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LENGTH-WEIGHT AND LENGTH-LENGTH RELATIONSHIPS OF RED-SPOTTED TROUT (Salmo trutta macrostigma (DUMERİL, 1858)) IN KARASU RIVER (EAST ANATOLIA, TURKEY)

ABSTRACT

In this study, the length-weight and length-length relationships were determined for *Salmo trutta macrostigma* (Dumeril, 1858) captured in the 15 different site of Karasu River (Tributary of Fırat River). A total of 104 specimens were catched by electroshocker, gill nets, and trammel nets between October 2014 to September 2015. The total length and weight of the sampled ranged between 8.6-27.4cm and 5.4-241g. The length-weight relationships were determined as $W=0.0097L^{3.06}$ ($R^2=0.86$) for females, $W=0.0095L^{3.08}$ ($R^2=0.96$) for males and $W=0.0068L^{3.19}$ ($R^2=0.97$) for all individuals. The types of growth for all individuals were positive allometric for *Salmo trutta macrostigma.* Length-length relationships were determined as TL=0.592+1.009FL, FL=-0.104+1.107SL and SL=-0.212+0.881TL for all individuals.

Keywords: Red-spotted Trout, *Salmo trutta macrostigma,* Length-Weight Relationships, Karasu River Length-Length Relationships

1. INTRODUCTION

Salmo trutta macrostigma (Dumeril, 1858) is distributed North Africa, South Europe, West Asia and Anatolia. This subspecies occurs in the upper parts of streams and rivers and was reported from many running waters in Turkey [1]. Specifically, they are spread throughout high-slope upper basins with pristine water quality. This is defined as the "trout zone" of rivers. It is economically and ecologically very important fish species [2, 3 and 4]. Length-weight relationships (LWRs) are used for estimating the weight corresponding to a given length, and condition factors are used for comparing the condition, fatness or well-being of fish, based on the assumption that heavier fish of a given length are in better condition [5]. It is necessary to use standard measures for all populations to render the results more reliable when making comparisons between populations. Therefore, the length-length relations of species under various environmental conditions should be known. The length-length relationship is also of great importance for comparative growth studies [6]. Many studies on some biological characteristics of *Salmo trutta macrostigma* in our country [1, 7, 8, 9, 10, 11, 12 and 13].

2. RESEARCH SIGNIFICANCE

Although length-weight conversion factors are of fundamental importance in fisheries science, recent data from Turkish freshwater

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fishes are generally lacking. This study is aim of this study is to determine length-weight and length-length relationships of *Salmo trutta macrostigma* from Karasu River.

3. MATERIAL AND METHODS

The study area, which is in the tributary of Karasu River (Yeşildere, Köşk, Ağasuyu, Sincan, Poik, Çiğdemli, Han, Karahasan, Taşağıl, Karataş, Büyükgöze, Deli, Eriç, Kırık, Karnı streams) in the East Anatolia region of Turkey. Specimens (104 individuals) were collected during October 2014 to September 2015 by electroshocker, gill nets, trammel nets from Karasu River (Figure 1). The samples were immediately preserved with ice and fixed with 5% formaldehid on arrival in the laboratory. All individuals were measured for total length (TL, in cm), fork length (FL, in cm), standard length (SL, in cm) to the nearest mm and weighted (W, total weight in g) to the nearest 0.01 g in situ. Standard length was measured from the anterior tip of the upper jaw to the tip of the hypural bone.

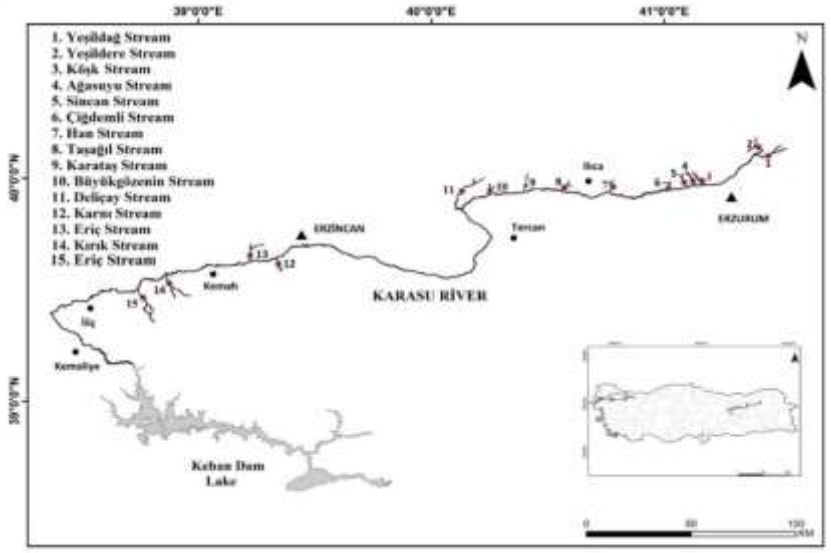

Figure 1. Sampling sites on the Karasu River

The length-weight relationship was calculated using the expression: $W=aL^b$ ([14], where the *W* is the body weight (g), *L* the total length (cm), "*a*" the intercept of the regression and "*b*" is the regression coefficient. Student t-test was used the determine whether the difference between length and weight are significant. In the length weight equation a and b are intercept and the slope (exponent) of the length weight curve, respectively [15]. The student's t-test used to test whether the slope (*b*) was importantly different from 3, indicate the growth type: isometric (*b*=3), positive allometric (*b*>3) or negative allometric (b<3). Additionally, standard error of the parameter *b* and the statistical significance level of R^2 were estimated. Length-length relationships were calculated using linear regression analysis. LLRs were measured as FL=a+bSL, SL=a+bTL and TL=a+bFL equations in all individuals.

4. RESULTS AND DISCUSSION

The total of 104 samples caught for the study, 38 (36.5%) were females, 44 (42.3%) were males and 22 (21.1%) were undetermined. The total length and weight of the sampled ranged between 8.6-27.4cm and 5.4-241g, respectively (Table 1). The previous studies of *S. t.*

macrostigma found that maximum total length by Alp et al., (2005), 48.5cm in the Fırnız stream [1], Kocabaş et al., (2012), 30cm in the Uzungöl dam lake [11], Başusta et al., (2013), 38.2cm in the Munzur River [16], Kocaman et al., (2004), 24.1cm (fork length) in the Tekederesi (Erzurum) [9]. But in these studies maximum total length value of *S.t. macrostigma* reported as 27.4cm in the Karasu River.

Table 1. Total length-weight relationships of *S. t. macrostigma* in Karasu River

Sex		Total Length(cm)		Weight(g)		Parameters of LWR		
	n	Min	Max	Min	Max	*a*	*b*	R^2
Female	38	15	24.6	35.0	182	0.0097	3.06	0.96
Male	44	15	27.4	36	241	0.0095	3.08	0.97
All	104	8.6	27.4	5.4	241	0.0068	3.19	0.97

Length-weight relationships for females, males and all individuals were determined as $W=0.0097L^{3.06}$, $W=0.0095L^{3.08}$, $W=0.0068L^{3.19}$, respectively. Length-weight relationships may show temporal or spatial variations due to their size range, reproductive activities and stage or environmental factors such as water temperature and quality, food quality and availability, diseases, and competition [17]. The results of this study could give useful insight for management and conservation of *S.t. macrostigma*.

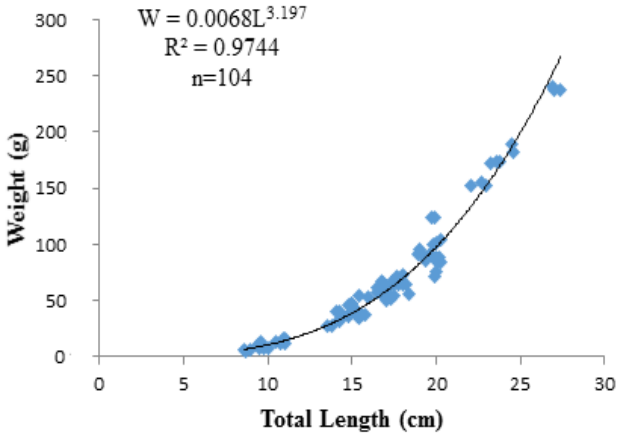

Figure 2. Length-weight relationships of *S. t. macrostigma* for all individuals

LWRs are important in fish population dynamics, notably to raise length-frequency samples to total catch, or to estimate fish biomass [18]. In this study, the LWRs were highly significant; all individuals of *S.t. macrostigma* were determined between length and weight very strong positive relationship in Karasu River (R^2=0.97). The high values of R^2 indicate that the length relationships are linear observed range of values. The lowest b values were reported as 2.59 by Kocaman et al., (2004) in the Tekederesi [9] and 2.95 by Kocabaş et al., (2012) in the Uzungöl dam lake [11]. On the other hand, the highest b values were given as 3.32 by Kocabaş et al., (2011) in the Munzur River [10] and 3.19 by Çiçek and Birecikligil (2013) in Ecemiş Creek [12] (Niğde). The differences can be attributed to the combination of several factors such as the number and size of examined individuals. The *b* values were determined as 3.06 for females, 3.08 for males and 3.19 for all individuals in Karasu River. 95% Confidence intervals of b=2.8674-3.0289, t-test $P<0.05$. The calculated *b* value of the LWR

indicated positive allometric growth (*b>3*) and the coefficient of determination (R^2) ranged from 0.97 for *S.t. macrostigma* of all individuals in Karasu River. No significant differences were found between total length-weight of males and females ($p<0.05$). Regression analysis of *S.t. macrostigma* is shown that fish length has high significant correlation with weight ($R=0.98$, $R^2=0.97$, $P<0.001$) and it is possible to say that 97% increase in weight was due to length increase. Besides, when the t-test results were analyzed for the significance of regression coefficients (t-test=213.268, $P<0.01$), it was found that fish-length data could be used in high accuracy to predict fish weight. Length-length relationships and the coefficient of determination of *S.t. macrostigma* are presented in Table 3. LLRs were significant ($p<0.001$) for all specimens with all R^2 values greater than 0.99. There are no data available on LLRs of *S.t. macrostigma.* Thus, this study provides first information LLRs which are useful for fishery biologist.

Table 3. Length-length relationships of *S.t. macrostigma* in Karasu River (n=104)

Sex	Equation	*a*	*b*
Female	TL=a+bFL	1.471	0.967
	FL=a+bSL	-2.109	1.115
	SL=a+bTL	0.184	0.854
Male	TL=a+bFL	0.675	1.002
	FL=a+bSL	-0.470	1.128
	SL=a+bTL	0.069	0.870
All	TL=a+bFL	0.592	1.009
	FL=a+bSL	-0.104	1.107
	SL=a+bTL	-0.205	0.880

This study provided the basic information on the length-weight and length-length relationships of *S.t. macrostigma* from the Karasu River that will be useful for the management of fishery resources plans in future.

NOTICE

This work is presented at 5-8 September 2017, 2nd International Science Symposium (ISS2017) in Tbilisi-Georgia.

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