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Original Article

Age and Growth of Rudd, *Scardinius erythophthalmus* (Linnaeus, 1758), in Ömerli Reservoir (İstanbul, Turkey)

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ABSTRACT

In this study, 317 rudds (*Scardinius erythrophthalmus* (Linnaeus, 1758) were captured between March 2005 - January 2007 from Ömerli Reservoir and growth features such as age, growth and condition factor were investigated. The age composition of rudd population varied between -0-8 years. Maximum number of rudds were 2 years of age. Females, males, and juvenile composition of the population was 54.26%, 43.22%, and 2.2%, respectively. The total length and weight of rudds varied between 6.8-29.0 cm and 3.4-392.7 g respectively. The von Bertalanffy growth equations were $L(t) = 34.63[1-e^{-0.170\ (t+1.327)}]$, $W(t) = 574.31[1-e^{-0.170\ (t+1.327)}]^{3.15\ \pm\ 0.029}$ for males, $L(t) = 37.43[1-e^{-0.153\ (t+1.371)}]$, $W(t) = 847.58[1-e^{-0.153\ (t+1.371)}]^{3.28\ \pm\ 0.024}$ for females and $L(t) = 37.55[1-e^{-0.153\ (t+1.389)}]$, $W(t) = 819.23[1-e^{-0.153\ (t+1.389)}]^{3.2\ 4\pm0.017}$ for all specimens in the Ömerli Reservoir. Length-weight relationship was calculated as $W = 0.0066TL^{3.24\pm0.017}$ for all individuals. According to age groups, condition factor varied between 1.121-1.678 for females and 1.172-1.724 for males, respectively.

Keywords: Age, growth performance, condition factor, rudd

INTRODUCTION

Rudd, *Scardinius erythophthalmus* (Linnaeus, 1758), is a widespread freshwater species in Europe, inland waters of Thrace, northern and middle Anatolia, The Black Sea and Azov Sea. It is used as not only food for people but also as natural food in fish farms (Geldiay and Balık, 1996). Rudd is a species found in littoral or near vegetation zone (Holcik, 1967). It would be very important component of freshwater ecosystems when become dominant and its mass removal has been commonly used for restoration eutrophic lakes in Europe (Benndorf, 1995; Perrow et al., 1997).

There are many studies on the age and growth features of rudd from several areas in Turkey (Balık et al.,1997; Erdem et al., 1994; Gaygusuz et al., 2006; Geldiay and Balık, 1996; Gürsoy et al., 2005a,b; Koyuncu et al., 2007; Tarkan et al., 2006; Tarkan, 2006) and from other localities in Europe (Benndorf, 1995; Berg, 1949; Frank,1962; Hacker,1979; Mann and Steinmetz, 1985; Papageorgiou and Neophytou, 1982; Perrow et al., 1997; Prokes and Rebickova, 1987; Slastenenko, 1956; Steinmetz, 1974; Zerunian et al., 1986; Zivkov et al., 2003).

It is essential to understand the age, growth and condition of fishes for the maximum utilisation and successful management of fishery resources. Therefore the aim of this study was to provide data on the growth of rudd including age, growth and condition in a temperate drinking-water reservoir. This might contribute the species conservation and the management of its fisheries in the study area.

Study Area

Ömerli Reservoir is the biggest reservoir in İstanbul and is located in northeast (approximately 30 km, 41°05′ N-40°57′ N ile 29°17′ E-29°27′ E) of the city. The reservoir provides approximately 48% of the city's drinking water. Morphometrically, the reservoir has a surface area of 23.5 km^2 and a 206 volume of 2.2 x 10^6 m^3 (Albay and Akçaalan, 2003). Its maximum depth is 62 m as reported by Istanbul Water Authority (ISKI) (Figure 1). The whole water system is mesotrophic (Albay and Akçaalan, 2003; Albay et al., 2003).

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Approximately 500-600 specimens of gibel carp, *Carassius gibelio* (Bloch, 1782) were introduced into Ömerli Reservoir by a fisherman in 1998 (Tarkan et al., 2007). *C. gibelio* developed well in this area and it is the most abundant fish species in the reservoir now. It is followed by big scale sand smelt *Atherina boyeri* Risso, 1810, bitterling *Rhodeus amarus* (Bloch, 1782), rudd *Scardinius erythrophthalmus* (Linnaeus, 1758), Baltic vimba *Vimba vimba* (Linnaeus, 1758) and carp *Cyprinus carpio* (Linnaeus, 1758), respectively (Özuluğ et al., 2005; Gaygusuz et al., 2007).

MATERIAL AND METHOD

A total of 317 rudd, *Scardinius erythrophthalmus* (Linnaeus,1758) individuals was examined. All specimens were captured with gill nets (from10 to 45 mm, 9 mesh sizes, total 450 m) from March 2005 to January 2007. Total length (TL) and weight (W) were measured to the nearest 1 mm and 0,1 g. respectively. Age was determined from scales, cleithra, opercula and otoliths. About ten scales from each specimen were placed on a 1 mm thick polycarbon plastic plate and press at roller press (Lagler, 1956; Gürsoy et al., 2005a). Prepared plates bearing the prints of scales were read using Microfish Reader (Lagler, 1956). Cleithra, opercula and otoliths were examined under a stereomicroscope. The results from all structures were compared with each other for age validation. All structures were read three times by the same operator during the study. To find out the best structure for ageing, Similarity, Average Percentage Error and Coefficient of Variation were calculated (Beamish and Fourner, 1981; Chilton and Beamish, 1982; Gürsoy et al., 2005b).

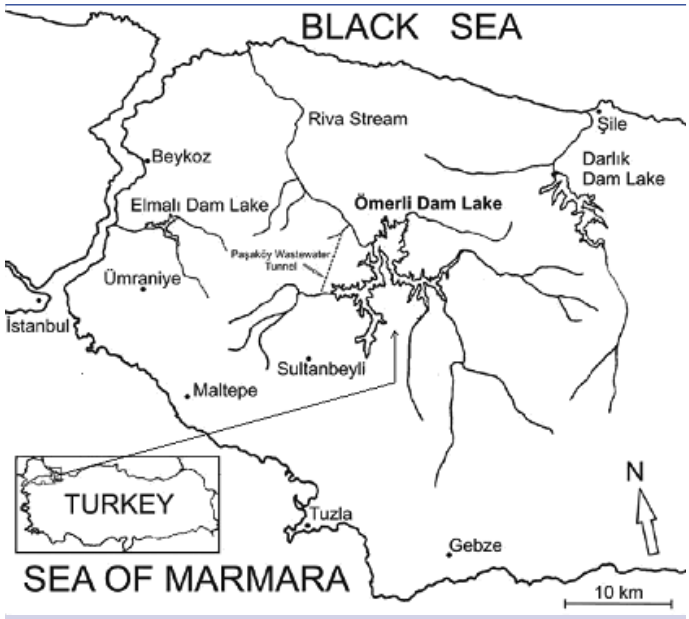

Figure 1. Map of the Ömerli Reservoir basin (Özuluğ et al, 2005)

Average Percentage Error calculated as:

$$APE_j = 100 * \left[\Sigma\left[(Xij - Xj)/Xj\right]/R\right],$$

R: the number of times each fish is aged,
Xj: the average age for the *j*th fish,
Xij: the *i*th reading of the *j*th fish.

Coefficient of Variation as:

$$CV_j = 100 * \left[\sqrt{\Sigma\left(X_{ij} - X_j\right)^2/(R-1)}\right]/X_j,$$

Table 1. Similarity, average pergentage error and coefficient of variation in ageing from different bone structures of *Scardinius erythrophthalmus* from the Ömerli Reservoir

	Similarity (%)	Average percentage error	Coefficient of variation
Cleithra	23.98	12.90	17.49
Opercula	47.95	9.88	13.46
Otolith	33.74	11.39	16.00
Scales	66.25	7.27	9.54

Table 2. The age and sex distribution of *Scardinius erythrophthalmus* from the Ömerli Reservoir

	Juvenile		Female		Male			All		
Age	n	%	n	%	n	%	p=0.05	n	%	F:M
0	6	1.89	8	2.52	6	1.89	p>0.05	20	6.31	1:0.75
I	2	0.63	22	6.94	32	10.09	p>0.05	56	17.67	1:1.46
II	55	17.35	60	18.93			p>0.05	115	36.28	1:1.09
III	41	12.94	21	6.62			p<0.05	62	19.56	1:0.51
IV	24	7.57	14	4.42			p>0.05	38	11.98	1:0.58
V	14	4.42	3	0.95			p<0.05	17	5.36	1:0.21
VI	2	0.63	1	0.32			p>0.05	3	0.95	1:0.50
VII	4	1.26						4	1.26	
VIII	2	0.63						2	0.63	
Total	8	2.52	172	54.26	137	43.22	p<0.05	317	100.00	1:0.80

p>0.05; not significant p<0.05; significant; F: female; M: male

Table 3. Size and age composition of *Scardinius erythrophthalmus* from Ömerli Reservoir

Sex	Parameter		Age groups 0	I	II	III	IV	V	VI	VII	VIII
Juvenile	Total Length	Range	6.8-7.4	7.8-8.8							
		Mean±sd	7.1±0.22	8.3±0.71							
	Weight	Range	3.4-3.9	4.8-7.4							
		Mean±sd	3.7±0.21	6.1±1.84							
Male	Total Length	Range	7.1-8.2	7.6-14.1	13.1-17.6	17.1-20.5	20.5-23.3	22.2-24.7	24.8		
		Mean±sd	7.6±0.40	10.8±2.36	15.6±1.09	18.6±0.86	21.7±0.79	23.6±1.29	24.8		
	Weight	Range	4.3-6.4	4.9-34.1	28.0-73.3	63.3-136.2	107.3-184.1	154.4-239.1	263.0		
		Mean±sd	5.3±0.85	16.9±10.40	45.5±11.12	82.3±17.45	143.1±21.40	195.5±42.41	263.0		
Female	Total Length	Range	7.0-8.1	7.7-14.4	14.0-17.6	17.6-20.2	19.8-23.3	22.6-26.1	25.4-26.7	25.7-28.8	28.2-29.0
		Mean±sd	7.5±0.41	10.3±0.33	16.0±0.97	18.8±0.73	21.4±0.83	23.8±1.17	26.1±0.92	27.4±1.51	28.6±0.57
	Weight	Range	4.0-6.3	4.3-38.9	34.8-72.8	59.8-115.1	94.0-184.9	165.6-306.2	231.9-343.7	268.8-353.0	391.6-392.7
		Mean±sd	4.8±0.74	14.7±11.01	51.6±9.75	84.6±14.36	140.6±23.72	208.8±44.57	287.8±79.06	306.1±39.96	392.2±0.78
All	Total Length	Range	6.8-8.2	7.6-14.4	13.1-17.6	17.1-20.5	19.8-23.3	22.2-26.1	24.8-26.7	25.7-28.8	28.2-29.0
		Mean±sd	7.4±0.40	10.5±2.34	15.8±1.05	18.7±0.78	21.5±0.82	23.8±1.15	25.6±0.97	27.4±1.51	28.6±0.57
	Weight	Range	3.4-6.4	4.3-38.9	28.0-73.3	59.8-136.2	94.0-184.9	154.4-306.2	231.9-343.7	268.8-353.0	391.6-392.7
		Mean±sd	4.6±0.92	15.6±10.58	48.4±10.90	83.8±15.37	141.5±22.63	206.5±43.20	279.5±57.70	306.1±39.96	392.2±0.78

sd: standart deviation

Table 4. Observed total length (TL) and weight (W) and expected total length (TL) and weight (W) of *Scardinius erythrophthalmus* from Ömerli Reservoir

Sex	Age	n	Observed TL	Expected TL	Observed W	Expected W	p=0.05*	p=0.05**
Female	0	8	7.53	7.06	4.75	3.58	p>0.05	p>0.05
	I	22	10.27	11.36	14.66	17.00	p>0.05	p>0.05
	II	55	15.97	15.05	51.65	42.74	p>0.05	p>0.05
	III	41	18.77	18.21	84.56	79.93	p>0.05	p>0.05
	IV	24	21.43	20.93	140.62	126.11	p>0.05	p>0.05
	V	14	23.81	23.27	208.79	178.34	p>0.05	p>0.05
	VI	2	26.05	25.27	287.80	233.82	p>0.05	p<0.05
	VII	4	27.38	26.99	306.05	290.16	p>0.05	p>0.05
	VIII	2	28.60	28.47	392.15	345.53	p>0.05	p>0.05
Male	0	6	7.58	6.98	5.33	3.68	p>0.05	p>0.05
	I	32	10.80	11.29	16.91	16.79	p>0.05	p>0.05
	II	60	15.56	14.93	45.45	40.50	p>0.05	p>0.05
	III	21	18.59	18.00	82.31	73.03	p>0.05	p>0.05
	IV	14	21.70	20.59	143.12	111.61	p>0.05	p<0.05
	V	3	23.63	22.78	195.50	153.44	p>0.05	p<0.05
	VI	1	24.80	24.63	263.00	196.18	p>0.05	p<0.05

*significance values belong to TL values; **significance values belong to W values

Table 5. Age and condition factos of *Scardinius erythrophthalmus* from Ömerli Reservoir

Sex	Age	n	C±sd	Minimum	Maximum
Female	0	8	1.121±0.181	0.884	1.393
	I	22	1.240±0.125	0.880	1.385
	II	55	1.256±0.098	1.033	1.443
	III	41	1.267±0.106	1.025	1.451
	IV	24	1.424±0.177	1.103	1.860
	V	14	1.530±0.157	1.242	1.722
	VI	2	1.610±0.276	1.415	1.806
	VII	4	1.489±0.073	1.405	1.584
	VIII	2	1.678±0.103	1.606	1.751
Male	0	6	1.217±0.105	1.088	1.402
	I	32	1.172±0.120	0.967	1.528
	II	60	1.183±0.093	0.949	1.546
	III	21	1.269±0.139	0.988	1.581
	IV	14	1.395±0.149	1.246	1.852
	V	3	1.465±0.106	1.396	1.587
	VI	1	1.724	-	-
All	0	20	1.124±0.146	0.884	1.402
	I	56	1.149±0.122	0.880	1.528
	II	115	1.218±0.102	0.949	1.546
	III	62	1.268±0.117	0.988	1.581
	IV	38	1.413±0.166	1.103	1.860
	V	17	1.519±0.148	1.242	1.722
	VI	3	1.648±0.206	1.415	1.806
	VII	4	1.489±0.073	1.405	1.584
	VIII	2	1.678±0.103	1.606	1.751

sd: standart deviation

CVj: Coefficient of Variation for the jth fish,
R: the number of times each fish is aged,
Xj: the average age for the *j*th fish,
Xij: the *i*th reading of the jth fish.

With the help of these formulas, the reliability of the bony structures used in age determination were tested. High percentage similarity, low average percentage error and coefficient of variation structure were preferred as the most reliable bony formation in age determination.

Sex of mature specimens was determined by naked eye (>10 cm), while microscopic examination was done for juvenile specimens (<10 cm). The overall ratio of males to females was evaluated by Chi-square (χ^2) test (p=0.05) (Zar, 1999). The relation of weight to total length was established by the exponential regression equation, $W=aTL^{b\pm SE}$, where *W* is the weight in g, *TL* the total length in cm, "*a*"and "*b*" the parameters to be established (Le Cren, 1951). The Student's t-test was used to test whether "*b*" differs from isometric growth (*b*=3) (Zar, 1999). *95% CI*=$b\pm(t_{0.05\,(n-2)}\,SE)$ was used in the calculation of the 95% confidence interval of *b* value (95% confidence interval). Standard error of *b* value was calculated (King, 2007). The growth of the rudd population was estimated with the following von Bertalanffy growth equations: $L_t=L_\infty\,[1\text{-}e^{-k\,(t\text{-}t_0)}]$ and $W_t=W_\infty\,[1\text{-}e^{-k\,(t\text{-}t_0)}]^{b\pm SE}$, where L_t is the total length in cm at age "*t*", L_∞ is the average asymptotic length in cm, *k* is the body growth coefficient and "t_0" is the hypothetical age when the fish total length is zero. W_t the weight in g at time "*t*", W_∞: the average asymptotic weight in *g*, and "*b*" is the constant in the length-weight relationship. The growth performance index (Φ') was calculated using the equation $\Phi'=\ln k + 2\ln L_\infty$ (Pauly and Munro, 1984; Sparre and Venema, 1992). Fulton's coefficient of condition factor was calculated by $C=(W/L^3)\times 100$ (Pauly and Munro, 1984; Sparre and Venema, 1992). A significance of differences in fish growth between males and females by age groups were tested with the Student's t-test (Zar, 1999).

RESULTS AND DISCUSSION

In total 317 specimen were caught during the study period, composing of 8 juvenile (2.52%), 172 females (54.26%) and 137 males (43.22%). Repeated readings of scales, cleithra, opercula and otolith revealed that the most suitable structures were scales for age validation in Ömerli Reservoir (Table 1).

The age of fish ranged from 0. to VIII. years. II. year old age group was the most abundant (36.28%) (Table 2). The overall ratio of females to males 1:0.80, and Chi-square (χ^2) analysis showed it was significant (p<0.05). The chi-square test of sex ratios for rudd, divided into age classes, showed that females dominated the third, fourth and fifth age classes (Table 2).

The total length of all individuals collected ranged from 6.8 cm to 29.0 cm and weight from 3.4 g to 392.7 g (Table 3). It was determined that there was a statistical difference at only II. age group (*t*-test, p<0.05) when it was compared the mean total length of female with the male ones from each ages. In other age groups, statistical differences between males and females were not significant (*t*-test, p>0.05).

Length-weight relationships were calculated for males, females and all specimens as: $W=0.0081TL^{3.15\pm0.029}$ (r^2=0.99), $W=0.0059TL^{3.28\pm0.024}$ (r^2=0.99) and $W=0.0066TL^{3.24\pm0.017}$ (r^2=0.99), respectively. The growth of rudd among males, females and all individuals in the Ömerli Reservoir were positive allometric. The von Bertalanffy growth equations were $Lt=34.63\,[1\text{-}e^{-0.170\,(t+1.327)}]$ for males, $Lt=37.43\,[1\text{-}e^{-0.153\,(t+1.371)}]$ for females and $Lt=37.55\,[1\text{-}e^{-0.153\,(t+1.389)}]$ for all specimens in the Ömerli Reservoir. The von Bertalanffy growth equations were $Wt=574.31\,[1\text{-}e^{-0.170\,(t\,+\,1.327)}]^{3.15\pm0.029}$ for males, $Wt=847.58\,[1\text{-}e^{-0.153\,(t\,+\,1.371)}]^{3.28\pm0.024}$ for females and $Wt=819.23\,[1\text{-}e^{-0.153\,(t\,+\,1.389)}]^{3.24\pm0.017}$ for all specimens in the Ömerli Reservoir. The differences between observed and expected lengths and weights were statistically not significant in all age groups (Table 4) (*t*-test, p> 0.05). The growth performance index (Φ') was found to be 5.37 for females, 5.32 for males and 5.37 for all individuals, respectively.

Table 6. Age, length, weigth and ratio of males to females for several populations of *Scardinius erythrophthalmus*

Reference	Site	Age	M:F	Length (cm) min.-max	Weigth (g) min.-max
Present Study	Ömerli Reservoir, Turkey	0-VIII	0.80:1	6.8-29.0	3.4-392.7
Tarkan, 2006	Sapanca Lake, Turkey	I-VII	1.2:1	13.4-34.0	8.8-381.9
Papageorgiou and Neophytou, 1982	Kastoria Lake, Greece	I-VII	-	5.0-18.0	-
Balık et al., 1997*	Kuş Lake, Turkey	0-IV	0.64:1	3.6-17.4	0.7-117.9
Koyuncu et al., 2007	Uluabat Lake, Turkey	I-V	0.53:1	9.5-28.1	15.0-332.0
Steinmetz, 1974	Beesd Lake, Netherlands	I-V	-	6.8-23.0	3.0-153.0
Berg, 1949*	Dnieper River, Russia	V	-	6.8-21.4	6.0-220.0
Berg, 1949*	Sudoche Lake, Russia	VI	-	6.3-23.0	-
Berg, 1949*	Aral Lake, Russia	V	-	5.9-22.4	-
Erdem et al., 1994*	Hamam Lake, Turkey	I-III	-	9.8-14.1	7.0-50.0
Frank, 1962	Elbe Region, Czech Republic	I-X	-	6.5-25.5	-
Frank, 1962	Vistula Mouth, Poland	III-XI	-	12.5-33.5	-
Zerunian et al., 1986	Bracciano Lake, Italy	I-IV	-	-	-
Mann and Steinmetz, 1985	Beesd Lake, Netherlands	I-V	-	-	-
Prokes and Rebickova, 1987	Musov Reservoir, Czech Republic	X-XV	-	-	-
Hacker, 1979	Neusidlerse, Australia	0-IV	-	7.6-17.4	-
Tarkan et al., 2006	Büyük Çekmece Lake, Turkey	-	-	7.8-22.9	-
Tarkan et al., 2006	Sapanca Lake, Turkey	-	-	7.2-29.1	-
Tarkan et al., 2006	Ömerli Reservoir, Turkey	-	-	6.7-29.0	-
Tarkan et al., 2006	Terkos Lake, Turkey	-	-	12.8-23.6	-
Slastenenko, 1956	Dnieper River, Russia	-	-	25.0	-

*significance values belong to TL values; **significance values belong to W values

The condition factor was calculated for all ages and sexes, respectively. Average values varied between as 1.172 (I. age group) and 1.724 (VI. age group) for males, 1.121 (0. age group) and 1.678 (VIII. age group) for females (Table 5). For all age groups, statistical differences between males and females were only significant in II. age group (*t*-test, $p<0.05$).

The population of rudd in the Ömerli Reservoir is composed of individuals ranging from 0. to VIII. age groups. The age range of rudd from Ömerli Reservoir was similar to Sapanca Lake (Tarkan, 2006) and Kastoria Lake (Papageorgiou and Neophytou, 1982) populations, but differentfrom some other localities (Table 6). The overall ratio females to males was 1:0.80 in the Ömerli Reservoir rudd population. A similar situation has been reported by Balık et. al. (1997) and Koyuncu et. al. (2007). However, Tarkan (2006) found males to be more numerous than females. The maximum total length values in the population of rudd from Ömerli Reservoir (29 cm) was smaller than that in Sapanca Lake (Tarkan, 2006) and Vistula Mouth (Frank, 1962), but bigger than that in other localities (Table 6). These differences may be caused by fishing method and gear or different environmental features of the locations in which the rudd populations lives.

The values of L_∞ and W_∞ of rudd population in Ömerli Reservoir were higher than that in other localities (Table 7). The differences in growth between regions can be attributed to the difference in the size of the largest individual sampled in each area. The growth performance index (Φ') was found 5.37 in Ömerli Reservoir. This value, however was similar to other localities (Table 7).

The growth of rudd in Ömerli Reservoir was positive allometric (b=3.24±0.017). This value was different from Hamam Lake (b=4.27) (Erdem et al., 1994) (Table 8). The b value of W-TL relationship is known to vary according to sex, maturity, age and environmental conditions (Le Cren, 1951).

Balık et al. (1997) (between 1.552-2.669 in females and 1.097-2.732 in males in Kuş Lake) and Zivkov et al. (2003) (2.73 for females, 2.91 for males in Ovcharista Reservoir and 2.96 in Batak Reservoir) reported higher values for the condition factor. Tarkan (2006) (1.20

Table 7. The von Bertalanffy growth equations and parameters of Φ' for different areas.

Reference		Site	Sex	L∞	W∞	k	t_0	Φ'
Ömerli Reservoir	Present Study	Turkey	♀	37.43	847.58	0.153	-1.371	5.37
			♂	34.63	574.31	0.170	-1.327	5.32
			♀+♂	37.47	819.23	0.153	-1.389	5.37
Uluabat Lake	Koyuncu et al., 2007	Turkey	♀	28.12	391.92	0.360	-0.400	5.65
			♂	26.48	381.12	0.380	-0.380	5.59
Kuş Lake	Balık et al., 1997*	Turkey	♀+♂	18.07	146.30	0.496	-0.098	5.09
Batak Reservoir	Zivkov et al., 2003	Bulgaria	♀+♂	36.50	1345.00	0.198	-0.272	5.58
Ovcharitsa Reservoir	Zivkov et al., 2003	Bulgaria	♀+♂	31.10	993.00	0.344	-0.093	5.81
Klicava Reservoir	Pivnicka, 1991**	Czech Republic	♀+♂	24.50	-	0.252	-0.081	5.02
Vaya Lake	Pavlova, 1980**	Czech Republic	♀+♂	27.40	-	0.401	-0.266	5.71

*fork length; **According to Zivkov et al., 2003

Table 8. Parameters of length-weigth relationship in different areas from Turkish inlands.

Site	Reference	Country	Sex	a	b
Hamam Lake*	Erdem et al., 1994	Turkey	♀+♂	0.7252	4.27
Kuş Lake*	Balıket al., 1997	Turkey	♀+♂	0.0065	3.46
Büyükçekmece Lake	Tarkan et al., 2006	Turkey	♀+♂	0.0078	3.21
Sapanca Lake	Tarkan et al., 2006	Turkey	♀+♂	0.0116	3.02
Ömerli Reservoir	Tarkan et al., 2006	Turkey	♀+♂	0.0057	3.20
Terkos Lake	Tarkan et al., 2006	Turkey	♀+♂	0.0035	3.45
Uluabat Lake	Koyuncu et al., 2007	Turkey	♀	0.0038	2.92
			♂	0.0025	3.15
Ömerli Reservoir	Present study	Turkey	♀	0.0059	3.28±0.024
			♂	0.0081	3.15±0.029
			♀+♂	0.0066	3.24±0.019

*fork length

for female and 1.02 for male) and Erdem et al. (1994), (between 1.482-1.705 in Hamam Lake), reported almost similar values with the present study. Fork length was used in the calculation of the condition factor of rudd in Kuş Lake and Hamam Lake whereas total length was used in our research and also in the other studies.

Gaygusuz et al. (2007), reported that catch per unit effort (CPUE) of natural species in the lake decreased while CPUE of gibel carp introduced by a fisherman in to Ömerli Reservoir in 1998 increased and females of gibel carp exhibited a gynogenetic reproductive strategy. Gaygusuz et al. (2006), reported that the individual number of rudd catches in Ömerli Reservoir during their study within two years was 632.

The reason that individual number caught in our study is lesser than that in the previous study (n=317), might be overfishing, pollution, increase in the number of gibel carp and reproductive behaviour. In spite of these negative conditions, it was observed that rudd had been a good perfonmance of growth.

CONCLUSIONS

This study provides some important information on the age, growth and condition factors of rudd. This would be benfical for fisheries biologist to propose suitable regulations for sustainable fishery management and conservation of this species in Ömerli Resevoir.

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