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Growth Parameters Research of the Rudd, *Scardinius erythrophthalmus*, in Lake Uluabat

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Abstract

The rudd**,** *Scardinius erythrophthalmus* (Linnaeus,1758) is a common freshwater fish species, which widely spread in Europe and middle Asia. *S. erythrophthalmus* was first reported Lake Uluabat in Turkey by Berg in 1921. This species does not have much economic value but it is important as food for carnivorous fish species living in the fresh water system. The present study aims to determine the population growth of *Scardinius erythorphthalmus* population in Lake Uluabat (also known as Lake Apolyont).

In this study, 417 individuals of *S. erythrophthalmus* were caught and examined each month between March 2006 and February 2007 by utilizing gill nets in various sizes. By utilizing the measured lengths, weights, and determined ages, the von Bertalanffy growth equations were calculated. Munro's Phi Prime Test was used in order to compare the calculated equations with previous studies

The ages of population ranged between I-VII age groups. The percentages of females were 59%, males 32 %and 9 %juvenile out of fish samples. Fork length of females ranged between 13-31.8 cm and 27-478 g in weight; as for males were 12.3-28 cm in length and 22.2-308 g in weight. The length-weight relationship was estimated as $W= 0.0087 L^{3.1782}$ for females and $W= 0.0091 L^{3.1593}$ for males. Bertalanffy growth parameters were computed for females as $L\infty$=38.47 cm, $W\infty$=945.01 g, K=0.191318 $year^{-1}$ and t_0= -1.15495 year; for males as $L\infty$= 31.72 cm, $W\infty$= 506.84 g, K=0.309779 $year^{-1}$ and t_0=-0.58332 year.

This study presents population structure and growth features of *S. erythrophthalmus* species in Lake Uluabat, which is one of the most important fish farms in Turkey, and compares growth features with other areas

Key words: *Scardinius erythrophthalmus*, Lake Uluabat, Growth Parameters, Turkey

INTRODUCTION

Inland waters are regions of aquaculture that significantly contribute to the economy of countries. According to 2006 aquaculture products statistics of the Turkish Statistical Institute of Turkey [1], 44,802 tons of products were cultivated in Turkish inland waters excluding aquaculture. Among the lakes that contribute greatly to this figure is Lake Uluabat located in Bursa province. Based on the records of Gölyazı Aquaculture Cooperative active at the Lake Uluabat, the fishing activity is performed by 165 certified fishers and boats at the lake. Cooperative records note that 412 tons of *Carassius gibelio*, 93.5 tons of *Esox lucius*, 31.5 tons of *Cyprinius carpio*, 61 tons of *Rutilus rutilus*, and 18.5 tons of *Scardinius erythrophthalmus* were caught as a result of this fishing activity.

The aim of this study is to determine the growth properties of *S. erythrophthalmus* population of which the fishing is carried out in significant amounts in Lake Uluabat.

S. erythrophthalmus is generally widespread throughout the entire Europe continent. However, in Turkey, this species is found predominantly in inland waters located in northern and central Anatolian regions and Thrace. The said species lives in the highly vegetated regions of such mild and shallow lakes. The most characteristic feature is its red color of ventral, anal, and caudal fins [2].

The studies conducted in Turkey on the biology of *S. erythrophthalmus* include the study by Erdem et al. [3] in Lake Hamam; Balık et al. [4] in Lake Kuş; Tarkan [5,6] in Lake Sapanca; Gümüş et al. [7] in Bafra fish lakes; Bostancı et al. [8] in Gölhisar Lake; and by Koyuncu et al. [9] in Lake Uluabat. Some studies carried out in Europe include the study by Hacker [10] in Austria; Berg [11] in Dnieper River, Sudoch Lake and Lake Aral, by Mann and Steinmetz [12] in European countries, Prokes and Rebickova [13] in Musov Reservoir, and studied growth properties of *S. erythrophthalmus* species.

MATERIALS AND METHODS

Lake Uluabat is located within the city limits of Bursa at the coordinates of 40° 10' North and 28° 35' East (Figure 1).

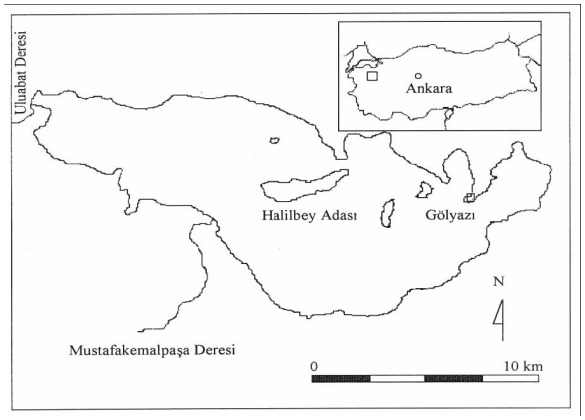

Figure 1. Map of Lake Uluabat.

Lake Uluabat has a surface area of 160 km², and although the depth of the lake was reported to be 7.5 meters in previous measurements, currently it is said to have a depth of 3 meters and it decreases down to 1 meter in summer months [14].

According to the 2nd and 3rd articles of the "Contract on Waterlogged Sites with International Significance as the Living Spaces Especially of Water Birds" published in the Official Gazette No 23314 dated 15 April 1998 and, the Ramsar Site was added to the International list and taken under preservation. The Ramsar Site covers an area of 17,425 hectares that contains a lake and its surroundings. 13,500 hectares of the site is the lake itself.

The Mustafakemalpaşa Brook in southwest feeds the Lake Uluabat. The water outlet is enabled by the Uluabat Brook. Uluabat Brook intersects with Susurluk (Simav) Brook and forms Koca Brook and disembogues into Marmara Sea [15].

In this study, 417 individuals of *S. erythrophthalmus* was caught and examined in each month between March 2006 and February 2007 by utilizing gill nets in various mesh sizes (18, 20, 25, 28, 32, and 40 mm).

Brought to the laboratory on the same day, the caught fishes were measured in lengths, weight, and gonad weight and gender of these samples were determined through gonad examination. The lengths of samples were measured by a measuring board in centimeters; bodyweights were measured by an Ohaus brand scale of 0.5 g sensitivity. Ages of the samples were determined from their scales

By utilizing the measured lengths, weights, and determined ages, the von Bertalanffy growth equations ($L_t = L_\infty (1\text{-}e^{-k(t-to)})$, $W_t = W_\infty (1\text{-}e^{-k(t-to)})^b$ were calculated. Munro's Phi Prime Test ($Ø' = LnK+2xLn\ L_{\infty)}$ was used in order to compare the calculated equations with previous studies. Length-weight relation of *Scardinius erythrophthalmus* population in Lake Uluabat by estimating $W=aL^b$ correlation [16].

RESULTS

Age and sex composition

As a result of the determination of age, the population was observed to show a distribution between the ages of I-VII, and that the individuals in the 3 and 4 age groups proved to be more dominant. Around 59% of the samples were female, 32% were male, and 9% were individuals not yet reached the gonadal maturity. The male-female ratio was found as 0.54:1.00, and female individuals were observed to be more dominant compared with males. The Chi Square difference test revealed the difference of male and female existence within the population (X^2=33.42, $p<0.001$). The distribution of age and sex groups of 417 *S. erythrophthalmus* caught in Lake Uluabat was given in Table 1.

Table 1. Sex distribution of *S. erythrophthalmus* based on age and their percentages

Age	Female		Male		Juvenile		Population	
	N	N%	N	N%	N	N%	N	N%
1	1	0.24	1	0.24	17	4.08	19	4.56
2	22	5.28	25	6.00	19	4.56	66	15.83
3	94	22.54	59	14.15	--	--	153	36.69
4	106	25.42	41	9.83	--	--	147	35.25
5	16	3.84	7	1.68	--	--	23	5.52
6	5	1.20	1	0.24	--	--	6	1.44
7	3	0.72	--	--	--	--	3	0.72
Total	247	59.23	134	32.13	36	8.63	417	100.00

Distribution of length

As a result of difference test conducted on total lengths of female and male individuals in *S. erythrophthalmus* population, a statistical difference was observed ($t=4.754$ $p<0.05$). In the population, the fish with the shortest length was found as 11 cm in length, and the tallest fish was observed as 31.8 cm in length. The mean length of fish was 21.41 cm for the all population, 22.62 cm for females and 21.34 cm for males. Mean length of female fishes was observed as higher compared with male individuals.

Distribution of weight

When checked the weight distribution of 417 *S. erythrophthalmus* individuals caught in Lake Uluabat, the entire population was observed to have varied between 15-478 g in weight. The mean weight of fish in the entire population was 160.35 g, females were 183.62 g, and males were found as 151.19 g in weight. And when checked in terms of mean values, female individuals had higher mean weight values compared with males.

Relation of Age-Length

Lengths of each age group from *S. erythrophthalmus* population in Lake Uluabat were estimated and the population was individually evaluated in terms of female and male samples. The obtained results were given in Table 2.

Table 2. Total length values of *Scardinius erythrophthalmus* individuals based on age

Total Length	Age	N	Min.	Max.	Average	Standard deviation
Female	1	1	13	13	13.00	
	2	22	13	22.2	18.09	3.067
	3	94	18.3	25.9	21.37	1.285
	4	106	22.1	25.9	23.77	0.864
	5	16	24	27.7	26.04	1.001
	6	5	27.4	28.1	27.92	0.295
	7	3	29	31.8	30.60	1.442
Male	1	1	12.3	12.3	12.3	
	2	25	14.1	22	18.61	1.760
	3	59	17.6	24.1	20.89	1.391
	4	41	21	24.7	23.03	0.877
	5	7	24.7	26	25.29	0.467
	6	1	28	28	28	
Total	1	19	11	13.2	11.85	0.789
	2	66	12.1	22.9	17.34	2.981
	3	153	17.6	25.9	21.19	1.343
	4	147	21	25.9	23.57	0.927
	5	23	24	27.7	25.81	0.932
	6	6	27.7	28.1	27.93	0.266
	7	3	29	31.8	30.60	1.442

By utilizing the calculated mean length values, the formulae that ensure the age-length relation growth parameters determined according to von Bertalanffy growth equations for female and male samples and the population, together with theoretical length calculation at any age were estimated and given in Table 3.

Table 3. Bertalanffy growth parameters for *S. erythrophthalmus* according to sex in Lake Uluabat

Sex	L∞	K	t_o
Female	38.47	0.191318	-1.15495
Male	31.72	0.309779	-0.58332
Total	37.47	0.213480	-0.78041

The asymptotic length (L∞ =38.47) and asymptotic weight (W∞= 945.01) females could attain was found as higher compared with the asymptotic length (L∞=31.72) and weight (W∞=506.84).

Relation of Length-Weight

Bearing in mind the total length and weight of 417 individuals from *S. erythrophthalmus* individuals in Lake Uluabat found through measurement, the length-weight relation equation of the entire female and male individuals was calculated (Fig. 2-4).

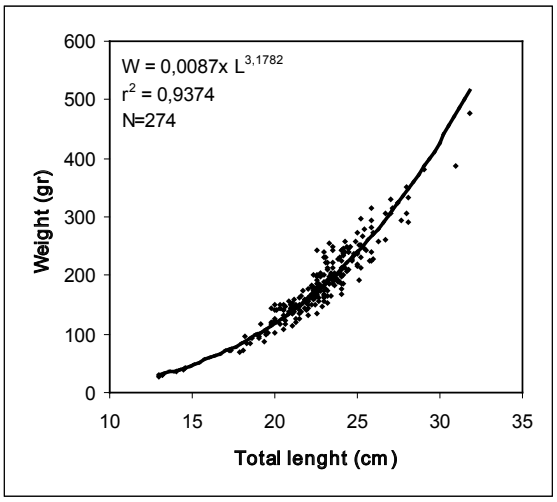

Figure 2. *S. erythrophthalmus* female total length-weight relation

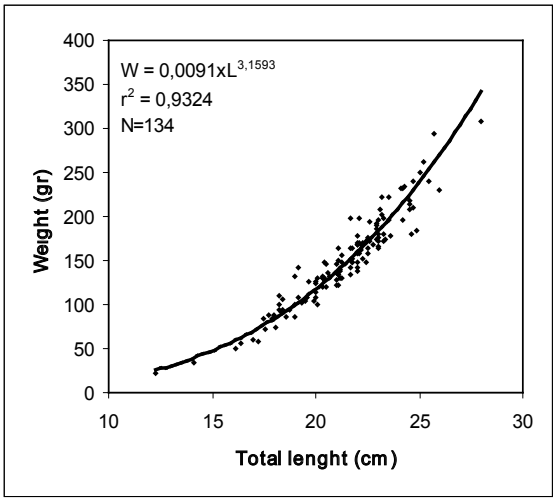

Figure 3. *S. erythrophthalmus* male total length-weight relation

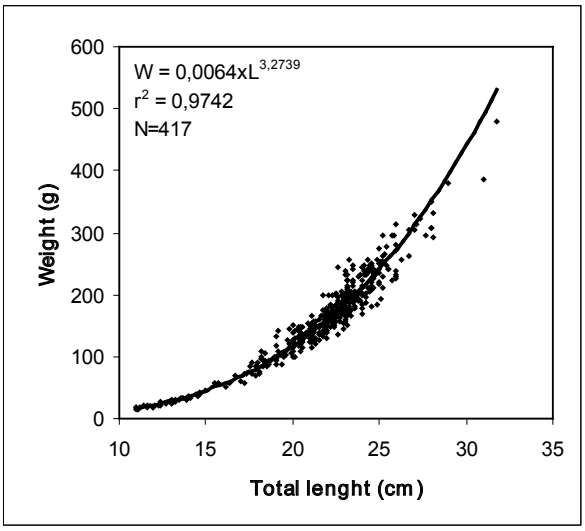

Figure 4. *S. erythrophthalmus* population total length-weight relation

DISCUSSION

In studies carried out in Turkey on *S. erythrophthalmus* [3,4,6,7], and the found individuals were up to the VII years of age. In the study by Tarkan et al. [5], individuals up to the age of 12 were found in Sapanca Lake. Also in studies conducted in countries other than Turkey, the reported individuals were by Hacker [10] up to IV years of age in Neusidlersee, Austria; by Berg [11] up to V in Dnieper River, VI in Sudoch Lake, V in Aral Lake; By Mann and Steinmetz [12] between the age groups of I – V in various European countries. However, Prokes and Rebickova [13] reported that *S. erythrophthalmus* could have a lifespan of X-XV years, and Berka [17] established this species could reach a maximum age of VII. In our study, the individuals that belong to *S. erythrophthalmus* population were established to manifest a distribution between the ages of I and VII. The age distributions were established in Lake Uluabat shows a parallelism with data obtained in Turkey's inland waters.

The male:female ratio of *S. erythrophthalmus* reported in studies conducted in Turkey are as follows: 0.65:1 in Lake Manyas [4]; 0.83:1 in Lake Sapanca [5]; 1.2:1 in Lake Sapanca [6]; 0.39:1 in Lake Gölhisar [8]; and 0.53:1 in Lake Uluabat [9]. In our study, the male:female ratio was established as 0.54:1. In all of Manyas, Sapanca, Gölhisar and Lake Uluabat, the rate of females was observed as higher compared with the males. When checked the Table 1, it manifests that the rates of male and female ratios proved to be quite close up to the first II years of ages. However, the rate of females shows an increase from the age of III compared with the rate of males, and the difference also rises as the age advances. This condition in Lake Uluabat might stem from the fact that male individuals reaching sexual maturity travel more with the instinct of mating, and thus, are more prone to a higher pressure of hunting.

The Munro's Phi Prime "Ø" values were estimated by utilizing von Bertalanffy growth invariants obtained for *S. erythrophthalmus* population in Lake Uluabat and values found in other studies, and these values were given in Table 4. In order to Munro's Phi Prime Test was performed (t_s=0.73) and a difference was not observed between the growth invariants of von Bertalanffy obtained in other studies and the values found in this study.

When compared the L∞ values, the L∞ values we estimated for *S. erythrophthalmus* in Lake Uluabat proved to be the highest in all other habitats except for Poltruba habitat located in Czechoslovakia. This finding shows us *S. erythrophthalmus* in Lake Uluabat could reach higher lengths compared with the ones in other habitats.

The W∞ values estimated by Balık [4] and Koyuncu [9] were lower compared with the W∞ values established in this study. The fact that L∞ and W∞ values found in this study were higher than the values in a study by Koyuncu [9] conducted at the same site shows that the asymptotic length and weight values of *S. erythrophthalmus* species in Lake Uluabat has been on an increase.

In this study, the length-weight relation equations of *S. erythrophthalmus* were estimated as $W= 0.0087\ L^{3.17}$ in female individuals, $W=0.0091\ L^{3.15}$ in male individuals, and $W= 0.0064\ L^{3.27}$ in the all population. The length-weight relation invariants obtained in studies conducted on *S. erythrophthalmus* are given in Table 5.

Table 4. The von Bertalanffy growth invariants and Ø' reported in studies conducted [4,9,18].

Area	Reference	Country	Sex	*von Bertalanffy Growth Parameter*				
				L∞	W∞	k	t_0	Ø'
Kuş Lake	Balık et. al. (1997)	T	♀♀+♂♂	18.07	146	0.496	-0.09	*5.09*
Lake Uluabat	Koyuncu et. Al (2007)	T	♀♀ ♂♂	28.12 26.48	391 381	0.36 0.38	-0.40 -0.38	*5.65* *5.59*
Lake Uluabat	In the present study	T	♀♀+♂♂	37.47	910	0.213	-0.78	*5.70*
*Prochazkova	Fishbase	C	♀♀+♂♂	14.08	--	0.391	-0.40	*4.35*
*Debas	Fishbase	H	♀♀+♂♂	15.6	--	0.261	--	*4.15*
*Mala Arazimova	Fishbase	C	♀♀+♂♂	18.8	--	0.277	-0.75	*4.58*
*Klicava	Fishbase		♀♀+♂♂	20.7	--	0.527	-0.17	*5.42*
*Kastoria Lake	Fishbase	G	♀♀+♂♂	23.9	--	0.178	-0.52	*4.62*
*Zaskalska	Fishbase	C	♀♀+♂♂	30.8	--	0.108	-2.5	*4.63*
*Volga	Fishbase	R	♀♀+♂♂	34.5	--	0.190	-0.61	*5.42*
*Poltruba backwarers	Fishbase	C	♀♀+♂♂	36.6	--	0.094	-0.38	*4.84*
**Poltruba*	*Fishbase*	*C*	♀♀+♂♂	*38.3*	--	*0.089*	*0.45*	*4.87*

T: Turkey, C: Czechoslovakia, H: Hungary, G: Greece, R: Russia

Table 5. The length-weight relation invariants established in studies of *S. erythrophthalmus* [2,3,6,7,8,9,18,19]

Area	Reference	Country	Sex	a	b
Hamam Lake	Erdem et al (1994)	T	♀♀+♂♂	0.7252	*4.26*
Kuş Lake	Balık ve ark (1997)	T	♀♀+♂♂	0.0064	*3.46*
Sapanca Lake	Okgerman (2003)	T	♀♀+♂♂	0.004	*3.37*
Büyük Çekmece Lake	Tarkan et. al. (2006)	T	♀♀+♂♂	0.0078	*3.21*
Bafra Lake	Gümüş et. al. (2007)	T	♀♀+♂♂	0.0105	*3.23*
Gölhisar Lake	Bostancı et. al (2007)	T	♀♀ ♂♂ ♀♀+♂♂	0.0141 0.0195 0.0146	*3.09* *2.98* *3.09*
Lake Uluabat	Koyuncu et. al (2007)	T	♀♀ ♂♂	0.0038 0.0025	*2.92* *3.15*
Lake Uluabat	In the present study	T	♀♀ ♂♂ ♀♀+♂♂	0.0087 0.0091 0.0064	*3.17* *3.15* *3.27*
Velka Arizomava	Fishbase	C	♀♀+♂♂	0.0369	*2.70*
Volga	Fishbase	R	♀♀+♂♂	0 183	*3.12*
Mala Arizomava	Fishbase	C	♀♀+♂♂	0.0121	*3.18*
Volvi Lake	*Fishbase*	*M*	♀♀+♂♂	*0.0036*	*3.48*

T: Turkey, C: Czechoslovakia, R: Russia, M: Macedonia

The b values established in studies with length-weight relation invariants that are given in Table 5 manifest a range between 2.70 and 4.26. The b value which we found for the all individuals of *S. erythrophthalmus* in Lake Uluabat was established as higher compared with the b value estimated in Büyükçekmece, Bafra and Gölhisar lakes, and as lower compared with b values estimated in Hamam, Manyas, and Sapanca lakes. The b value we estimated for *S. erythrophthalmus* population in Lake Uluabat (3.27) points to an allometric growth of this species in Lake Uluabat.

This study attempted to reveal the structure and growth properties of *S. erythrophthalmus* living in Lake Uluabat.

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REFERENCES

[1] Su Ürünleri İstatistikleri 2006. [Fishery Statistics 2006] TC. Başkakanlık İstatistik Kurumu (TUIK). ISSN 1013-6177.

[2] Geldiay R. and Balık S**.,** 1988. Türkiye Tatlı Su Balıkları, Ege Üniversitesi Fen Fakültesi Kitaplar Serisi No: 97, s: 1-159, İzmir, Turkey.

[3] Erdem Ü. Ve ark. 1994. Hamam Gölü'ndeki (Kırklarel-İğneada) Yaşayan Kızılkanat (*Scardinius erythrophthalmus* L.,1758) ve Havuz Balığı (*Carassius carassius* L., 1758) Türlerinin Bazı Biyolojik Özellikleri, Ulusal Biyoloji Kongresi 6-8 Temmuz 1994 Edirne, Turkey.

[4] Balık S. ve ark., 1997. Kuş Gölü'ndeki (Bandırma) Kızılkanat (*Scardinius erythrophthalmus*) Populasyonunun Büyüme Özellikleri, IX Ulusal Su Ürünleri Sempozyumu 17-19 Eylül 1997 Eğirdir/ Isparta, Turkey.

[5] Tarkan A., S., 2002: Sapanca Gölü'nde Kızılgöz (*Rutilus rutilus* L.1758) ve Kızılkanat (*Scardinius erythrophthalmus* L.,1758) Balıklarının Eşeysel Olgunluğa Erişme Büyüklükleri ve Yumurta Verimlilikleri, MSc Thesis. İstanbul Üniversitesi Fen Bilimleri Enstitüsü, İstanbul, Turkey.

[6] Tarkan A.S., 2006, Reproductive ecology of two cyprinids fishes in an oligotrophic lake near the southern limits of their distribution range. Ecology of Freshwater Fish, 15, 131-138.

[7] Gümüş A.ve ark, 2007. Age determination of *Scardinius erythrophthalmus* (Cyprinidae) inhabiting Bafra fish lakes (Samsun; Turkey) based on otolith readings and marginal increment analysis, Cybium, 3 (1):59-66.

[8] Bostancı D., Yılmaz S., Polat N., 2007. Gölhisar gölü (Burdur)'ndeki Kızılkanat (*Scardinius erythrophthalmus* Linnaeus, 1758) populasyonunda yaş belirleme, boy-ağırlık ilişkisi ve kondisyon faktörü üzerine bir araştırma, Turkish Journal of Aquatic Life , 3-5: 5-8: 99-107.

[9] Koyuncu V. ve ark., 2007, Uluabat gölünde (Bursa) yaşayan *Scardinius erythrophthalmus* L., 1758, (Kızılkanat Balığı) populasyonunun büyüme parametrelerinin araştırılması, Turkish Journal of Aquatic Life 3-5:5-8: 288-296.

[10] Hacker R., 1979. Fishes And Fishery In Neusiedlersee. In:H. Löffer (Ed.) Neusiedlersee: The Limnology Of A Shallow lake in Central Europa. Dr W. Junk bv Publisher, London, 423-438.

[11] Berg L. S. 1949. Fresh Water Of The Ussr And Adjacent Countries (Translated By O. Ronen in Israel prog.for Scien. Trans ,Jerusalem,1964) Vol. 2, 7.

[12] Mann R.H.K., Steinmetz B., 1985, On the accuracy of age-determination using scales from rudd, *Scardinius erythrophthalmus* (L.), of known age. J.Fish Biol. 26,621-628.

[13] Prokes M., Rebickova, M., 1987. Seasonal Growth Of The Fry Rudd (*Scardinius erythrophthalmus*) in the Musov Reservoır. Folia Zoologica 36 (1), 73-83.

[14] İnan M. ve ark., 1999. Uluabat Gölü Çevre Durum Raporu, Bursa Valiliği İl Çevre Müdürlüğü, Bursa.

[15] Bebek M. T., 2001, Uluabat gölü ve gölü besleyen su kaynaklarında ağır metal kirliliğinin araştırılması, MSc Theis.Gazi Üniversitesi Fen Bilimleri Enstitüsü, Ankara, Turkey.

[16] Avşar D**.** 2005. Balıkçılık Biyolojisi ve Populasyon Dinamiği.[Fisheries Biology and Population Dynamics] Nobel Kitabevi Adana, Turkey.

[17] Berka, R, 1989. Inland Capture Fisheries of the USSR, FAO Fisheries Thecnical Paper, No. 311, Roma, FAO, 149pp.

[18] Fish Base, http://www.fishbase.org/Summary/speciesSummary.php?ID= 2951& genus name=Scardinius&speciesname=erythrophthalmus

[19] Okgerman H., 2003, Sapanca Gölü'nde Kızılkanat (*Scardinius erythrophthalmus* (L.)) Balığının Boy Ağırlık İlişkisi ve Kondisyon Faktöründeki Mevsimsel Değişimler İle Üreme Zamanının Tespiti, XII. Ulusal Su Ürünleri Sempozyumu 2-5 Eylül 2003,Elazığ, Turkey 171-178.