

GROWTH PROPERTIES OF TENCH (*Tinca Tinca L.*, 1758) LIVING IN KAPULUKAYA DAM LAKE, TURKEY

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Abstract

*This study is concerned to the growth properties of Tench (*Tinca tinca L.*, 1758) living in Kapulukaya Dam Lake. Among the 364 fish specimens caught between November 2001 - October 2002 ranging between I - VIII ages it was determined that the population was mainly constituted by IV and V. age group individuals. Among the context of growth properties the length and weight growth relationship and condition factor of the fish were investigated. The relation of the length of the fish to its weight was found to be $W=0.00015259 \times L^{2.6317}$. The condition factor was determined as 1.95.*

Key words: *Tinca tinca, Tench, Growth, Condition, Kapulukaya Dam Lake.*

KAPULUKAYA BARAJ GÖLÜ'NDE YAŞAYAN KADİFE BALIĞI (*Tinca Tinca L.*,1758)'NİN BÜYÜME ÖZELLİKLERİ

Özet

*Bu araştırmada Kapulukaya Baraj Gölü'nde yaşayan *Tinca tinca*'nın büyüme özellikleri incelenmiştir. Kasım 2001-Ekim 2002 arasında yapılan bu çalışmada 364 adet balığın I-VIII yaşları arasında dağılım gösterdiği IV ve V. yaş grubunun populasyonun çoğunluğunu oluşturduğu tespit edilmiştir. Kapulukaya Baraj Gölü'nde yaşayan *Tinca tinca*'nın büyüme özellikleri kapsamında; boy ve ağırlıkça büyüme ve kondisyon faktörü araştırılmıştır. Populasyon geneli için boy-ağırlık ilişkisi denklemi $W = 0.00015259 \times L^{2,6317}$ olarak hesaplanmıştır. Kondisyon faktörü değeri 1,95 olarak tespit edilmiştir.*

Anahtar Sözcükler: Tinca tinca, Kadife, Büyüme, Kondisyon, Kapulukaya Baraj Gölü

1. INTRODUCTION

In Turkey, Cyprinidae are the richest and the most important family of fish, and its members are distributed world-wide. These family members are distributed widely in fresh water sources (1, 2). Tench, *Tinca tinca* (L.), is widely distributed in Europe and Asia, and has been introduced into the Americas, South Africa and Austria (3).

Tinca tinca, is a fish with an economic importance which shows a large distribution

in inland waters of Turkey. They are highly resistance against outside effects and diseases since their body is covered with thin scales and a mucus layer (2). They cause a decrease in the number of other fish species where they live (4). Since they mix the bottom mud continuously, they play an important role in mineralization (1). In eutrophic lakes, they also prevent the transition of inorganic nutrient salts, nitrogen and phosphorus accumulated in sediment to the water because they feed on aquatic plants (5).

Some of the researches related to *Tinca tinca* in Turkey and in the world are as follows:

The growth properties of tench (*Tinca tinca* L., 1758) was investigated in Mogan Lake (6), Porsuk Dam Lake (7), Kayaboğazı Dam Lake (8), Kesikköprü Dam Lake (9), Bayındır Dam Lake (10), Çivril Lake (11), Kapulukaya Dam Lake (12), Beyşehir Lake (13, 14, 15, 16), Hirfanlı Dam Lake (17), in two gravel pit lakes (18), Volga Delta (19) and in different habitats in North-West of Spain (20).

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 growth in *Tinca tinca*. This is the first such study of tench from Cyprinidae family (*Tinca tinca* L., 1758) in Kapulukaya Dam Lake.

2. MATERIAL AND METHOD

This study was carried out between November 2001 and October 2002. The fish samples were either caught from three different stations previously determined at each month with the use of 18 × 18 mm, 40 × 40 mm and 55 × 55 mm mesh nets or purchased from the local fishermen (Figure 1).

The total lengths, fork lengths and standard lengths of 386 *Tinca tinca* individuals were accurately determined. There were 30-40 scales taken from the samples from the region between dorsal fin and lateral line in order to determine the age of the species. The age determination process was carried out with SDZ-PL model Kyowa binoculars according to the method determined by Lagler (21).

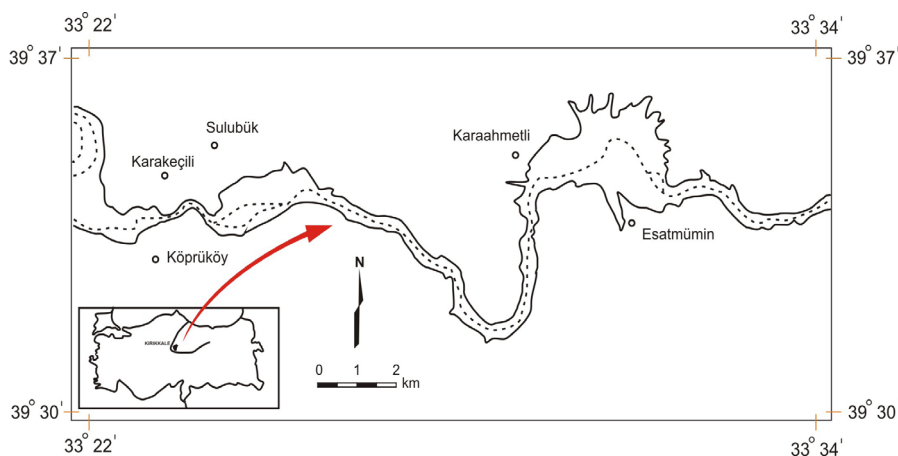


Figure 1. Kapulukaya Dam Lake and sampling stations.

The differences between the mean fork lengths and mean weights of the males and females in each age group were evaluated by the use of t-test (22). The linear and exponential relations between weight and length $\log W = \log a + b \cdot \log L$ and $W = a \times L^b$ (23). Condition factor was calculated with the use $C = (W / L^3) \times 10^5$ formula (21). The difference between the condition factors of the female and males at the same age group was determined by the use of t-test ($p < 0.05$).

3. RESULTS

The age group and sex distribution of all specimens examines are shown in Table 1. The investigated specimens varied form I to VIII years old. There were no individuals encountered above VIII years of age. The distribution of length and weight according to age and gender are given in Table 2 and Table 3. The gender of the individuals at I year of age was taken as female + male because it was impossible to determine their sex. Length for females and males ranged from 160 to 395 mm, respectively. The length of the females ranged between 190 mm and 395 mm and the length of the males changed between 205 mm and 380 mm. The weights varied between 40 g and 1210 g. The weight of females ranged between 165 g and 1210 g while the weights of the males changed between 180 g and 920 g.

The relation between the mean weight and lengths of *Tinca tinca* is depicted in Figure 2. The growth parameters of *Tinca tinca* population were calculated with the use of $W = a \times L^b$ formula (23). The correlation between the length and weights of the females and males are tabulated in Table 4.

Table 1. Age distribution of *Tinca tinca* population living in Kapulukaya Dam Lake

Age	Female		Male		Female+Male	
	N	%	N	%	N	%
I	-	-	-	-	15	3.89
II	16	4.15	15	3.89	31	8.03
III	32	8.29	42	10.88	74	19.17
IV	30	7.77	56	14.50	86	22.27
V	51	13.21	44	11.40	95	24.61
VI	28	7.25	30	7.77	58	15.03
VII	11	2.85	8	2.07	19	4.92
VIII	4	1.04	4	1.04	8	2.08
Total	172	44.56	199	51.55	386	100.0

Table 2. The mean length values of *Tinca tinca* according to age groups.

A G E S	(mm.)									
	Female			Male			Female + Male			
	N	$\bar{E} \pm S$ (Min - Max)	S_x	N	$\bar{E} \pm S$ (Min - Max)	S_x	t - test (p<0,05)	N	$\bar{E} \pm S$ (Min - Max)	S_x
I	-	-	-	-	-	-	-	15	194,33 ± 14,71 160 - 210	3,80
II	16	222,5 ± 15,28 190 - 245	3,82	15	223,73 ± 13,98 205 - 250	3,61	P < 0,05	31	223,10 ± 14,43 190 - 250	2,59
III	32	249,38 ± 11,48 225 - 270	2,03	42	248,24 ± 12,83 225 - 280	1,98	P < 0,05	74	248,73 ± 12,20 225 - 280	1,42
IV	30	269,80 ± 16,07 245 - 300	2,93	56	272,54 ± 20,29 240 - 305	2,71	P < 0,05	86	271,58 ± 18,87 240 - 305	2,04
V	51	296,27 ± 16,40 265 - 320	2,30	44	298,64 ± 22,73 270 - 340	3,43	P < 0,05	95	297,37 ± 19,51 265 - 340	2,00
VI	28	324,29 ± 21,89 290 - 370	4,14	30	325,23 ± 22,79 280 - 370	4,16	P < 0,05	58	324,78 ± 22,17 280 - 370	2,91
VII	11	355,91 ± 22,00 310 - 380	6,63	8	351,25 ± 28,50 320 - 380	10,08	P < 0,05	19	353,95 ± 24,30 310 - 380	5,57
VIII	4	388,75 ± 6,29 380 - 395	3,15	4	377,50 ± 5,00 370 - 380	2,50	P > 0,05	8	383,13 ± 7,99 370 - 395	2,82

Table 3.The mean weight values of *Tinca tinca* according to age groups.

A G E S	(g.)									
	Female			Male			Female + Male			
	N	$\bar{W} \pm S$ (Min - Max)	S_x	N	$\bar{W} \pm S$ (Min - Max)	S_x	t - test (p<0,05)	N	$\bar{W} \pm S$ (Min - Max)	S_x
I	-	-	-	-	-	-	-	15	149,67 ± 59,05 40 - 240	15,25
II	16	215,94 ± 30,01 165 - 250	7,50	15	217,33 ± 32,12 180 - 270	8,29	P < 0.05	31	216,61 ± 30,53 165 - 270	5,48
III	32	305,63 ± 38,97 205 - 350	6,89	42	299,05 ± 30,98 240 - 360	4,78	P < 0.05	74	301,89 ± 34,57 205 - 360	4,02
IV	30	398,00 ± 51,62 300 - 500	9,42	56	388,75 ± 44,88 285 - 485	6,00	P < 0.05	86	391,98 ± 47,24 285 - 500	5,09
V	51	512,75 ± 55,99 380 - 660	7,84	44	504,32 ± 54,59 300 - 590	8,23	P < 0.05	95	508,85 ± 55,21 300 - 660	5,66
VI	28	651,25 ± 132,19 460 - 1000	24,98	30	635,67 ± 80,74 440 - 800	14,74	P < 0.05	58	107,96 643,19 ± 815,79 440 - 1000	14,18
VII	11	152,76 818,18 ± 680 - 1210	46,06	8	812,5 ± 97,80 680 - 920	34,58	P < 0.05	19	129,20 680 - 1210	29,64
VIII	4	1015 ± 155,88 840 - 1210	77,94	4	915 ± 10,00 900 - 920	5,00	P < 0.05	8	965 ± 115,39 840 - 1210	40,80

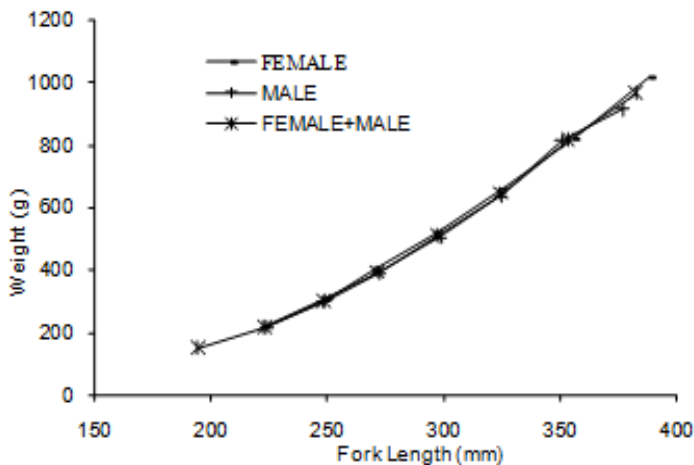


Figure 2. Weight – Length relation of *Tinca tinca* living in Kapulukaya Dam Lake

Table 4. Weight – Length relations of *Tinca tinca* living in Kapulukaya Dam Lake

	Weight –length equations	Correlation
Female	$W = 0.00022618 \times L^{2.5654}$ $\log W = -3.6455 + 2.5654 \log L$	0.913
Male	$W = 0.00043812 \times L^{2.4436}$ $\log W = -3.3584 + 2.4436 \log L$	0.924
Female + Male	$W = 0.00015259 \times L^{2.6317}$ $\log W = -3.8165 + 2.6317 \log L$	0.917

The condition factors calculated for *Tinca tinca* individuals are tabulated in Table 5. It was observed that the condition factors of the males superior to the females in VII years age group. The opposite was the case for the other age groups. The difference between the males and females was not found to be statistically significant (t-test). The condition factor was observed to decrease by the age. The condition factors for the females, males and female + males were found to be 1.97, 1.93; and 1.95 respectively.

Table 5. Condition factors for the *Tinca tinca* individuals according to age and gender

Age	Condition Factor										
	Female			Male				Female + Male			
N	$C \pm S$ (Min - Max)	S_x	N	$C \pm S$ (Min - Max)	S_x	t- test (p<0.05)	N	$C \pm S$ (Min - Max)	S_x		
I	-	-	-	-	-	-	15	2.00 ± 0.74 0.98 - 3.50	0.19		
II	16	2.00 ± 0.49 1.43 - 3.50	0.12	15	1.95 ± 0.25 1.54 - 2.25	0.07	P < 0.05	31	1.97 ± 0.39 1.43 - 3.50	0.07	
III	32	1.98 ± 0.31 1.42 - 2.53	0.05	42	1.97 ± 0.25 1.41 - 2.45	0.04	P < 0.05	74	1.97 ± 0.27 1.41 - 2.53	0.03	
IV	30	2.04 ± 0.30 1.63 - 2.58	0.05	56	1.95 ± 0.30 1.55 - 2.58	0.04	P < 0.05	86	1.98 ± 0.30 1.55 - 2.58	0.03	
V	51	1.99 ± 0.31 1.53 - 2.68	0.04	44	1.93 ± 0.36 1.48 - 2.51	0.05	P < 0.05	95	1.96 ± 0.33 1.48 - 2.68	0.03	
VI	28	1.92 ± 0.37 1.40 - 2.52	0.07	30	1.87 ± 0.31 1.39 - 2.43	0.06	P < 0.05	58	1.90 ± 0.34 1.39 - 2.52	0.04	
VII	11	1.83 ± 0.33 1.46 - 2.49	0.10	8	1.90 ± 0.28 1.54 - 2.20	0.10	P < 0.05	19	1.86 ± 0.30 1.46 - 2.48	0.07	
VIII	4	1.72 ± 0.19 1.53 - 1.96	0.09	4	1.70 ± 0.05 1.68 - 1.78	0.03	P < 0.05	8	1.71 ± 0.13 1.53 - 1.96	0.05	

4. DISCUSSION

There were 386 *Tinca tinca* caught in order to determine the bio ecologic features of the *Tinca tinca* population living in Kapulukaya Dam Lake.

Age distributions of males and females ranged from I to VIII years. According to Nikolskii (24) the distribution of fish is effected by various ecologic factors. One of the most important one in these factors is the distribution and amount of food available. The age distribution is also effected by mortality and fishing. Some of the studies carried out on the *Tinca tinca* population in various location reported the following ranges of age: I-V in Bayındır Dam Lake (10), I-VI in Kesikköprü Dam Lake (9), I-V in Çivril Lake (11), I-VIII Porsuk Dam Lake (7), I-XIV in two gravel pit lakes (18) and I-VI in Hirfanlı Dam Lake (25). Kennedy and Fitzmaurice (26) reported that they encountered *Tinca tinca* individuals at XII years of age in Irish Channel. Weatherley (27) also stated that they encountered the individuals above IX years of age in their study the carried out in Tasmania. According to these data it is seen that the age distribution of the *Tinca tinca* individuals Kapulukaya Dam Lake is similar to that reported for Porsuk Dam Lake reported by Yılmaz (7).

The *Tinca tinca* individuals at I. year of age were not subjected to any gender differentiation and they were taken as female + male. The males were found to dominate the females at III, IV and VI years of age. The population was found to be constituted by 51.55% males and 46.56% females. The male / female ratio was found to be 1.157:1. It was stated that the climatic factors at the time of the study were effective on the gender maturity, breeding, breeding time, egg development and egg hatching periods (28). The male / female ratio of *Tinca tinca* was found to be 0.9594:1 in Porsuk Dam Lake (7), 0.94:1 in Kesikköprü Dam Lake (9), 0.96:1 in Bayındır Dam Lake (10), 1.184:1 in Hirfanlı Dam Lake (25) and 1.0294:1 in Mogan Lake (6). According to Nikolskii (24) the gender ratio is close to 1:1 in many species. The values obtained for Kapulukaya Dam Lake are very close to those obtained by Şanlı (25) and Göktaş (6). The percentage of *Tinca tinca* population in Kapulukaya Dam Lake increases between I and V. years of age and decreases afterwards. The highest and lowest percentages among the population were observed for the samples at V and VII years of age with 24.61% and 2.07%. The age composition of *Tinca tinca* population varied in the studies carried out at different times and locations by various workers. The highest percentages of the population according to ages were found to be III. age group in Porsuk Dam Lake by with Yılmaz (7) with 31.70%; IV. age group in Kesikköprü Dam Lake by Altındağ et.al (9) 28.57%; I. age group in Bayındır Dam Lake by Altındağ et al. (10) with 65.9 %; III. age group in Hirfanlı Dam Lake by Şanlı (25) with 28.22%. There are similarities and differences between the present study and the values reported in literature. The difference may largely be due to the difference in fishing methods and the tools used in fishing. Even if the fishing is made using same type of nets in different location the age compositions may tend to be different since the growth rate may differ according to regions.

It was determined the growth in length is rapid between III to IV years of age when the sexual maturity is reached and slows down at latter periods. Altındağ et.al (9) found that annual relative increase in length was between 0.06-0.47 in Kesikköprü Dam Lake. This value was found to be 0.120-0.302 in Bayındır Dam Lake (10), 0.08-0.28 in Porsuk Dam Lake (7) an 0.06-0.24 in Hirfanlı Dam Lake (25). The annual relative increase in length in this study was found to be lower than these values. These variations in annual relative increase in length of *Tinca tinca* populations in various lakes may be attributed to the effect of biotic and abiotic factors on growth process.

The weight-length equations for *Tinca tinca* population investigated in this study are $W = 0.00022618 \times L^{2.5654}$ for females, $W = 0.00043812 \times L^{2.4436}$ for males and $W = 0.00015259 \times L^{2.6317}$ for females + males. The value of the n in $W = c \times L^n$ proposed by Le Cren (23), Brown (29) reported that the b value for length-weight relationship in the fish population, indicating the type of growth nature in fish, has been shown to be ranging from 2 to 4. According to these values the n value of *Tinca tinca* population Kapulukaya Dam Lake is within normal values. The closer is this value to 3 the more ideal it is (2). The fact that the n value in this study is lower than 3 may stem from the competition between the fish for food. The value obtained in this study (2.6317) is lower than those found by Altındağ et al (10) (3.1747); Altındağ et al (9) (3.1743); Balık et al (11) (3.01); Şanlı (25) (2.928); Wright and Giles (18) (2.9848) and higher than those reported by Yılmaz (7) (2.68) and Göktaş (6) (1.78). The data obtained for Kapulukaya Dam Lake showed that the feeding capacity of *Tinca tinca* population is low.

Fishing is an important source of income for the local people .It was observed that the local people do fishing with the use of nets with different mesh sizes. The fact there was no *Tinca tinca* above VIII. years of age encountered showed the presence of fishing on this species. The start of the hunting of economically important fish species after their breeding period is of great importance for the future of their populations. It is therefore vitally important that the fish population be given necessary time for breeding. The fish below 25 cm should not be fishing taken the fact that *Tinca tinca* population in Kapulukaya Dam Lake reaches the sexual maturity at III years of age.

Consequently, as no studies have been done on population structure of *Tinca tinca* living in Kapulukaya Dam Lake, no comparison. Thus, the present investigation provides basic information about the population structure of *Tinca tinca* in Kapulukaya Dam Lake.

5. REFERENCES

1. Demirsoy, A. 1988. Yaşamın Temel Kuralları, Omurgalılar/Anamniyota, A-155, Hacettepe Üniversitesi Yayınları, pp. 1210.
2. Geldiay, R. ve Balık, S. 1996. Türkiye Tatlısu Balıkları. Ege Üniversitesi Su Ürünleri Fak. Yayın No: 46 (II.Baskı) İzmir. pp. 532.

3. Rosa, H., 1958. A synopsis of the biological data on the tench, *Tinca tinca* (L., 1758). FAO 58(2). 951.
4. Çelikkale, M.S. 1994. İçsu Balıkları Yetiştiriciliği, Cilt:II K.T.Ü. Sürmene Deniz Ürünleri ve Teknolojisi Yüksekokulu, pp. 460.
5. Michaels, V.K., 1988. Carp Farming. Printed in Great Britain by Henry Ling Ltd. The Dorset Press, Dorchester, 200 pp.
6. Göktaş, M., 1987. Mogan Gölü'ndeki Kadife (*Tinca tinca* L.) Balığının Boy-Ağırlık İlişkisinde Mevsimsel Değişiklikler, MSc. Thesis, Ankara: Ankara University.
7. Yılmaz, F. 1997. Porsuk Baraj Gölü'nde Yaşayan *Cyprinus carpio* ve *Tinca tinca*'nın Biyo-ekolojik Özellikleri Üzerine Bir Araştırma. MSc. Thesis, Ankara: Gazi University.
8. Alaş, A. 1998. Kayaboğazı Baraj Gölü (Tavşanlı-Kütahya)'nde yaşayan *Leuciscus cephalus* (L., 1758) ve *Tinca tinca* (L.,1758)'nın biyo-ekolojik özellikleri üzerine bir araştırma, PhD. Thesis, Ankara: Gazi University.
9. Altındağ, A. Yiğit, S. Ahıska S. and Özkurt, Ş. 1988. Kesikköprü Baraj Gölü'ndeki Kadife Balığının (*Tinca tinca* L., 1758) Büyüme Özellikleri, Turk. J. Zool. 22: 311-318.
10. Altındağ, A. Shah, S. and Yiğit, S. 2002. The Growth Features of Tench (*Tinca tinca* L., 1758) in Bayındır Dam Lake, Ankara, Turkey. Turk. J. Zool. 26: 385-391.
11. Balık, S. Sarı, H.M. Ustaoglu, M.R. and İlhan, A. 2004. Çivril Gölü (Denizli, Türkiye) Kadife Balığı *Tinca tinca* (L., 1758) Populasyonunun Yapısı, Mortalitesi ve Büyümesi, Turk. J. Vet. Anim. Sci. 28: 973-979.
12. Şanlı Benzer, S. 2004. Kapulukaya Baraj Gölü'nde Yaşayan Kadife (*Tinca tinca* L., 1758) ve Turna (*Esox lucius* L., 1758) Balıklarının Biyo-Ekolojik Özellikleri ve Beslenme Rejimleri. PhD. Thesis, Ankara: Gazi University.
13. Erol, K.G. Çetinkaya, S. Tümgelir, L. and Çubuk, H., 2006. Beyşehir Gölü'ndeki Kadife Balığı (*Tinca tinca* L., 1758)'nın Büyüme Özellikleri, I. Uluslararası Beyşehir ve Yöresi Sempozyumu, Beyşehir/Konya, 11-13 Mayıs, 315-321.
14. Ak, A. 2006. Beyşehir Gölü (Konya)'nde Yaşayan Kadife Balığı (*Tinca tinca* L.,1758)'nın Büyüme Özelliklerinin İncelenmesi, MSc. Thesis, Niğde: Niğde University.
15. Alaş, A. and Ak, A. 2007. Investigation of Some Population Parameters of the Tench (*Tinca tinca* L., 1758) Inhabiting Beyşehir Lake (Konya-Turkey), Turkish Journal of Fisheries and Aquatic Sciences, 7: 139-145.
16. Balık, İ., Çubuk, H., Çınar, Ş. and Özkök, R., 2009. Population structure, growth, mortality and estimated stock size of the introduced tench, *Tinca tinca* (L.), population in Lake Beyşehir, Turkey, Journal of Applied Ichthyology, 25, 206–210.
17. Benzer, Ş. S., Gül, A. and Yılmaz, M., 2009. Growth Properties of Tench (*Tinca tinca*, L., 1758) Living in Hirfanlı Reservoir (Kırşehir, Turkey). Iranian Journal of Fisheries Sciences, 8(2), 219-224.
18. Wright, R.M., Giles, N. 1991. The population biology of tench, *Tinca tinca* (L.), in two gravel pit lakes. Journal of Fish Biology, 38:17-28.
19. Vetlugina, T. A. 1992. The biology of tench, *Tinca tinca* in the Volga Delta. J.Ichtyol, 32(5):58-64.
20. Gonzales, G., Maze, R.A., Dominiguez, J. and Pena, J.C. 2000. Trophic ecology of the tench in different habitats in North-West of Spain. Cybium, 24(2):123-138.

21. Lagler, K.F. 1966. Freshwater Fishery Biology. W.M.C. Brown Company Publishers, Dubuque, Iowa, pp. 421.
22. Düzgüneş, O. 1963. Bilimsel Araştırmalarda İstatistik Prensipleri ve Metodları, Ege Üniversitesi Matbaası, İzmir, pp. 375.
23. Le Cren, E.D. 1951. The Length-Weight Relationship and Seasonal Cycle in Gonad Weight and Condition in the Perch (*Perca fluviatilis*). Animal Ecology, 20(2): 201-219.
24. Nikolskii, G.W. 1980. Theory of Fish Population Dynamics. Otto Koetz Science Publishers. Koenigstein, pp. 323.
25. Şanlı, S. 1998. Hirfanlı Baraj Gölü'nde Yaşayan *Tinca tinca* 'da Büyüme Özellikleri ve Sindirim Kanalı Muhteviyatı. MSc. Thesis, Ankara: Gazi University.
26. Kennedy, M. and Fitzmaurice, P. 1970. The biology of the tench *Tinca* (L.) in Irish waters, Preceding of the Royal Irish, Academy 69: 31-82.
27. Weatherley, A.H. 1959. Some Features of the Biology of the Tench (*Tinca tinca* L.) in Tasmania. The Journal of Animal Ecology, 28: 73-88.
28. Hellawell, J.M., 1971. The autecology of the chub *Squalis cephalous* (L.) of at the River Logan the atone lionfish, Freshwater Biology, 1: 29-60.
29. Brown, M.E. 1957. The Physiology of Fishes, Academic Pres. Inc., New York, pp. 361-400.