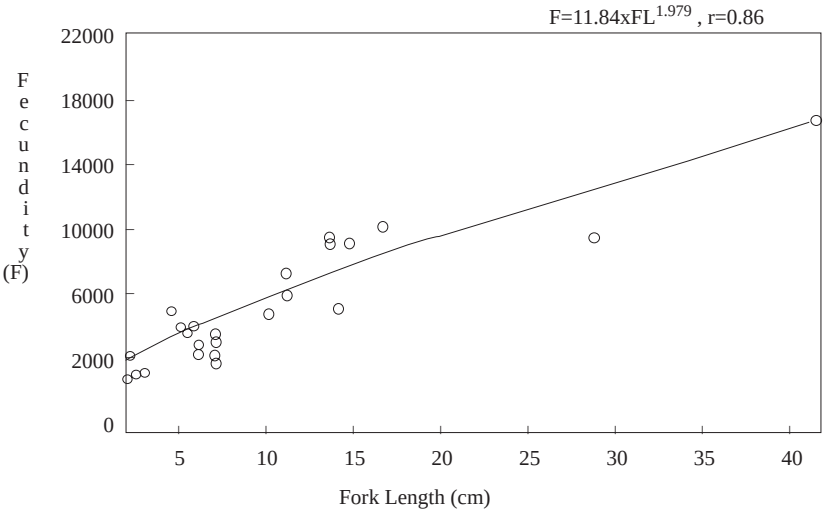

Figure 5. Fecundity-fork length relation

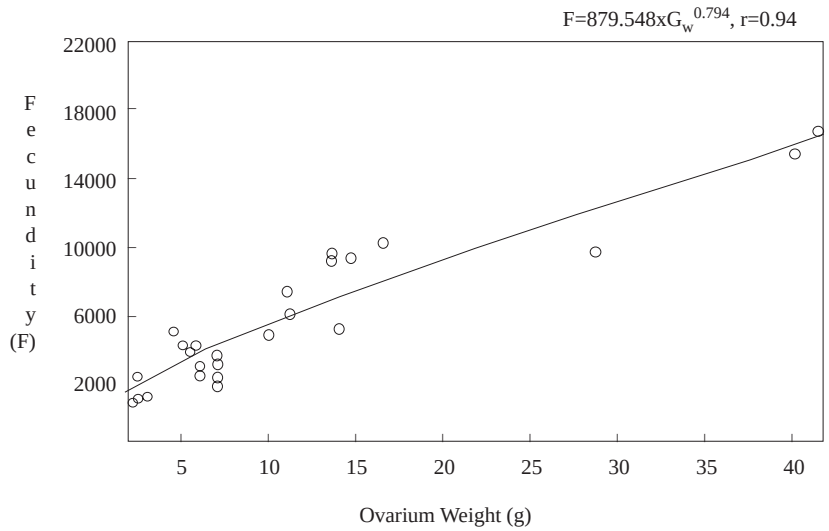

Figure 6. Fecundity-ovarium weight relation

Age	Population $\overline{FL}\pm S_{\bar{x}}$ (cm)	Male $\overline{FL}\pm S_{\bar{x}}$ (cm)	Female $FL\pm S_{\bar{x}}$ (cm)
I	9.56±0.099	9.44±0.125	9.71±0.156
II	12.21±0.008	11.98±0.099	12.52±0.132
III	15.27±0.086	15.17±0.007	15.45±0.151
IV	19.10±0.159	18.78±0.202	19.47±0.245
V	22.57±0.410	21.72±0.494	23.15±1.134
VI	25.03±0.610	25.00	25.00±0.424
VII	27.01±0.640	26.30	27.18±0.435
VIII	29.12±0.425	-	29.12±0.425
IX	31.50±1.994	31.20	31.80
X	35.50	35.50	-
XI	35.80	-	35.80
XII	40	-	40

Table 4. The length mean ($\overline{FL}$), standard error (Sx)

Discussion

One of the basic aims of rational fisheries management is to determine the reproduction properties of fish species living in lakes and rivers. Thus, the determination of properties such as spawning age, spawning season and fecundity is important for continutiy of the fish population (31).

The distribution of age in the population varied between I and XII, and age group III was observed to have the highest number (Table 1). These results are lower than those of Özdemir (10), but higher than those of Solak (8), Yanar (11), Akgül (12), EKmekçi (20), Yılmaz et al. (23), Geldiay and Balık (24), and Şen (25). In *Capoeta* species living in lakes, the dominant age groups are IV and V. (10, 20, 25). In *Capoeta* species living in rivers, the dominant age groups are II-III (11, 12, 23, 24). The variations in results can be accounted for by the different catching methods used.

The population was 55.75% male and 44.25% female, and the differences between the sexes were statistically significant ($p<0.05$). Males were more numerous than females in age groups I to VI, but the ratio of females to males was higher after age group VI (Table 2). Similar results have been found by other researchers (10, 15, 20, 21, 25). This suggests that males mature earlier than females and use more energy than females during the spawning period (28).

In this study, the age of maturity of *Capoeta tinca* was determined to be age II for males and age III for females (Table 2). Akgül (12, 13), Bircan and Aral (19), Ekmekçi (21), and Cengizler and Erdem (27) reported that ages of maturity for males and females were 2 and 3, 2 and 2,

3-4 and 4-5, 2 and 2, 3 and 3 in other *Capoeta tinca* populations, respectively. The reason for these differences is that the first spawning age is affected by age, species, size of fish and environmental factors (28, 31).

Monthly variation of water temperature and GSI values used to determine spawning period are plotted in figure 2, which shows that although the spawning period began in june of the first year, it began in may of the second year, and both years the spawning period ended in july. Solak (7), Akgül (12), Bircan and Aral (19), and Ekmekçi (21) have reported that spawning occurred in may-june, july-september, april-june and may-august in other *Capoeta tinca* populations, respectively. The spawning characteristics of fish varied with respect to their species and the ecological characteristics of the water system in which they live. These characteristics are determined by environmental factors. It has also been observed that the spawning characteristics of fish the same length having different ecological features but belonging the same species have some variation (24). Fecundity varied from a mean of 1768 eggs per female to a mean of 29120 eggs per female. Fecundity was significantly correlated with length, weight, ovarium weight and age increased. Longer and older fish had higher fecundity. Akgül (13) and Bircan and Aral (19) found 1932-16840 and 11840-57427 eggs/female in *Capeota tinca* populations respectively. Fecundity is affected by the egg size, species, feeding of fish, season and environmental conditions. In addition, it differs between populations of same species and does not remain constant from year to year. A major feature of fecundity is its increase (with certain limits) during the growth of fish. A large fish lays more eggs than a small one, and the correlation of fecundity with the weight of fish is higher than that with length and age (32).

Based on these analyses, it is wery important to give each fish the chance of reproduction at least once in its life time in order to maintain the population in equilibrium. Therefore, the minimum fishing size should be 21.47 cm in terms of total length, which is equal to 19.47 cm fork length (Table 4). It is also recommended that fishing be prohibited during the spawning season, which Lasts from April to August. It is also recommended that water temperature be taken into cunsideration.

Acknowledgements

I wish to thank the Atatürk University Research Fund for supporting this study. We are also grateful to Prof. Dr. İhsan Akyurt for his contributions.

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