

Population Structures and Some Growth Properties of Three Cyprinid Species [*Squalius cephalus* (Linnaeus, 1758); *Tinca tinca* (Linnaeus, 1758) and *Alburnus escherichii* Steindachner, 1897] Living in Camkoru Pond (Ankara-Turkey) ^[1]

Deniz INNAL * 

[1] This study is summarized from the author's MSc Thesis and presented as 3 posters in XIV. Symposium of Fisheries, Muğla - Turkey

* Mehmet Akif Ersoy University, Department of Biology, TR-15100 Burdur - TURKEY

Makale Kodu (Article Code): KVFD-2010-2346

Summary

This study concerns an investigation of the population structures and some growth properties of European Chub [*Squalius cephalus* (Linnaeus, 1758)], Tench [*Tinca tinca* (Linnaeus, 1758)] and Anatolian Bleak (*Alburnus escherichii* Steindachner, 1897) living in Camkoru Pond (Camlıdere- Ankara- Sakarya Basin). For this purpose the population densities, age and sex compositions, growth in length and weight, length-weight relationships of fish species have been obtained and compared with other studies. The densities of fish species are (38.78%) Tench; (31.19%) European Chub; (25.69%) Anatolian Bleak. The maximum ages for Tench and Anatolian Bleak were VIII, and for European Chub was X. The length and weight relationship for European Chub, Anatolian Bleak and Tench populations was as follows: $W = 0.0134 L^{3.0126}$, $W = 0.0066 L^{3.2501}$ and $W = 0.0144 L^{3.0066}$. Student's t test showed that differences in length and weight between females and males of the same age groups of species were statistically insignificant ($P > 0.05$)

Keywords: *Tinca tinca*, *Squalius cephalus*, *Alburnus escherichii*, Population structures, Growth properties, Camkoru Pond

Çamkoru Göleti (Ankara-Türkiye)'nde Yaşayan Üç Cyprinid Türünün [*Squalius cephalus* (Linnaeus, 1758), *Tinca tinca* (Linnaeus, 1758) ve *Alburnus escherichii* Steindachner, 1897] Populasyon Yapısı ve Bazı Büyüme Özellikleri

Özet

Bu çalışma Çamkoru Göleti (Çamlıdere-Ankara-Sakarya Havzası)'nde yaşayan Kefal [*Squalius cephalus* (Linnaeus, 1758)], Kadife [*Tinca tinca* (Linnaeus, 1758)] ve İnci (*Alburnus escherichii* Steindachner, 1897) balığının populasyon yapısı ve bazı büyüme özelliklerinin araştırılması ile ilişkilidir. Bu amaçla, balık türlerinin populasyon yoğunluğu, yaş ve eşey kompozisyonu, boy ve ağırlık büyümesi ve boy-ağırlık ilişkisi saptanmış ve diğer çalışmalarla karşılaştırılmıştır. Balık türlerinin yoğunluğu; Kadife (38.78%); Kefal (31.19%); İnci (25.69%)'dir. Kadife ve İnci balığı için maksimum yaş VIII, Kefal için X'dir. Kefal, İnci ve Kadife populasyonunun boy - ağırlık ilişkisi sırasıyla $W = 0.0134 L^{3.0126}$, $W = 0.0066 L^{3.2501}$ ve $W = 0.0144 L^{3.0066}$ 'dir. Türlerin aynı yaş gruplarında erkek ve dişi bireyler arasında boy ve ağırlık açısından fark, t-testiyle önemsiz ($P > 0.05$) olarak gözlenmiştir.

Anahtar sözcükler: *Tinca tinca*, *Squalius cephalus*, *Alburnus escherichii*, Populasyon yapısı, Büyüme özellikleri, Çamkoru Göleti

 İletişim (Correspondence)

 +90 248 2122780/1692

 innald@yahoo.com

INTRODUCTION

The Tench (*Tinca tinca*), European Chub (*Squalius cephalus*) and Anatolian Bleak (*Alburnus escherichii*) belong to the family Cyprinidae, which contains numerous species of fish present in Turkey¹. *S. cephalus* and *A. escherichii* are the native fish species of Camkoru Pond. After the reservoir construction *T. tinca*, *Cyprinus carpio* and *Oncorhynchus mykiss* were introduced into Camkoru Pond. Although stocking programmes of alien fish species have been applied into this pond there is no published data about population structures and biological properties of fish species.

Many investigations have been made to determine the various biological properties of Chub²⁻⁷ and Tench⁸⁻¹⁴, but there is only one study about Anatolian Bleak¹⁵.

The aim of the study; the population densities, age and sex compositions, growth in length and weight, length-weight relationships of fish species (*S. cephalus*, *A. escherichii*, *T. tinca*) have been obtained and compared with other studies.

MATERIAL and METHODS

The study was carried out on the determination of population structures and some growth properties of *Squalius cephalus*, *Alburnus escherichii* and *Tinca tinca* population in Camkoru Pond (Camlidere-Ankara) located on the Kadinboğazi Creek, 105 km northwest of Ankara with a surface area of 7 ha. Fish species were caught monthly with nets of various mesh sizes (10, 17, 23, 30, 40 and 50 mm) between August 2002 and August 2003. The abundance of species was ascertained according to Sisli¹⁶. Abundance % = $[Ni/Nt] \times 100$, (Ni: The number of specimens of the species; Nt: The total number of specimens). After being caught, the fish samples were transported to the

laboratory where their size (fork length; cm, referred to as LF in the text and weight; g, referred to as W in the text) were measured and weighed to the nearest 1.0 mm and 0.1 g, respectively. Age determination was carried out according to the method of Lagler¹⁷ (The roman numerals indicate a subjective classification of ages). Proportional growth in weight and length between the ages were calculated from the Relative growth (R) equations; $RW = [(W_{t+1} - W_t)/W_t] \times 100$, $RFL = [(FL_{t+1} - FL_t)/FL_t] \times 100$ respectively, where W_{t+1} are the weight in grams and FL_{t+1} length in cm at age t+1, W_t is weight in grams and FL_t is length in cm at age t. Length-weight relationship was described by the following equation: $W: aL^b$. Where: W: mass in grams; L: fork length in centimeters. a: constant; b: constant described as isometric or allometric growth type. Differences between growth in males and females within the same age groups were tested by Student's t test ($P > 0.05$).

RESULTS

Fish Species and Abundance

Origin of species and the frequency-abundance data are given in [Table 1](#).

Six fish species, 1199 specimens were captured from Camkoru Pond. *Tinca tinca* (38.78%) was determined to have the greatest population size followed by *Squalius cephalus* (31.19%), *Alburnus escherichii* (25.69%), *Gobio gobio* (3.34%), *Cyprinus carpio* (0.92%) and *Oncorhynchus mykiss* (0.08%).

The Sex and Age Compositions

The age group and sex distribution of species are shown in [Table 2](#).

The ages of the captured specimens of *S. cephalus* ranged from I to X years and the 3rd group was dominant

Table 1. Origin of species and the frequency-abundance data

Tablo 1. Türlerin kaynağı ve yoğunluk-bolluk verisi

Species	Family	Origin of Species	Introduction			Number of Individuals		
			Purpose	Year	Number	Total	%	Rank
<i>Squalius cephalus</i>	Cyprinidae	Native	-			374	31.19	2
<i>Alburnus escherichii</i>	Cyprinidae	Native	-			308	25.69	3
<i>Gobio gobio</i>	Cyprinidae	Native	-			40	3.34	4
<i>Tinca tinca</i>	Cyprinidae	Introduced	Accidental	1993	200	465	38.78	1
<i>Cyprinus carpio</i>	Cyprinidae	Introduced	Recreational Fishing	2001	5000	11	0.92	5
				2002	6000			
				2003	5000			
<i>Oncorhynchus mykiss</i>	Salmonidae	Introduced	Recreational Fishing	1997	8000	1	0.08	6
				2001	6000			

Table 2. The sex and age compositions of species**Tablo 2.** Türlerin yaş ve eşey kompozisyonları

AGE	<i>Squalius cephalus</i>						<i>Alburnus escherichii</i>						<i>Tinca tinca</i>							
	Female		Male		F+M		Female		Male		F+M		Female		Male		F+M			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		
I	-	-	-	-	25	8.14	-	-	-	-	-	-	-	-	-	-	-	-	41	13.1
II	10	3.26	6	1.95	16	5.21	2	0.66	1	0.33	3	1	37	11.8	32	10.2	69	22		
III	114	37.1	61	19.9	175	57	81	26.9	74	24.6	155	51.5	51	16.2	39	12.4	90	28.7		
IV	28	9.12	15	4.89	43	14	16	5.32	19	6.31	35	11.6	30	9.55	47	15	77	24.5		
V	11	3.58	6	1.95	17	5.54	23	7.64	26	8.64	49	16.3	11	3.5	6	1.91	17	5.41		
VI	6	1.95	2	0.65	8	2.61	23	7.64	20	6.64	43	14.3	4	1.27	3	0.96	7	2.23		
VII	9	2.93	2	0.65	11	3.58	7	2.33	7	2.33	14	4.65	5	1.59	3	0.96	8	2.55		
VIII	3	0.98	2	0.65	5	1.63	-	-	2	0.66	2	0.66	3	0.96	2	0.64	5	1.59		
IX	3	0.98	-	-	3	0.98	-	-	-	-	-	-	-	-	-	-	-	-		
X	4	1.3	-	-	4	1.3	-	-	-	-	-	-	-	-	-	-	-	-		
TOTAL	188	61.2	94	30.6	307	100	152	50.5	149	49.5	301	100	141	44.9	132	42.1	314	100		

Table 3. The minimum, maximum and average fork length (cm)-weight (gr) of the age groups of *S. cephalus***Tablo 3.** *S. cephalus*'ta yaş gruplarının minimum, maksimum ve ortalama çatal boy ve ağırlık değerleri

AGE	N	Female				N	Male				t - test		N	Female + Male					
		L (cm)		W (gr)			L (cm)		W (gr)		L (cm)	W (gr)		L (cm)		W (gr)			
		(min-max)	S	(min-max)	S		(min-max)	S	(min-max)	S				(min-max)	S	(min-max)	S		
I		-	-	-	-	-	-	-	-	-	-	25	9.19±0.55 (8-10.1)	0.1	9.95±1.25 (8.3-12.7)	-			
II	10	13.42±1.19 (11.3-14.6)	0.4	37.08±10.09 (18.2-46.3)	3.19	6	13.75±1.58 (11-14.9)	0.7	38.03±14.84 (18.9-50.2)	6.06	0.37 (P>0.05)	0.89 (P>0.05)	16	13.54±1.30 (11-14.9)	0.3	37.44±11.61 (18.2-50.2)	2.9		
III	114	17.06±1.25 (14-20.2)	0.1	70.24±15.30 (46.5-110.3)	1.43	61	16.66±1.17 (14.9-20)	0.2	64.64±12.97 (48-105)	1.66	0.46 (P>0.05)	0.39 (P>0.05)	175	16.92±1.23 (14-20.2)	0.1	68.28±14.73 (46.5-110.3)	1.11		
IV	28	20.54±2.29 (18.2-24.7)	0.4	126.31±38.31 (84-192)	7.24	15	21.00±2.26 (17.9-24.1)	0.6	129.93±39.75 (83-187)	10.3	0.53 (P>0.05)	0.78 (P>0.05)	43	20.70±2.26 (17.9-24.7)	0.3	127.57±38.38 (83-192)	5.85		
V	11	24.33±0.89 (23.4-26.1)	0.3	207.32±29.31 (179-262.3)	8.84	6	24.03±1.18 (22.2-25.5)	0.5	200.68±21.28 (172.5-226)	8.69	0.61 (P>0.05)	0.6 (P>0.05)	17	24.22±0.98 (22.2-26.1)	0.2	204.98±26.25 (172.5-262.3)	6.37		
VI	6	26.67±1.47 (24.9-29)	0.6	266.45±29.96 (230.2-295.5)	12.2	2	27.35±0.64 (26.9-27.8)	0.5	290.00±5.66 (286-294)	4.0	0.41 (P>0.05)	0.12 (P>0.05)	8	26.83±1.31 (24.9-29)	0.5	272.3±27.65 (230.2-295.5)	9.77		
VII	9	29.92±1.55 (27.2-32.4)	0.5	361.67±45.36 (290.5-435.5)	15.1	2	31.00±2.83 (29-33)	2.0	381.50±72.83 (330-433)	51.5	0.69 (P>0.05)	0.77 (P>0.05)	11	30.12±1.70 (27.2-33)	0.5	365.27±47.34 (290.5-435.5)	14.3		
VIII	3	33.27±0.78 (32.4-33.9)	0.5	491.67±25.70 (462-507)	14.8	2	33.45±1.91 (32.1-34.8)	1.4	457.50±57.28 (417-498)	40.5	0.92 (P>0.05)	0.55 (P>0.05)	5	33.34±1.11 (32.1-34.8)	0.5	478±38.74 (417-507)	17.3		
IX	3	35.30±0.6 (34.7-35.9)	0.4	584.33±13.05 (572-598)	7.54	-	-	-	-	-	-	-	3	35.30±0.6 (34.7-35.9)	0.4	584.33±13.05 (572-598)	7.54		
X	4	37.38±0.87 (36.3-38.4)	0.4	764.75±66.14 (702-845)	33.1	-	-	-	-	-	-	-	4	37.38±0.87 (36.3-38.4)	0.4	764.75±66.14 (702-845)	33.1		

in the population. The fish population was 61.24% female and 30.62% male. The ages of captured specimens of *T. tinca* ranged from I to VIII and the 3rd group was dominant in the population. The fish population was 44.90% female and 42.04% male. The ages of captured specimens of *A. escherichii* II to VIII and the 3rd group was dominant in the population. The fish population was 50.50% female and 49.50% male.

Length and Weight Composition

The minimum, maximum and average fork lengths (cm) - weights (gr) with confidence intervals (CI) at 95% significance levels and standard error (S) for male, female of the age groups of species are given in [Tables 3, 4 and 5](#). Length-weight relationships of species are given in [Fig. 1](#).

Determined minimum and maximum fork length values of *S. cephalus* were 8 and 38.4 cm. Among the European Chub caught 66.12% were 12-20 cm, 9.45% were shorter than 12 cm and 24.43% were longer than 20 cm. Weights of European Chub ranged between 8.3 gr and 845 gr, the majority being (44.95%) 60-120 gr.

Fork Lengths of Anatolian Bleak ranged between 7.5 cm and 16.4 cm. Among the Anatolian Bleak caught 44.85% were 9-11 cm, 9.64% were shorter than 9 cm, and 45.51% were longer than 11 cm. Weights of Anatolian Bleak ranged between 7.1 gr and 56.8 gr, the majority being (59.80%) 7-17 gr.

Fork Lengths of Tench ranged between 8.2 cm and 32.5 cm. Among the Tench caught 71.97% were 12-22

cm, 15.28% were shorter than 12 cm, and 12.75% were longer than 22 cm. Weights of Tench ranged between 8.2 gr and 453 gr, the majority being (54.15%) 40-160gr .

The differences in length and weight between males and females was statistically insignificant ($P>0.05$) in all age groups of three species.

The parameter b of the fishes ranged from a minimum of 3.0066 for *T. tinca* to a maximum of 3.2501 for *A. escherichii*.

Growth in Length and Weight

The relative increase in length and weight of European Chub, Anatolian Bleak and Tench from Camkoru Pond during the study are given in [Table 6](#).

Table 4. The minimum, maximum and average fork length (cm)-weight (gr) of the age groups of *A. escherichii*

Table 4. *A. escherichii*'de yaş gruplarının minimum, maksimum ve ortalama çatal boy ve ağırlık değerleri

AGE	N	Female				N	Male				t - test		N	Female + Male			
		L (cm)		W (gr)			L (cm)		W (gr)		L (cm)	W (gr)		L (cm)		W (gr)	
		(min-max)	S	(min-max)	S		(min-max)	S	(min-max)	S				(min-max)	S	(min-max)	S
I		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
II	2	7.65±0.21 (7.5-7.8)	0.15	7.15±0.07 (7.1-7.2)	0.05	1	7.5 -	-	7.1 -	-	-	-	3	7.60±0.17 (7.5-7.8)	0.1	7.13±0.06 (7.1-7.2)	0.03
III	81	9.68±0.74 (8-11.6)	0.08	10.49±1.79 (7.3-14.8)	0.2	74	9.65±0.64 (8.1-11)	0.07	10.39±1.90 (7.1-14.5)	0.22	0.8 ($P>0.05$)	0.74 ($P>0.05$)	155	9.67±0.69 (8-11.6)	0.06	10.45±1.84 (7.1-14.8)	0.15
IV	16	11.44±0.72 (10.4-12.6)	0.18	17.01±5.48 (12.6-28.5)	1.37	19	11.62±0.47 (10.7-12.4)	0.11	18.03±4.16 (13.2-27.3)	0.95	0.39 ($P>0.05$)	0.54 ($P>0.05$)	35	11.54±0.60 (10.4-12.6)	0.1	17.56±4.76 (12.6-28.5)	0.8
V	23	13.09±0.48 (12.1-13.7)	0.1	30.64±3.47 (21.2-36.5)	0.72	26	13.27±0.47 (11.5-13.8)	0.09	30.87±3.79 (17-36.2)	0.74	0.18 ($P>0.05$)	0.83 ($P>0.05$)	49	13.18±0.48 (11.5-13.8)	0.07	30.76±3.61 (17-36.5)	0.52
VI	23	14.30±0.33 (13.5-14.8)	0.07	40.27±4.39 (35-48)	0.91	20	14.13±0.29 (13.5-14.7)	0.07	38.19±3.75 (32-43.8)	0.84	0.07 ($P>0.05$)	0.1 ($P>0.05$)	43	14.22±0.32 (13.5-14.8)	0.05	39.30±4.19 (32-48)	0.64
VII	7	15.13±0.46 (14.4-15.7)	0.17	43.90±4.19 (40.9-52.1)	1.59	7	15.31±0.54 (14.5-15.8)	0.2	44.91±4.96 (39-52.3)	1.88	0.5 ($P>0.05$)	0.69 ($P>0.05$)	14	15.22±0.49 (14.4-15.8)	0.13	44.41±4.45 (39-52.3)	1.19
VIII		-	-	-	-	2	16.30±0.14 (16.2-16.4)	0.1	55.10±2.40 (53.4-56.8)	1.7	-	-	2	16.30±0.14 (16.2-16.4)	0.1	55.10±2.40 (53.4-56.8)	1.7

Fig 1. Length-weight relationships of species

Şekil 1. Türlerin boy-ağırlık ilişkisi

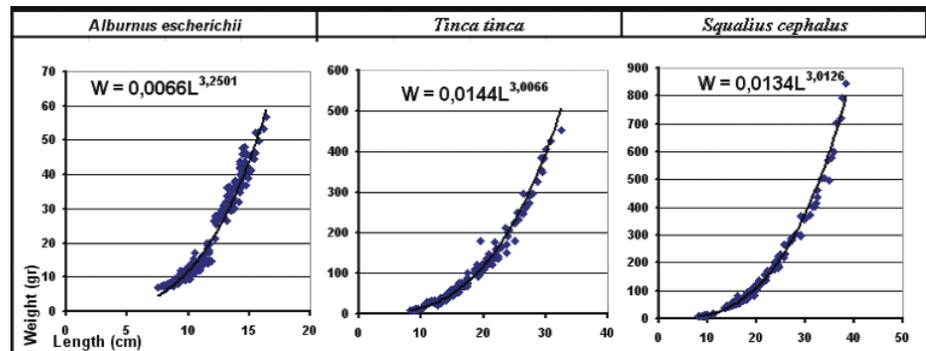


Table 5. The minimum, maximum and average fork length (cm)-weight (gr) of the age groups of *T. tinca***Tablo 5.** *T. Tinca*'da yaş gruplarının minimum, maksimum ve ortalama çatal boy ve ağırlık değerleri

AGE	N	Female				N	Male				t - test		N	Female + Male			
		L (cm)		W (gr)			L (cm)		W (gr)		L (cm)	W (gr)		L (cm)		W (gr)	
		(min-max)	S	(min-max)	S		(min-max)	S	(min-max)	S				(min-max)	S	(min-max)	S
I		-	-	-	-	-	-	-	-	-	-	-	41	9.16±0.47 (8.2-10.3)	0.07	10.61±1.58 (8.2-14.3)	0.25
II	37	12.86±0.86 (10.7-14.7)	0.16	31.48±6.09 (21.3-50.2)	1	32	12.42±0.73 (10.6-14.5)	0.13	28.41±5.38 (23.0-48.6)	0.95	0.92 (P>0.05)	0.93 (P>0.05)	69	12.65±0.82 (10.6-14.7)	0.1	30.06±5.93 (21.3-50.2)	0.71
III	51	16.50±1.89 (13.9-19.5)	0.26	70.25±24.20 (38.7-112.3)	3.39	39	16.08±1.68 (13.5-19.4)	0.27	66.85±21.96 (37.8-116)	3.51	0.28 (P>0.05)	0.49 (P>0.05)	90	16.32±1.80 (13.5-19.5)	0.19	68.78±23.19 (37.8-116)	2.44
IV	30	20.23±0.95 (17.5-22.3)	0.17	123.64±16.38 (98-180.3)	2.99	47	19.95±1.10 (18.5-22.3)	0.16	117.00±15.04 (96.4-146.3)	2.19	0.25 (P>0.05)	0.8 (P>0.05)	77	20.06±1.05 (17.5-22.3)	0.12	119.59±15.81 (96.4-180.3)	1.8
V	11	23.47±1.40 (21.9-25.2)	0.42	183.99±30.79 (142.5-225.9)	9.28	6	23.45±0.82 (21.8-23.9)	0.34	181.55±20.76 (150.3-211.4)	8.48	0.97 (P>0.05)	0.85 (P>0.05)	17	23.46±1.20 (21.8-25.2)	0.29	183.13±26.99 (142.5-225.9)	6.55
VI	4	26.43±0.73 (25.7-27.4)	0.36	268.23±31.31 (233.7-298.2)	15.7	3	26.23±0.67 (25.5-26.8)	0.38	253.37±6.48 (248.4-260.7)	3.74	0.73 (P>0.05)	0.42 (P>0.05)	7	26.34±0.65 (25.5-27.4)	0.25	261.86±23.82 (233.7-298.2)	9
VII	5	28.72±0.96 (27.4-29.6)	0.43	333.18±45.65 (274.2-385.5)	20.4	3	27.83±0.67 (27.1-28.4)	0.38	312.33±26.39 (282-330)	15.2	0.18 (P>0.05)	0.44 (P>0.05)	8	28.38±0.93 (27.1-29.6)	0.32	325.36±38.81 (274.2-385.5)	13.7
VIII	3	30.6±1.71 (29.2-32.5)	0.98	414.1±35.24 (384.3-453)	20.4	2	30.3±0.85 (29.7-30.9)	0.6	403.2±31.11 (381.2-425.2)	22	0.81 (P>0.05)	0.74 (P>0.05)	5	30.48±1.29 (29.2-32.5)	0.58	409.74±29.98 (381.2-453)	13.4

Table 6. The relative increase in length and weight values of species**Tablo 6.** Türlerin boy ve ağırlık değerlerinde relatif artış

AGE	<i>Squalius cephalus</i>						<i>Alburnus escherichii</i>						<i>Tinca tinca</i>							
	Female		Male		F+M		Female		Male		F+M		Female		Male		F+M			
	RFL	RW	RFL	RW	RFL	RW	RFL	RW	RFL	RW	RFL	RW	RFL	RW	RFL	RW	RFL	RW		
I	-	-	-	-	0.47	2.76	-	-	-	-	-	-	-	-	-	-	-	-	0.38	1.83
II	0.27	0.89	0.21	0.7	0.25	0.82	0.27	0.47	0.29	0.46	0.27	0.47	0.28	1.23	0.29	1.35	0.29	1.29		
III	0.2	0.8	0.26	1.01	0.22	0.87	0.18	0.62	0.2	0.74	0.19	0.68	0.23	0.76	0.24	0.75	0.23	0.74		
IV	0.18	0.64	0.14	0.54	0.17	0.61	0.14	0.8	0.14	0.71	0.14	0.75	0.16	0.49	0.18	0.55	0.17	0.53		
V	0.1	0.29	0.14	0.45	0.1	0.33	0.09	0.31	0.06	0.24	0.08	0.28	0.13	0.46	0.12	0.4	0.12	0.43		
VI	0.12	0.36	0.13	0.32	0.12	0.34	0.06	0.09	0.08	0.18	0.07	0.13	0.09	0.24	0.06	0.23	0.08	0.24		
VII	0.11	0.36	0.08	0.2	0.11	0.31	-	-	0.06	0.23	0.07	0.24	0.07	0.24	0.09	0.29	0.07	0.26		
VIII	0.06	0.19	-	-	0.06	0.22	-	-	-	-	-	-	-	-	-	-	-	-		
IX	0.06	0.31	-	-	0.06	0.31	-	-	-	-	-	-	-	-	-	-	-	-		
X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

DISCUSSION

The age composition in present study of European Chub, Anatolian Bleak and Tench populations was as follows: I-X; II-VIII and I-VIII. Because of the large mesh size (>10 mm), fish less than I year old for European Chub and Tench populations and II year old for Anatolian Bleak populations were not represented.

The age composition in previous studies of European Chub populations was as follows: Işıklı Lake, I-V¹⁸; Topçam Dam Lake, I-VII³; Sır Dam Lake, I-VI¹⁹; Sarıyar

Dam Lake, I-X²⁰. The life span of the European Chub population in the Camkoru Pond was longer than the other studies except Sarıyar Dam Lake. The age composition in previous studies of Tench populations was as follows: Kesikköprü Dam Lake, I-VI⁹; Bayındır Dam Lake, I-V²¹. Kayaboğazı Dam Lake I-VII²². Porsuk Dam Lake, I-VIII²³; Abant Lake, II-IX¹³; Hirfanlı Dam Lake I-VI²⁴. The age composition of Anatolian Bleak populations in Sakarya Basin reported as I-V¹⁵; These differences in the age distribution of the populations may be due to sampling differences, fishing activity, trophic status and ecological characteristics of the water bodies.

Overall, the percent female and male population in each age class of European Chub was as follows for females and males, respectively: Age 1., 8.14% (Immature); age 2., 3.26% (female) and 1.95% (male); age 3., 37.1% and 19.9%; age 4., 9.12% and 4.89%; age 5., 3.58% and 1.95%; age 6., 1.95% and 0.65%; age 7., 2.93% and 0.65%; age 8., 0.98% and 0.65%; age 9., 0.98% (female); age 10., 1.95% (female). Females were more numerous in all age groups of the European Chub populations and males were not sampled in age groups IX and X. It can be stated from these results that male individuals of the European Chub population are shorter lived than females.

The percent female and male population in each age class of Anatolian Bleak was as follows for females and males, respectively: Age 2., 0.66% and 0.33%; age 3., 26.9% and 24.6%; age 4., 5.32% and 6.31%; age 5., 7.64% and 8.64%; age 6., 7.64% and 6.64%; age 7., 2.33% and 2.33%; age 8., 0.66% (male). Males were more numerous in IV and V age groups of the Anatolian Bleak populations.

The percent female and male population in each age class of Tench was as follows for females and males, respectively: Age 1., 13.1% (Immature); age 2., 11.8% and 10.2%; age 3., 16.2% and 12.4%; age 4., 9.55% and 15%; age 5., 3.5% and 1.91%; age 6., 1.27% and 0.96%; age 7., 1.59% and 0.96%; age 8., 0.96% and 0.64. Females were more numerous in II, III, V, VII and VIII age groups of the Tench populations.

Of all the European Chub examined, 25 were immature, 188 were female, and 94 were male. The sex ratio was 1.0 females to 0.5 male in the European Chub populations in present study. The sex composition differed between the ages, with a higher percentage of females in the all age classes. It was determined that female strongly dominated in the population of European Chub in the Camkoru Pond. There were significant differences in the ratio of females to males in the European Chub populations. The unequal sex ratio for mature fish respects different survival rates for males and females. It is not clear which factors might be responsible in the fluctuation of male and female population distribution of *S. cephalus* in Camkoru Pond. The sex ratio (female:male) in previous studies of European Chub populations was as follows: Tödürge Lake, 1:0.42²⁵ Işıklı Lake Chub, 1:1.46¹⁸; Topçam Dam Lake, 1:0.37³; Sir Dam Lake 1:0.82¹⁹; Karakaya Dam Lake, 1: 0.57⁴; İkizcetepeler Dam Lake, 1:1.41⁷. The sex ratio of European Chub populations in the Tödürge Lake, Karakaya Dam Lake and Camkoru Pond are quite similar.

Of all the Anatolian Bleak examined, 152 were

female, and 149 were male. The sex ratio was 1.0 females to 0.98 male in this population. Of all the Tench examined, 41 were immature, 141 were female, and 132 were male. It was 1.0 females to 0.94 male in the Tench populations. The almost equal ratio of females to males at relatively similar sizes in two fish populations (*A. escherichii* and *T. tinca*) indicate that equal numbers of two sexes are born and enter the population.

The sex ratio (female:male) in previous studies of Tench populations was as follows: Kesikköprü Dam Lake, 1:0.94⁹; Bayındır Dam Lake, 1:1.04²¹; Kayaboğazı Dam Lake, 1:0.95²²; Abant Lake 1:0.83¹³; Hirfanlı Dam Lake 1:1.42²⁴ Porsuk Dam Lake, 1:0.96²³. The sex ratio of Tench populations in the Kesikköprü Dam Lake, Kayaboğazı Dam Lake, Porsuk Dam Lake and Camkoru Pond are quite similar. The sex ratio differs from one population to another of the same species and may vary from year to year in the same population. The reasons of this variation may be different and numerous: the seasonal aspect, the feeding and maturation periods, different growth rates in males and females, mortality difference for each sex and perhaps the climatical and biological conditions.

The Fork length of the European Chub population in Camkoru Pond ranged from 8 cm to 38.4 cm. The mean fork length of all samples was 18.51 cm. Lengths for ages I, II, III, IV, V, VI, VII, VIII, IX and X were 9.19; 13.54; 16.92; 20.70; 24.22; 26.83; 30.12; 33.34; 35.30 and 37.38 cm respectively. The fork lengths in age groups II, IV, VI, VII and VIII were higher for males, and in III and V age groups for females. The mean female body length was 19.71 cm and individual length ranged from 11.3 to 38.4 cm. The mean male body length was 18.57 cm and individual length ranged from 11 to 34.8 cm. The fork length of the age groups of European Chub populations in the Sarıyaz Dam Lake²⁰ and Camkoru Pond are quite similar.

The mean fork length of all samples of Anatolian Bleak examined was 11.37 cm and individual fish ranged in length from 7.5 cm to 16.4 cm. Lengths for ages II, III, IV, V, VI, VII and VIII were 7.60; 9.67; 11.54; 13.18; 14.22; 15.22 and 16.30 cm respectively. The fork lengths in age groups IV, V and VII were higher for males, and in II, III and VI age groups for females. The mean female body length was 11.31 cm and individual length ranged from 7.5 to 15.7 cm. The mean male body length was 11.44 cm and individual length ranged from 7.5 to 16.4 cm. The fork length of the IV age group of Anatolian Bleak populations in the Sakarya 3 basin (11.40 cm)¹⁵ and Camkoru Pond are quite similar.

The Fork length of the Tench population in Camkoru Pond ranged from 8.2. cm to 32.5 cm and The mean fork

length of all samples was 16.73. Lengths for ages I, II, III, IV, V, VI, VII and VIII were 9.16; 12.65; 16.32; 20.06; 23.46; 26.34; 28.38 and 30.48 cm respectively. The fork lengths in all age groups were higher for females. The mean female body length was 17.90 cm and individual length ranged from 10.7 to 32.5 cm. The mean male body length was 17.84 cm and individual length ranged from 10.6 to 30.9 cm. The fork length of the III and IV age groups of Tench populations in the Abant Lake¹³ and Camkoru Pond are quite similar.

The total weights of the European Chub population in Camkoru Pond ranged from 8.3 gr to 845 gr and the total weights for ages I, II, III, IV, V, VI, VII, VIII, IX and X were 9.95; 37.44; 68.28; 127.57; 204.98; 272.3; 365.27; 478; 584.33; 764.75 gr respectively. The weights in age groups II, IV, VI and VII were higher for males, and in III, V and VIII age groups for females. The mean body weight of all samples was 114.78 gr. The mean female body weight was 134.74 gr and individual weight ranged from 18.2 to 845 gr. The mean male body weight was 102.73 gr and individual weight ranged from 18.9 to 498 gr. The body weight of the III and IV age groups of European Chub populations in the Topçam Dam Lake and Camkoru Pond are quite similar.

The total weights of the Anatolian Bleak population in Camkoru Pond ranged from 7.1 gr to 56.8 gr and the total weights for ages II, III, IV, V, VI, VII and VIII were 7.13; 10.45; 17.56; 30.76; 39.30; 44.41 and 55.10 gr respectively. The weights in age groups IV, V and VII were higher for males, and in II, III and VI age groups for females. The mean body weight of all samples was 20.48 gr. The mean female body weight was 20.23 gr and individual weight ranged from 7.1 to 52.1 gr. The mean male body weight was 20.74 gr. and individual weight ranged from 7.1 to 56.8 gr. The body weight III of the IV age group of Anatolian Bleak populations in the Sakarya 3 basin (11.13 and 15.78 gr)¹⁵ and Camkoru Pond are quite similar.

The total weights of the Tench population in Camkoru Pond ranged from 8.2 gr to 453 gr and the fork lengths for ages I, II, III, IV, V, VI, VII and VIII were 10.61; 30.06; 68.78; 119.59; 183.13; 261.86; 325.36 and 409.74 gr respectively. The weights in all age groups were higher for females. The mean body weight of all samples was 88.29 gr. The mean female body weight was 102.57 gr and individual weight ranged from 21.3 to 453 gr. The mean male body weight was 97.17 gr and individual weight ranged from 23 to 425.2 gr.

The length and weight values according to age show great variation between different habitats these differences are attributes to different age readings by the different

researchers, feeding habitats, population density, ecological conditions, parasite load and sexual maturity age as well as the differences in habitat.

The slope (b) values of the length weight regression of both sexes combined of European Chub, Anatolian Bleak and Tench populations was as follows: 3.0126; 3.2501 and 3.0066. The b value, showing the type of growth in fish, has been shown to range from 2 to 4²⁶. When the b value for the length-weight relationship in a fish population is 3 or very close, it can be classified as isometric; however, if this value is considerably different than 3, it can be classified as allometric. For the European Chub, the b value was reported to be 3.12 in Topçam Dam Lake³, 3.04 in Işıklı Lake¹⁸, 3.19 in Sır Dam Lake¹⁹. For the Tench, the b value was reported to be 3.08 in Abant Lake¹³, 3.17 in Bayındır Dam Lake²¹, 3.17 in Kesikköprü Dam Lake⁹; 2.63 in Hirfanlı Dam Lake²⁷; 3.01 in Mogan Lake²⁸. The length-weight relationship in fish may vary according to species, age and sexes. Geographic location and associated environmental conditions, such as seasonality (date and time of capture), stomach fullness, disease and parasite loads, can also affect the value of b^{26,29}. The slope (b) values of the length weight regression of both sexes combined of Anatolian Bleak and European Chub populations were significantly different from 3. Length-weight relationship showed that the Tench populations in Camkoru pond grows isometric; Anatolian Bleak and European Chub populations grow allometric (Weight increased allometrically with length).

The highest relative increases in length were in age group I of European Chub and Tench populations and II age group of Anatolian Bleak in Camkoru Pond. The relative increases in length among II, IV and VII age groups of European Chub; only V age groups of Anatolian Bleak; V and VI age groups of Tench were higher for females than males. The highest relative increases in weight were in age group I of European Chub and Tench populations and IV age group of Anatolian Bleak in Camkoru Pond. The relative increases in weight among II, IV, VI and VII age groups of European Chub; II, IV and V age groups of Anatolian Bleak; III, V and VI age groups of Tench were higher for females than males. As can be seen in [Table 6](#). The relative increases in length decreased gradually with age in three fish species but the relative increases in weight decreased gradually with age in two fish species (European Chub and Tench).

Six fish species, 1199 specimens were captured from Camkoru Pond. *Tinca tinca* (38.78%) was determined to have the greatest population size followed by *Squalius cephalus* (31.19%), *Alburnus escherichii* (25.69%), *Gobio gobio* (3.34%), *Cyprinus carpio* (0.92%) and *Oncorhynchus*

mykiss (0.08%). Some native fish species living in inland waters of Turkey have become endangered due to a combination of introduction of exotic fishes, aquaculture, overexploitation, excessive water abstraction (Innal, pers. observation). The introduction of species into an aquatic system has been shown to directly, or indirectly, impact aquatic macrophytes, water quality and aquatic fauna including plankton, benthic macroinvertebrates, fishes and wildlife.

The introduction of *Tinca tinca* into Camkoru Pond was met with great success by showing adaptation to the pond's ecological characteristics but no such success was met with the introduction of *Cyprinus carpio* and *Oncorhynchus mykiss*. In order to increase the population density of native fish species (European Chub and Anatolian Bleak), It will be necessary to control the Tench population in Camkoru Pond.

ACKNOWLEDGEMENTS

The author thanks to Professor F. Erk'akan (Hacettepe University, Ankara-Turkey) for her continuous supports during the study.

REFERENCES

- Geldiay R, Balik S:** Türkiye Tatlısu Balıkları. 3. Baskı, 231-374, Ege Üniv Su Ürünleri Fak. Yayınları, 1996.
- Altındag A:** Some population feature, growth and condition of the Chub (*Leuciscus cephalus* L.,1758) in Akşehir Lake (Konya). *Turk J Zool*, 20 (Suppl): 53-65, 1996.
- Sasi H, Balik S:** Age, growth and sex ratio of Chub (*Leuciscus cephalus* L., 1758) in Topcam Dam Lake (Aydın). *Journal of Fisheries and Aquatic Sciences*, 20 (3-4): 503-515 (in Turkish with English abstract), 2003.
- Kalkan E, Yılmaz M, Erdemli U:** Some biological properties of the *Leuciscus cephalus* (L., 1758) population living in Karakaya Dam Lake in Malatya (Turkey). *Turk J Vet Anim Sci*, 29, 49-58, 2005.
- Unver B, Erk'akan F:** A natural hybrid of *Leuciscus cephalus* (L.) and *Chalcalburnus chalcooides* (Güldenstädt) (Osteichthyes - Cyprinidae) from Lake Todurge (Sivas, Turkey). *J Fish Biol*, 66 (4): 899-910, 2005.
- Sen F, Altun M, Elp M, Kankaya E:** Growth and reproduction properties of Chub in Savur Stream in Turkey. *Indian Vet J*, 84, 428-429, 2007.
- Torcu Koc H, Erdogan Z, Tinkci M, Treer T:** Age, growth and reproductive characteristics of Chub, *Leuciscus cephalus* L., 1758) in the İkizcetepeler Dam Lake (Balıkesir), Turkey. *J Appl Ichthyol*, 23, 19-24, 2007.
- Alas A:** Kayaboğazi Baraj Gölü (Taşanlı-Kütahya)'nde yaşayan *Leuciscus cephalus* (Linnaeus, 1758) ve *Tinca tinca* L. 1758)'nin biyo-ekolojik özellikleri üzerine bir araştırma. *Doktora Tezi*. Gazi Üniversitesi, Fen Bil Enst, Ankara, 1998.
- Altındag A, Yigit S, Ahıska S, Ozkurt S:** The growth features of Tench (*Tinca tinca* L.,1758) in the Kesikköprü Dam Lake. *Turk J Zool*, 22, 311-318, 1998.
- Yılmaz F:** Reproductive biology of the Tench *Tinca tinca* (L., 1758) inhabiting Porsuk Dam Lake (Kütahya, Turkey). *Fish Res*, 55 (1): 313-317, 2002.
- Balik S, Sari HM, Ustaoglu MR, Ilhan A:** The Structure, mortality and growth of the Tench [*Tinca tinca* (L., 1758)] population in Civril Lake, Denizli, Turkey. *Turk J Vet Anim Sci*, 28, 973-979, 2004a.
- Tekin Ozan S, Kir I:** Comparative study on the accumulation of heavy metals in different organs of Tench (*Tinca tinca* L., 1758) and plerocercoids of its endoparasite *Ligula intestinalis*. *Parasitol Res*, 97, 156-159, 2005.
- Hos AC:** Studies on Bio-ecology of *Salmo trutta abanticus* Tortonese, 1954 (Abant Trout) and *Tinca tinca* Linnaeus, 1758), (Tench) living in Abant Lake (Bolu-Turkey). *Phd Thesis*. Hacettepe University, Inst Sci, Ankara, 2005.
- Ak A:** A study on the growth features of Tench (*Tinca tinca* L., 1758) inhabited in Beyşehir (Konya) Lake. *Msc Thesis*. Nigde University, Inst Sci, 2006.
- Erk'akan F:** Sakarya Havzası balıklarının sistematigi ve biyo-ekolojik ilişkileri üzerine araştırmalar. *Doktora Tezi*. Hacettepe Üniversitesi, Fen Bil Enst, Ankara, 1981.
- Şişli MN:** Ekoloji, Çevre Bilim, 1-492, Yeni Fersa Matbaacılık, Ankara, 1996.
- Lagler KF:** Freshwater Fishery Biology. Brown, Dubuque, Iowa, 1952.
- Balik S, Sari HM, Ustaoglu MR, Ilhan A:** Age and growth characteristics of Chub (*Leuciscus cephalus* L., 1758) population in Işıklı Lake, Civril, Denizli. *Journal of Fisheries and Aquatic Sciences*, 21 (3-4): 257-262, 2004.
- Kara C, Solak K:** Growth properties of Chub (*Leuciscus cephalus* L., 1758) in Sır Dam Lake (Kahramanmaraş). *KSU J Eng Sci*, 7 (2): 1-8, 2004.
- Ekmekci FG:** Sarıyar Baraj Gölü'nde yaşayan tatlısu kefalı (*L. cephalus*, L.,1758)'nin büyüme ve üreme özellikleri. *Turk J Zool*, 20, 153-160, 1996.
- Altındag A, Shah SL, Yigit S:** The growth features of Tench (*Tinca tinca* L.,1758) in Bayındır Dam Lake, Ankara, Turkey. *Turk J Zool*, 26, 385-391, 2002.
- Alas A, Solak K:** The Reproductive Biology of the Tench (*Tinca tinca* L., 1758) in Kayaboğazi (Kütahya, Turkey) Dam Lake. *Turk J Vet Anim Sci*, 28, 879-885, 2004.
- Yılmaz F:** A bioecological research on *Cyprinus carpio* L., 1758 and *Tinca Tinca* (L., 1758) inhabiting Porsuk Dam Lake. *Phd Thesis*. Gazi University, Inst Sci, Ankara, 1997.
- Sanli S:** Observations on Growth and Digestive tract content of *Tinca tinca* (L., 1758) Live in Hirfanlı Dam Lake. *MSc Thesis*. Gazi University,Inst Sci, 1998.
- Unver B:** Tödürge Gölü'ndeki tatlısu kefalı (*Leuciscus cephalus* L., 1758)'nin büyüme ve üreme özellikleri. *Yüksek Lisans Tezi*. Cumhuriyet Üniversitesi, Fen Bil Enst, Sivas, 1995.
- Bagenal TB, Tesch FW:** Age and growth. In, TB Bagenal (Ed): Methods for Assesment of Fish Production in Fresh Waters. IBP Handbook. Vol. 3. pp. 101-136, Blackwell Science Inc., London, 1978.
- Benzer Sanli S:** Bioecologic charecteristics and feeding regimes of Tench (*Tinca tinca* L., 1758) and Pike (*Esox lucius* L., 1758) Live in Kapulukaya Dam Lake (Kızılırmak River). *Phd Thesis*. Ankara, Gazi University, Inst Sci, 2004.
- Ergonul MB:** The effects of Ligulosis on the growth features of the Tench (*Tinca tinca* L., 1758) inhabiting Lake Mogan (Ankara). *Msc Thesis*. Ankara University, Inst Sci, Ankara, 2004.
- Le Cren ED:** The length-relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *J Anim Ecol*, 20, 210-218, 1951.