Breeding properties of *Tinca tinca* (L., 1758) living in Kapulukaya Reservoir (Kırıkkale, Turkey)

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Abstract

This study involves the investigation of *Tinca tinca* (L., 1758) living in Kapulukaya Reservoir in Turkey. It was observed that the fish reach sexual maturity at the age of III and the breeding period starts in May and ends in July. The mean monthly gonadosomatic indices varied from 1.38 ±0.06 (in October) to 8.01±1.03 (in May). According to monthly variations of the GSI, spawning of the tench takes place between May (8.01 ± 1.03) and June (5.50 ± 0.57). The average egg number per fish was estimated to be 23403 ± 17047. The eggs diameters varied from 0.50 mm to 1.33 mm (mean 0.86 mm). The relations between the fecundity (F) and body length (L) and body weight (W) were found as $F = 0.037799 \times L^{1.0212}$ (r = 0.70) and $F = 0.00000175 \times W^{2.8696}$ (r = 0.62).

Keywords: *Tinca tinca*, Tench, Breeding, Kapulukaya Reservoir, Kırıkkale Turkey

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Introduction

T. tinca was originated in Near-East and Siberia and spread all over the world (Lukowicz and Proske, 1979). It is known that this species is abundantly present in the rivers which flow into the Black Sea and lakes located in various parts of Anatolia (Lukowicz and Proske, 1979; Kuru, 1994). This fish has a fairly slow growth rate and is of very little economic importance. It is consumed locally. Some of the researches related to *T. tinca* in Turkey and in the world are as follows:

Cerny (1968) examined its growth properties, Horoszewicz (1983) in natural ponds, Göktaş (1987) in Mogan Lake, Pimpicka (1990, 1991) reproduction in Lake Drweckie, Neophiotu (1993) growth in Pamvotida Lake (Greece), Hubenova-Siderova et al. (1995) in pond culture in Bulgaria, Perez-Regadera and Gemio (1995) reproduction in spawning ponds, Yılmaz (1997) in Porsuk Dam Lake, Altındağ et al. (1998) growth in the Kesikköprü Reservoir, Yılmaz (2002) in Porsuk Dam Lake, Alaş and Solak (2004) reproduction in Kayaboğazı Reservoir, Erol et al. (2006) growth in Beysehir Lake, Benzer et al. (2007) reproductive biology in Hirfanlı Reservoir, Alaş and Ak (2007) in Beysehir Lake, Benzer et al. (2009) in Hirfanlı Reservoir and Balık et al. (2009) growth in Beysehir Lake.

Ecological factors affect the biological and reproduction characteristics of fish populations and so these kinds of investigations should be carried out periodically. The main purpose of the present investigation was to study reproduction biology in *T.tinca*. This is the first study of *T.tinca* in Kapulukaya Reservoir.

Materials and methods

This study was carried out on 380 *T. tinca* fish (170 females and 194 males) caught between November 2003 and October 2004 in Kapulukaya Reservoir constructed on Kızılırmak River (Figure 1). The fish were caught with trap nets having a length of 20, 40, 60 m, width of 2.5 - 3 m and mesh size of 18, 23, 32, 36, 45, 55 and 60 mm.

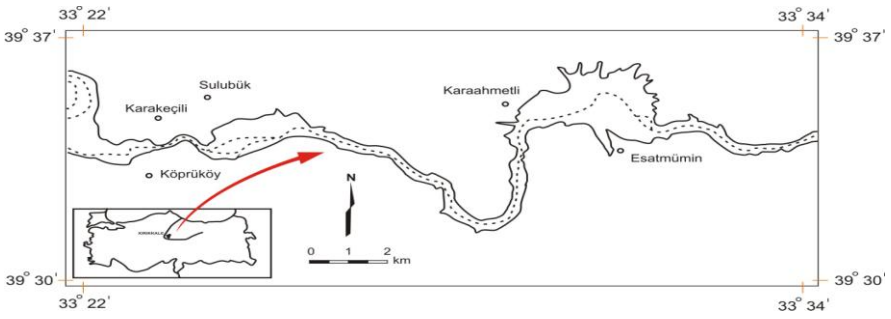

Figure 1: Kapulukaya Reservoir.

The weight and the length of the fish were measured at an accuracy of 0.1 g and 1mm. There were 30-40 scales taken from dorsal fin to lateral line of each fish and

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they were appropriately prepared to determine the ages of the fish (Lagler, 1966; Geldiay and Balık, 1988).

The gender of the fish was determined from the gonads. The fecundity was investigated on 150 female individuals. The ovaries of each fish were weighted. A 1-gram piece was taken from each ovary and the numbers of its eggs were counted under a microscope. The total fecundity of each individual was then determined by the use of the ratio of this 1-gram piece to the total weight of the ovary.

The radii of approximately 30 eggs taken from the upper, middle and lower parts of the ovaries were measured by the use of calipers and the change of the radii was determined. The number of eggs was estimated by gravimetric methods (Bagenal, 1978).

The ovaries of the females were followed throughout the breeding period and the number and the ratio of the ones, which did not spawn eggs, were tabulated. The period of breeding was determined according to gonadosomatic index (GSI), variation in egg radii according to months and the number of individuals who did not spawn eggs. GSI was computed using the following equation (Lagler, 1966; Bagenal, 1978). GSI = GW / W x 100 (GW= Gonad Weight, W=Body Weight).

Sexual maturity was confirmed by noting macroscopically according to the presence of "yolked eggs" or sperm in the gonads (Nikolsky, 1963). On the other hand, Fecundity (F) - fork length (L) and Fecundity - body weight (W), were calculated with regressions analyses. Fecundity (F) was calculated from the equation (Nikolsky, 1969).

$F = a.L^{b}$ and $F = a.W^{b}$

Results

The investigation of the gonads of *T. tinca* individuals living in Kapulukaya Reservoir showed that they reach sexual maturity at the age of III. The monthly variations in GSI values and egg radii were followed. The GSI value was found to be the highest in May and the lowest in August and started to increase after that (Figure 2). It was determined that the egg diameter reached the maximum value of 1.22 mm in May and ovariums were empty in July (Figure 3). The fecundity was determined to range between 14.512 and 52.292 and increase with age (Table 1). The assessment of the main spawning season of this species in the reservoir was based on the GSI and analyses of seasonal development in mean egg diameter and water temperature (Table 2). The examination of the monthly variations of GSI values and egg radii of the fish revealed that its breeding takes place between April and June (Table 2). It was determined that the egg diameter of *T.tinca* in Kapulukaya Reservoir reached the maximum value in May (Table 2 and Figure 3).

Discussion

The breeding age of *T. tinca* living in Kapulukaya Reservoir was found to be III. Göktaş (1987) determined the breeding age of the *T. tinca* individuals in Mogan Lake as III for females and III-IV for males. Yılmaz (2002) found the same values as III for females and III-IV for

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males in *T. tinca* population living in Porsuk Reservoir.

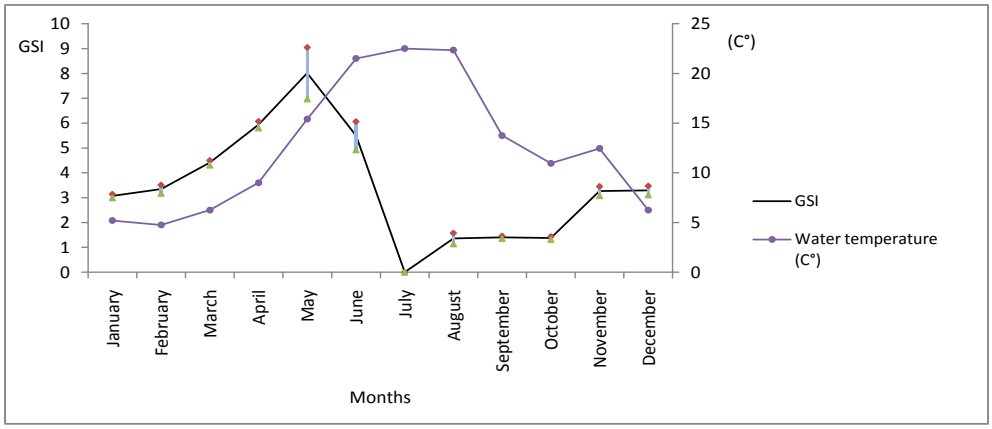

Figure 2: The variation of gonadosomatic index (GSI) and water temperature *T. tinca* living in Kapulukaya Reservoir according to months

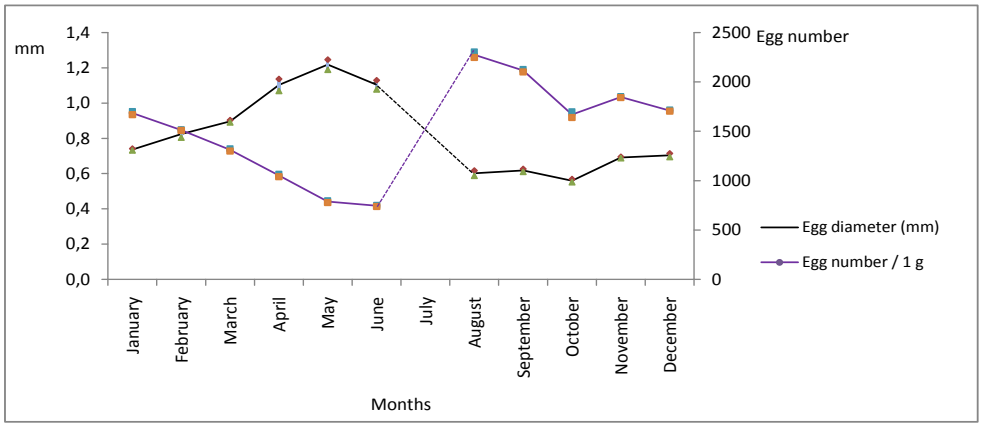

Figure 3: Seasonal changes in egg diameter and egg number of *T. tinca* living in Kapulukaya Reservoir

Table 1: The average fork length, weight and fecundity of female *T. tinca* according to age

AGE	N	FL ± SD	W ± SD	F ± SD	95% Cl
III	32	249.37 ± 2.03	305.62 ± 6.89	14512.03 ± 421.50	15338.16 - 13685.90
IV	28	269.78 ± 3.15	394.78 ± 9.72	16715.53 ± 1159.05	18987.25 - 14443.82
V	49	296.53 ± 2.38	513.67 ± 8.14	23383.08 ± 1365.85	26060.10 – 20706.06
VI	26	326.53 ± 4.13	658.65 ± 26.35	35689.23 ± 4981.04	45451.90 - 25926.57
VII	11	355.9 ± 6.63	818.18 ± 46.06	44518.18 ± 7477.04	59172.90 - 29863.46
VIII	4	388.75 ± 3.14	1015 ± 77.94	52292.5 ± 11935.82	75686.28 - 28898.72

SD: Standard Deviation; FL:Fork Length ; W: Weight ; F: Fecundity ; Cl: Confidence limit

The regression equations were $F = 0.037799 \times L^{1.0212}$ (r = 0.70) for fecundity and fork length (L) and $F = 0.00000175 \times W^{2.8696}$ (r = 0.62) for fecundity and weight (W). The statistical results of these relations are given in Figure 4.

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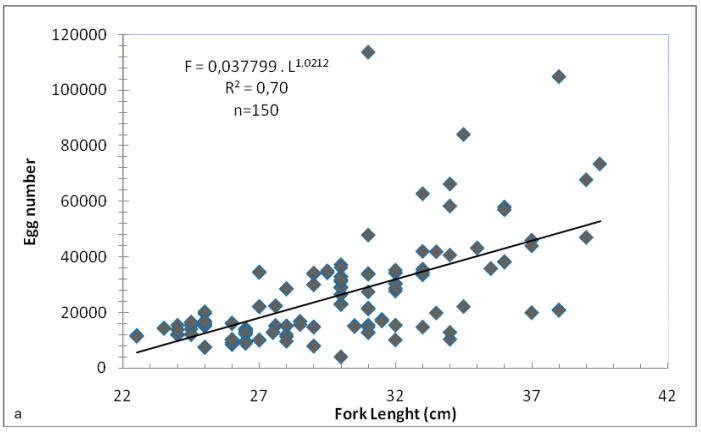
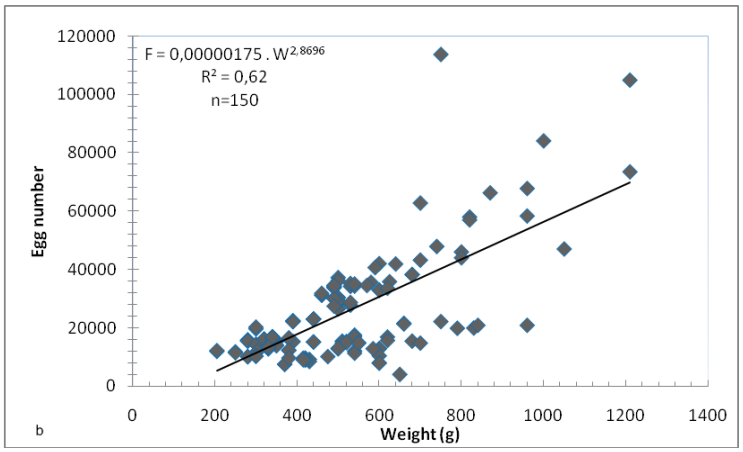
Table 2: The average fork length, weight and fecundity of female *T. tinca* according to months

MONTHS	GSI (X ± SD)	95% CI	Egg diameter (mm) (X ± SD)	95% CI	Egg number/g (X ± SD)	95% CI	Water temp. (C°)
November	3.38 ± 0.19	3.00 - 3.76	0.69 ± 0.00	0.68 - 0.70	1846.66 ± 8.33	1830.33 - 1863.00	12.45
December	3.35 ± 0.20	2.94 - 3.76	0.70 ± 0.01	0.69 - 0.73	1710.38 ± 9.07	1692.22 - 1727.78	6.25
January	3.13 ± 0.04	3.04 - 3.21	0.74 ± 0.00	0.73 - 0.74	1672.81 ± 11.65	1649.97 - 1695.65	5.20
February	3.29 ± 0.26	2.96 - 3.62	0.86 ± 0.01	0.85 - 0.88	1520.71 ± 3.16	1514.51 - 1526.92	4.75
March	4.32 ± 0.12	4.07 - 4.57	0.90 ± 0.01	0.89 - 0.92	1334.58 ± 11.27	1312.49 - 1356.68	6.25
April	5.95 ± 0.14	5.68 - 6.22	1.10 ± 0.03	1.04 - 1.18	1057.89 ± 12.74	1032.92 - 1082.87	9.00
May	8.01 ± 1.03	5.98 - 10.05	1.22 ± 0.03	1.16 - 1.27	789.00 ± 10.28	768.85 - 809.15	15.40
June	5.50 ± 0.57	4.38 - 6.61	1.10 ± 0.03	1.05 - 1.15	745.67 ± 7.23	731.51 - 759.83	21.50
July	ND	ND	ND	ND	ND	ND	22.50
August	1.33 ± 0.23	0.87 - 1.79	0.60 ± 0.02	0.57 - 0.63	2290.83 ± 26.81	2238.28 - 2343.38	22.35
September	1.41 ± 0.05	1.30 - 1.51	0.62 ± 0.01	0.60 - 0.63	2114.37 ± 12.80	2089.28 - 2139.46	13.75
October	1.38 ± 0.06	1.26 - 1.50	0.56 ± 0.01	0.54 - 0.58	1670.00 ± 30.29	1610.63 - 1729.37	10.95

ND: Not Defined SD: Standard Deviation; CI: Confidence limit





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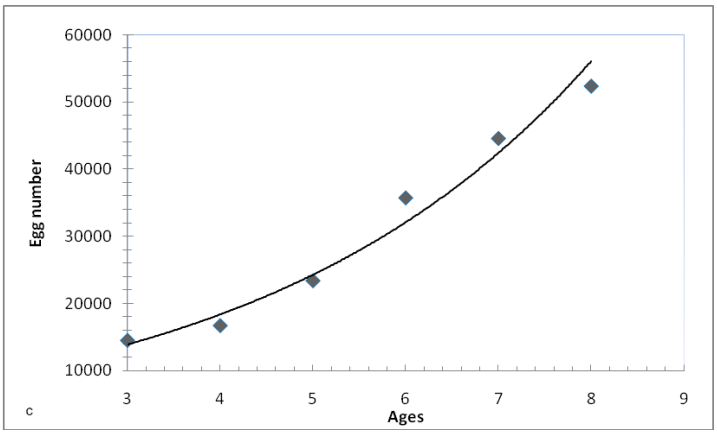

Figure 4: Relationships between fecundity-fork length (a), fecundity-total weight (b) and fecundity- ages (c) of *T. tinca* living in Kapulukaya Reservoir

Alaş and Solak (2004) found the same values as III for males and IV for females in Kayaboğazı Reservoir and Benzer et al. (2007) found the same values as III for males and females in *T. tinca* population living in Hirfanlı Reservoir. Neophitou (1993), on the other hand determined the age of breeding for *T. tinca* inhabiting Pamvotida Lake in Greece as III for both sexes.

The spawning period of *T. tinca* individuals living in Kapulukaya Reservoir was determined to be between the end of April and to the beginning of July. Göktaş (1987) and Yılmaz (2002), on the other hand determined this period as July–September and April–July for *T. tinca* populations in Mogan and Porsuk Reservoir. Alaş and Solak (2004) determined this period as June–July in Kayaboğazı Reservoir and Benzer et al. (2007) determined this period as April-July in Hirfanlı Reservoir. Neophitou (1993) states that the spawning period of *T. tinca* individuals in Pamvotida Lake in Greece as May- June.

Poncin et al. (1987) states that *T. tinca* individuals spawned their eggs in June and July which began to develop in April. Nikolsky (1963) reported that *T. tinca* individuals carried out their breeding activities from mid April to the beginning of August. Berg (1963) however claims that the breeding period of *T. tinca* is between May and June.

The surface water mean temperature of Kapulukaya Reservoir was 9 ºC in April and 21.50 ºC in June when *T. tinca* spawns its eggs. The increase of temperature was found to have a positive effect on the egg spawning process. Alaş and Solak (2004) report that the surface water mean temperature of Kayaboğazı Reservoir was 16.1 ºC – 19.2 ºC in June–July, the breeding period of *T. tinca*. Yılmaz (2002) indicates that the surface water temperature of Porsuk Reservoir was 23.4 ºC in June and 25.6 ºC in July which corresponds to the breeding period of *T. tinca* population living there. Benzer et al. (2007) reports that the surface water temperature of Hirfanlı Reservoir was 16.4 ºC – 22 ºC in May and 24.3 ºC - 24.7 ºC in June, the breeding period of *T. tinca*. Neophitou (1993) says that the surface temperature of Pamvotida Lake in May–June was 18 ºC - 20 ºC when *T. tinca* living in the lake start to breed. Finally Perez-Regadera and Gemio (1995) reported that the *T. tinca* individuals living in culture pools spawned their eggs in

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May-June when the surface water temperature was 18 ºC.

Alaş and Solak (2004) calculated the average fecundity of *T. tinca* individuals as 42.723 in Kayaboğazı Reservoir. Yılmaz (1997) determined this value as 21.954 for *T. tinca* population in Porsuk Reservoir. Benzer et al. (2007) calculated the fecundity of *T. tinca* as 23.105 in Hirfanlı Reservoir. This value was found to be 23403 ± 17047 for Kapulukaya Reservoir.

The egg radii of *T. tinca* were found to range between 0.606 and 1.195 mm in Porsuk Reservoir (Yılmaz, 1997), 0.532 and 1.078 mm in Kayaboğazı Reservoir (Alaş and Solak, 2004) and 0.400 and 1.300 mm in Hirfanlı Reservoir (Benzer et al., 2007). The egg radii were found to range between 0.500 and 1.325 mm in Kapulukaya Reservoir.

A positive correlation between fecundity and fish weight and length has been described in most freshwater fish populations (Ünlü and Balcı, 1993). Alaş and Solak (2004) found the regression equations of *T. tinca* as Log F = -2.18301 + 2.923 Log L (r=0.96) for fecundity and fork length (L) and Log F = -2.889918 + 0.792 Log W (r=0.97) for fecundity and weight (W) in Kayaboğazı Reservoir. In this study, an acceptable correlation was calculated between fecundity,fish weight and length.

In conclusion, *T.tinca* was able to adapt well in Kapulukaya Reservoir because of its good reproduction ability. Therefore we suggest that specimens should not be caught before they reach sexual maturity age and from the beginning of May and the end of July to be able to preserve the *T.tinca* population in this lake.

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