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The Age and Growth Features of Tench (*Tinca tinca* L., 1758) in Kapulukaya Dam Lake, Central Anatolia, Turkey

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Abstract: In this study age and growth features of tench (*Tinca tinca* L., 1758) living in Kapulukaya Dam Lake (Ankara, Turkey) were studied between April 2000 and March 2001. Totally, 150 tench were examined. Fish aged I-VII years were present and the population was 55.31% female and 44.69% male. The fork length and weight of females varied from 18.6-36.1 cm and from 85-1060 g, respectively and in males from 16.6-34.4 cm and from 140-1120 g, respectively. Age-length and age-weight relations were calculated according to von Bertalanffy growth equation formula. The following values were obtained for females and males, respectively. $L_t = 45.11 [1-e^{(-0.15607 (t+1.97938)}]$, $W_t = 1974.62 [1-e^{(-0.1617 (t+1.8213)}] 3.1752$, $L_t = 44.61 [1-e^{(-0.1617 (t+1.8213)}]$, $W_t = 1730.58 [1-e^{(-0.15607 (t+0.97938)}] 2.9571$. The length-weight correlation was found to be $W = 0.0228 L^{2.9571}$ for males and $W = 0.0111 L^{3.1752}$ for females.

Key words: Growth, condition factor, tench, age, correlation, Turkey

INTRODUCTION

The tench, *Tinca tinca* (L., 1758), commonly inhabits relatively shallow weedy lakes and slow flowing rivers. They are very tolerant to low concentrations of oxygen and high concentrations of carbon dioxide and also to high temperatures to which their tolerance varies according to the season. They commonly occur in meanders of rivers but could also exist in swamps, weedy fish ponds and waters that were heavily polluted with organic materials (Weatherley, 1959). Since the 19th century, these fish have been bred as an important pool fish in central Europe particularly for cleaning carp pools and garden pools (Michaels, 1988).

In Turkey, these fish live in rivers flowing into the Black Sea from Thrace and Northern Anatolia (Kuru, 1996).

Although, several studies have already been conducted on these fish by Le-Cren (1951); Weatherley (1959); Skora (1964); Cerny (1968); Lukowicz and Proske (1979); Labee-Lund (1985); Wright and Giles (1991); Siderova *et al*. (1995); Pimpicka and Piros (1999) and Gonzales *et al*. (2000) in Turkey there are very few such as Yigit (1995); Altindag *et al*. (1998, 2002); Balik *et al*. (2000) and Yilmaz (2002). The aim of present study is to investigate the population structure and growth features of tench in Kapulukaya Dam Lake.

MATERIALS AND METHODS

Study area: Kapulukaya Dam Lake (39°40'N-33°30'E) located on the Kizilirmak River has been operated since 1989 for drinking, irrigation and energy supply. It has a surface area of 20.60 km^2 and a maximum depth of 60 m. The other fish species that inhabit the lake are *C. carpio* L., 1758, *Stizostedion lucioperca* L., 1758, *Squalius cephalus* L., 1758, *Esox lucius* L., 1758, *Chondrostoma* sp., *Barbus plebejus* Steindachner, 1897, *Capoeta capoeta* Heckel, 1843, *Silurus glanis* L., 1758 *and Capoeta tinca* Heckel, 1843. However, tench is the most abundant species in the lake and widely captured by the local fishermen.

On the other hand, this lake is under the threat of pollution and cyanophyta blooms occur during summer (Basaran *et al*., 2004). Prior to this study, extensive research on the fish populations of the lake is completely lack except the biology of *Capoeta. tinca*, *C. carpio*, *S. cephalus* and *S. lucioperca* (Yilmaz, 1994; Gul, 1994). The aim of present study was to examine the population structure and growth features of tench in Kapulukaya Dam Lake.

Sampling methods: The study was carried out in Kapulukaya Dam Lake on Kizilirmak River (Fig. 1) between April 2000 and March 2001. A total of 150 specimens were

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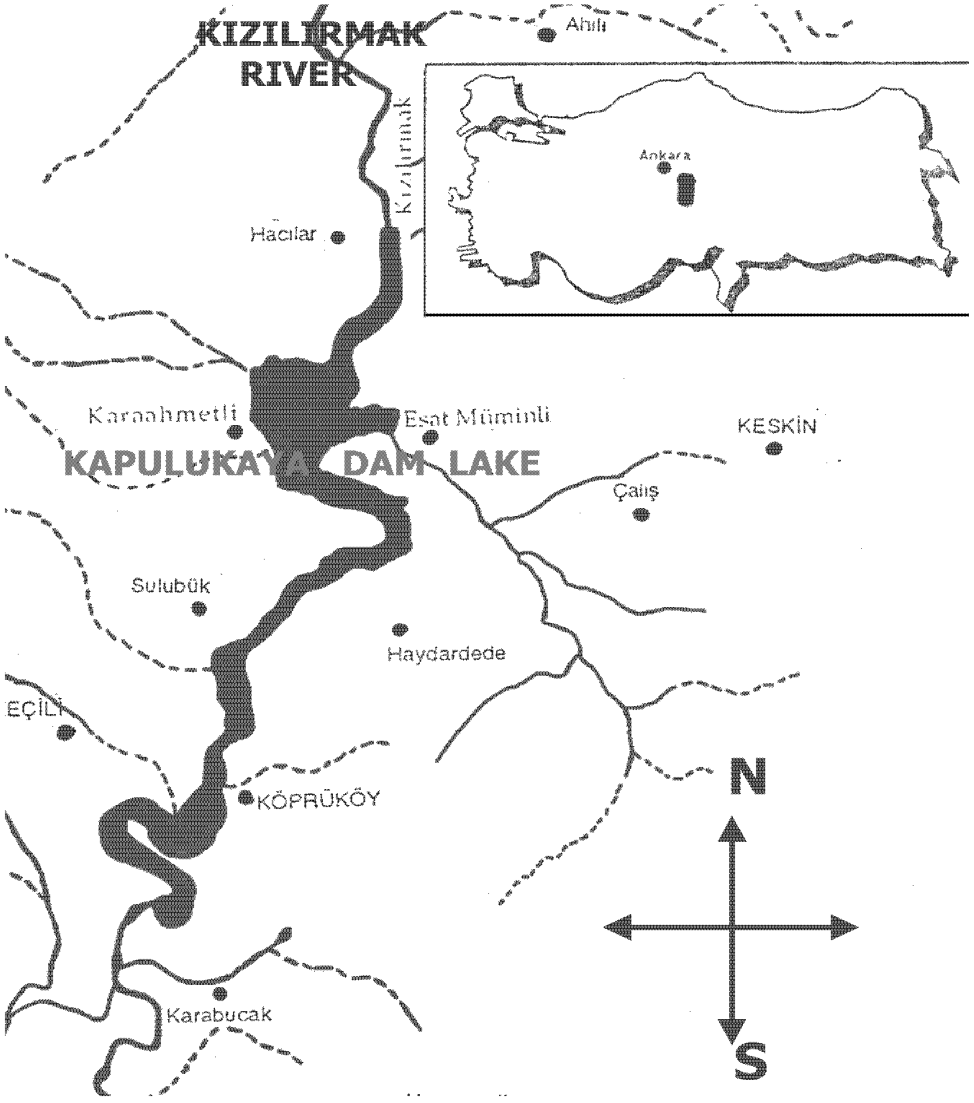

Fig. 1: Study area and kapulukaya dam lake basin

captured with gill-nets of various mesh sizes. Fork Length (FL) and Weight (W) were recorded nearest to 1 mm and 0.01 g, respectively. Sex was determined by macroscopical examination of gonads. Age of tench was ascertained from scales by a microfiche reader according to Lagler (1966). The scales from the left side of the body between the lateral line and dorsal fin were gathered and analyzed (Lagler, 1966).

Von Bertalanffy's growth equation was used to determine age-length and age-weight relationships. Growth was investigated by fitting the von Bertalanffy growth function to pooled size at age and weight-at-age data for both sexes using standart non-linear optimization methods. The von Bertalanffy growth function were calculated according to; $Lt = L\infty\ (1\text{-}e^{k(t\text{-}to)})$ for FL and weight $W_t = W_\infty\ (1\text{-}e^{k(t\text{-}to)})^b$ (Bertalanfy, 1938). Where L_t length at age t, $L\infty$ the asymptotic length, k the growth coefficient and t_o is the hypothetical age at which length is equal to zero, W_t is the weight of the fish in g at age t, W_∞ is the asymptotoic weight of the fish in g and b is the constant in the length-weight relationship (Ricker, 1975; Sparre and Venema, 1992).

The length-weight relationship ($W = aFL^b$) was calculated separately for the two sexes using the least squares method with length expressed in cm and weight in grams (Ricker, 1975).

The comparison of the length, weight between sexes was done for age classes using t-test. Statistical analyses were carried out with SPPS for Windows V 11.0.

RESULTS AND DISCUSSION

Population structure: Population structure of the tench was revealed examining 150 specimens. It was determined that the tench population constitute on 55.31% of female and 44.69% male. Age variation ranged from the age group I to the age group VII and the most common group was the age III (42.00%) (Fig. 2).

The average lengths of females in age group I were 19.00 and 35.00 cm for age group VII. The average lengths of males in age group I were 17.05 and 34.20 cm for age group VII. Apart from the length the average weights of specimens varied from 183 g for age I to 980 g for age VII in females and 194 g for age 1-1058 g for age VII in males (Table 1).

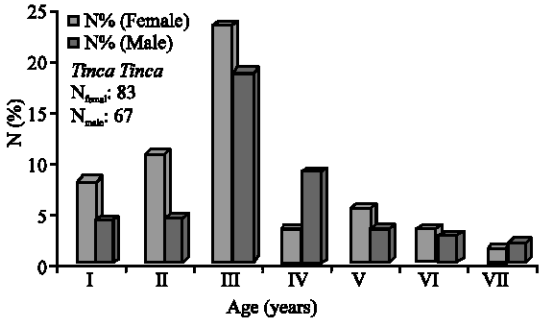

Fig. 2: Distribution of males and females of tench according to age in Kapulukaya Dam Lake

Age-length and age-weight relationship: The von Bertalanfy growth equation was obtained by using the mean lengths of each age groups of males and females ultimate lengths and ultimate weights of males and females were determined (Table 2, 3 and Fig. 3, 4). Maximum length of the females was higher than maximum length of males.

Length-weight relationship: The Length-weight relationship of tench was calculated separately for both sexes and length-weight curves were drawn for males and females (Fig. 5). Length-weight equation was found to be $W = 0.0228\ L^{2.9571}$ ($R^2 = 0.9705$) for males and $W = 0.0039\ L^{3.1752}$ ($R = 0.9618$) for females. b value of female individuals was higher than that of the male individuals.

The age distribution of the tench population in Kapulukaya Dam Lake ranged from I-VII age groups. Of the specimens examined, it was determined that, age group III was the largest, followed by groups II, IV, I, V, VI and VII (Fig. 1). In Kesikkopru Dam Lake which is constructed on the Kizilirmak, the age distribution between the same age groups was 51.43% for females and 48.57% for males and the population density was high in age group IV (28.57%) (Altindag *et al*., 1998). In the Kapulukaya Dam Lake, it was high in age groups III and II (42.00 and 15.33% respectively; total 57.33% (Fig. 1). In Isikli Lake, most of the age variation was observed between age groups I and V. High individual numbers were observed in age group I and II (Balik *et al*., 2000).

Table 1: Mean Fork Length (FL, cm) and mean Weight (W,g), Standart Error (SE) for different age groups of tench males and females in Kapulukaya Dam Lake caught in 2000 and 2001

	Female			Male				
Age	N	FL±SE (Min.-Max.)	W±SE (Min.-Max.)	N	FL±SE (Min.-Max.)	W±SE (Min-Max.)	p = 0.05*	p = 0.05**
I	12	19.00±0.390 (18.6±22.3)	(182.5±10.58) (85-225)	6	17.05±0.051 (16.6-21.5)	193.57±6.65 (180.4-225)	p<0.05	p<0.05
II	16	22.71±0.058 (21.6-23.1)	226.25±6.77 (180-285)	7	21.16±0.059 (81.04-22)	212.86±7.86 (190-240)	p<0.05	p<0.05
III	35	24.37±0.121 (23.4-26.7)	282.31±7.15 (145-380)	28	24.16±0.247 (23.2-25.6)	310.41±12.91 (140-403.6)	p<0.05	p>0.05
IV	5	29.62±0.215 (26.8-30.9)	535±24.19 (500-610)	14	28.14±0.234 (27.8-30.2)	472.5±38.44 (365-950)	p<0.05	p>0.05
V	8	30.81±0.263 (30.6-32.1)	586.25±22.89 (510 - 710)	5	29.50±0.210 (30.6-31.8)	598 ± 27.00 (525 - 670)	p>0.05	p<0.05
VI	5	33.40±0.263 (34.5-36.1)	697±45.21 (575 - 780)	4	32.70±0.328 (32.5-34)	837.5±31.46 (750 - 900)	p<0.05	p<0.05
VII	2	35.00±0.250 (34.4-35.6)	980±80.00 (900-1060)	3	(34.2±0.405) 34.1-34.4	1058.33±1.99 (955-1120)	p>0.05	p<0.05

N: number of tench (*Tinca tinca*), values of p; significance level, min-max: minimum and maximum values, *Significance values belong to FL values, **Significance values belong to W values

Table 2: Von Bertalanffy length-growth parameters and equations of the tench in Kapulukaya dam lake

	Growth parameters			
Sex	L_∞	k	t_o	Growth equations
Females	45.11	0.15607	-1.97938	$L_t = 45.11\ (1\text{-}e^{(-0.15607\ (t+1.9793))})$
Males	44.61	0.16170	-1.82130	$L_t = 44.61\ (1\text{-}e^{(-0.1617\ (t+1.8213))})$

Table 3: The weight-growth parameters and equations of tench according to von bertalanffy for sex in Kapulukaya dam lake

	Growth parameters				
Sex	W_∞	k	t_o	b	Growth equations
Females	1730.58	0.156	-1.9794	2.9571	$W_t = 1730.58\ (1-e^{-0.15607\ (t+1.97938)})$ 2.9571
Males	1974.62	0.161	-1.8213	3.1752	$W_t = 1974.62\ (1-e^{-0.1617\ (t+1.8213)})$ 3.1752

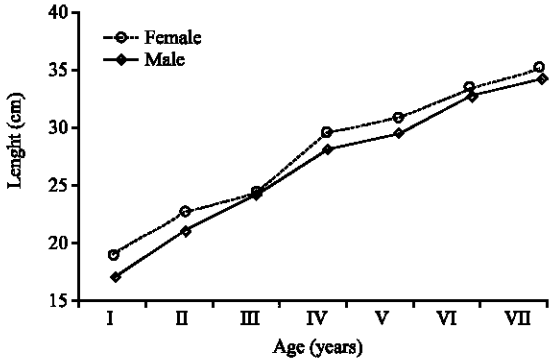

Fig. 3: The curve of the age-length relationship of female, male for tench

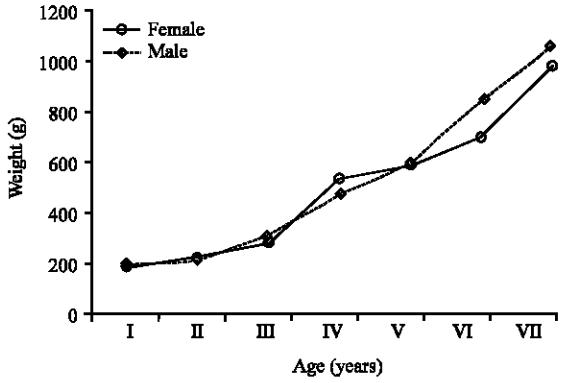

Fig. 4: The curves of the age-weight relationship of females, males and sex combined for tench

In Vegoritis Lake high individual numbers in the tench population have been reported in age group III (Sinis *et al*., 1999). The values obtained from the present study are similar to that of Lake Vegoritis. Nikolsky (1963) stated that many factors such as available food items, population density and temperature may have a direct or indirect effect on the growth rate in length and weight of fish. However, the difference from those of Kesikkopru and Bayindir Dam Lake may be attributed to the use of various nets of different mesh sizes.

The studies on the age-length relationship of tench population in Turkey and in other country were shown in the Table 4. Age-length values of tench show differences according to the researchers (Table 4). This

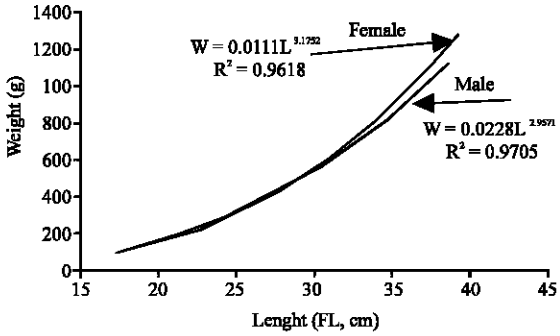

Fig. 5: The curve of the length-weight relationship of tench in the Kapulukaya dam lake

situation may be derived from differences of ecological factors in the lake. Differences in length in relation to age may be attributed to temperature variations affecting fish growth and different ecological conditions of the lake studied.

Weights of tench individuals in this study, ranged from 85-1120 g (85-1060) g for female and 180.4-1120 g for male, respectively). In Kesikkopru Dam Lake it was 85-1350 g for female and 83-1127 g for males (Altindag *et al*., 1998). In Bayindir Dam Lake the weight of the specimens was 51.4- 650.8 and 52.8- 822.6 g for females and males (Altindag *et al*., 2002). The age-weight value of tench population in Kapulukaya Dam Lake (according to the each age group) was higher than those of Bayindir Dam Lake. But similarly was the same value with Kesikkopru Dam Lake. It indicates that, tench population in Kapulukaya and Kesikkopru Dam Lake was well fed when compared to Bayindir Dam Lake. The differences in weight distribution in those studies may be due to the water quality (such as temperature), food availability and/or use of nets of various mesh sizes.

The length-weight relationship in fish may vary according to the species, age, nutrition, season and sexual maturity (Ricker, 1975; Bagenal, 1978). The length-weight relationship of tench in Kapulukaya Dam Lake was Length-weight equation was found to be $W = 0.0228\ L^{2.9571}$ ($R^2 = 0.9705$) for males and $W = 0.0039\ L^{3.1752}$ ($R = 0.9618$) for females. In Mogan Lake this relationship was, LogW = -1.8632+3.0402 LogL for females, LogW = -1.8210+2.9836 LogL for male. In addition this the length-weight relation of tench in Kesikkopru Dam Lake for females and males was recorded by LogW = -3.9315+3.2470 LogL; Log W = -2.294+3.0358

Table 4: The Age-forked length relationship of *Tinca tinca* (combined sex) in Turkey and other countries

Locality	I	II	III	IV	V	VI	VII	Researchers
Mogan lake (Turkey)	8.30	12.87	18.28	21.20	23.37	25.63	27.73	Ergonul (2004)
Bayindir dam lake	16.52	21.12	26.14	29.77	33.35	-	-	Altindag *et al.* (2002)
Kesikkopru dam lake (Turkey)	16.20	22.83	25.67	28.94	31.57	36.89	-	Altindag *et al.* (1998)
Isikli lake (Turkey)	14.09	19.06	22.63	26.08	27.40	-	-	Balik *et al.* (2000)
Porsuk dam lake (Turkey)	-	19.43	22.10	23.90	25.30	28.30	30.40	Yilmaz (2002)
Kapulukaya dam lake (Turkey)	19.00	22.71	24.37	29.62	30.81	33.40	35.00	Present study
Vegoritis lake (Greece)	-	17.20	19.50	23.10	25.80	30.10	36.00	Sinis *et al.* (1999)
Goczalkowice reservoir (Poland)	7.10	11.50	15.60	19.60	28.10	31.30	33.80	Skora (1964)
Slapy reservoir (Poland)	5.70	10.10	14.30	18.40	21.80	26.10	29.20	Cerny (1968)
Coal stream (Tasmania)	3.00	5.40	8.70	13.40	18.00	21.40	23.80	Weatherley (1959)
Jorkjenn lake (Norway)	4.10	8.20	13.60	17.20	21.20	23.10	25.20	Labee-Lund (1985)
Main lake (England)	-	7.50	10.00	20.50	26.0	28.50	30.00	Wright and Giles (1991)

LogL, respectively (Altindag *et al*., 1998). The variations of b value observed in different regions could be the results of environmental factors (Le-Cren, 1951; Nikolsky, 1963; Cushing, 1968).

CONCLUSION

Tench are found in several natural and dam lakes in Turkey. Although it is not very an economically important fish it may be consumed as an alternative in the future when stocks of economically important fish decrease. In addition, these fish may also be used to clean carp pools and in the mineralization process. This study provides basic information about the growth and population structure of tench in Kapulukaya Dam Lake.

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