



Length-Weight Relationships and Condition Factor of *Garra turcica* Karaman, 1971 from Asi River Basin, Turkey

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Abstract

This study was carried out in *Garra turcica* Karaman, 1971, obtained from Asi River Basin (Arsuz/Hatay) between September 2017 and March 2018. A total of 124 specimens, 64 females and 60 males, were caught by using electrofisher and tulle net. The dominant length class in the male and female individuals was 8.0 cm, TL. The length-weight relationship was described as $W = 0.0258L^{2.761}$ ($R^2 = 0.973$) with negative allometric growth for both sexes. The exponent b of the length-weight relationships (LWRs) values were 2.805 for females and 2.706 for males. The b values for females, males, and both sexes were significantly different from 3.0 ($P < 0.05$). The condition factor (CF) was calculated, 1.601 for both sexes. The study presented a comprehensive description and first reference on length-weight relationships and condition factors for *G. turcica* according to their sexes from Asi River (southeastern Anatolia, Turkey). The present results will be useful in managing and conserving this species in the River basin.

Keywords:

Cyprinidae, length-weight parameters, Asi River drainage, Hatay

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Introduction

Garra turcica Karaman, 1971 was first time described and reported as *Garra rufa turcica* based on a single individual by Karaman (1971) from the Ceyhan River drainage. Bayçelebi et al. (2019) stated that *Garra turcica* is different not only morphologically but also at a molecular level, and they defined this species as a valid species.

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Garra turcica is found in the rivers Seyhan, Ceyhan including small coastal streams and Asi drainage (Baycelebi et al., 2018). *G. turcica* is a benthopelagic species and is not a migratory species. They are common found in slow-flowing rivers, small ponds, and lakes, and ecosystems with stony, gravel, sandy, and muddy ground, but they not found from standing waters (Krupp & Schneider, 1989). *Garra* species usually hides under and among stones and vegetation, and it feeds on benthic algae on the stones (Krupp & Schneider, 1989; Yalçın-Özdilek & Ekmekçi, 2006).

Garra turcica has a high tolerance to environmental conditions, can easily live in waters with an extensive temperature range in habitats that have changed due to anthropogenic effects (IUCN, 2021). Although *G. turcica* was previously declared as a subspecies of *G. rufa*, *G. turcica* is distinguished from red garra, *G. rufa* in having a more slender body and a shorter rostral cap (Baycelebi et al., 2018).

Fish length, weight, and condition data are essential and are important components for population dynamics. In addition, research on the biological characteristics of fish is very valuable for fisheries management (Pauly, 1983).

Length-weight relationships (LWRs) and condition factor (CF) are used for assessing the general well-being of a fish population. This situation is done by estimating the weight of the fish of a given length by establishing a mathematical relation between the groups (Le Cren, 1951). In this relationship, growth in length equations is converted into growth in weight equations used in stock assessment models (Pauly, 1993).

In fisheries science, the condition factor is commonly used to compare the condition and fatness of fish based on the hypothesis that heavier fish of a particular length are in a better physiological condition. Condition factor is also an essential parameter for the evaluation of fish stocks. Besides, this parameter is widely used for studies of fisheries studies (Bagenal, 1978).

To date, there is no information on length-weight and condition for *G. turcica* in the Asi River system (Southeastern Anatolia, Turkey). The present paper provides the first comprehensive description of the length-weight relationship and condition factor from the Asi River system, Turkey of *G. turcica*.

Materials and Method

A total of 124 (64 female and 60 male) individuals were captured from Asi (Orontes) River basin (Arsuz, Hatay) using an electrofisher (SAMUS 725MG) and tulle net at 0-1 m depths in October 2017 and March 2018 (Coordinates: 36° 10' N, 35° 51' E-36° 13' N, 35° 51' E). Fish individuals were identified according to Baycelebi et al. (2018). Total length, TL, and total weight (TW) were determined to be the nearest 1 mm and 0.01 g, respectively. The sex of each individual was determined by examining the gonads under a stereo binocular microscope. The sex ratio was checked by a chi-square test.

The length-weight relation (LWR) was determined with the following equation (Ricker 1975); $W = aL^b$ (Ricker, 1975), where W is the total weight (g) of the fish, TL is the total length, a is the intercept, and b is the slope. The relationship between total length, TL , and weight was calculated for females, males, and both sexes. The significance of the regression was tested by ANOVA. The b value for *G. turcica* was tested by a Student t-test at the 0.05 significance of differences (95% level) to verify if it was significantly different from 3 (Zar, 1999).

The condition factor (CF) was calculated with the formula; $CF=W/L^3 \times 100$, where; CF is the coefficient of allometric; L is total length (cm), and total W is weight (g) (Fulton 1904). Data were statistically analyzed by using Excel and SPSS 22.0 package programs.

Results

A total of 124 individuals (64 female and 60 male) were collected during the presently reported study. The population consisted of 51.61% of females and 48.39% of males. The sex ratio for female and male individuals (F:M) was 1.00:0.94. The chi-squared (χ^2) test showed ($\chi^2=3.119$, $P>0.05$) that there was no significant difference in sex ratio from the expected 1:1. Total length in females ranged from 3.10-14.50 cm (average: 8.81 ± 2.97 cm). Total length in males ranged from 3.40-14.40 cm (average: 8.28 ± 2.67 cm), (Table 1). The t-test showed a significant difference between sexes in overall total length and total weight (t_{test} , $P<0.05$). Weights of *G. turcica* varied from 0.38 to 41.50 g for males and from 0.29 to 42.10 g for females. The differences between sexes were not statistically significant ($P>0.05$).

Table 1. Length (L) and weight (W) characteristics according to sexes of *G. turcica* in Asi River

Sex	N	Length		Weight	
		L _{Mean} ±SD	L _{min} -L _{max} (cm)	W _{Mean} ±SD	W _{min} -W _{max} (cm)
Females	64	8.81±2.97	3.10-14.50	13.35±10.82	0.29-42.10
Males	60	8.28±2.67	3.40-14.40	11.06±9.29	0.38-41.50
Both Sexes	124	8.55±2.83	3.10-14.50	12.24±10.13	0.29-42.10

N: Sample number; SD: Standard Deviation Min: Minimum; Max: Maximum

Length frequency distributions of *G. turcica* collected in Asi River are given in Figure 1. Males were more abundant in the 7.5-8.5 cm length class than females. The dominant length class in the male and female individuals was 8.0 cm (Figure 1).

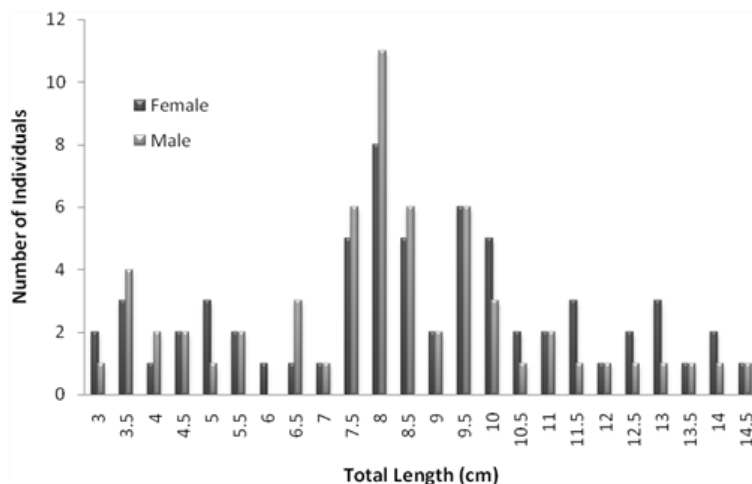


Figure 1. Length frequency distributions of *G. turcica* in Asi River

The parameters of the length-weight relationships are provided for each sex and all individuals in Table 2. Length-weight relationships of *G. turcica* were found as $W=0.0234L^{2.805}$, $R^2=0.974$, for females, $W=0.0290L^{2.706}$, $R^2=0.971$, for males and $W=0.0258L^{2.761}$, $R^2=0.973$ for both sexes. Length and weight relationship for the females, the males, and both sexes were shown in Figure 2, Figure 3, and Figure 4.

Table 2. Length-weight relationship constants (a is the intercept, b the slope) for each sex

Sex	N	a	b	S.E. (b)	R ²	P
Females	64	0.0234	2.805	0.57	0.974	<0.00
Males	60	0.0290	2.706	0.60	0.971	<0.00
Both Sexes	124	0.0258	2.761	0.41	0.973	<0.00

N: Sample number; SE: Standard Error; P: P-value for Student's t-test

The *b* values were determined as 2.805 for females, 2.706 for males, and 2.761 for both sexes. There was a significant difference between the sexes (*t*-test, $P < 0.05$). A negative allometric growth ($b < 3$) between size and weight was observed for males, females, and both sexes (Table 2). The coefficient of determination (R^2) was found to be > 0.97 , a highly significant value of the result. The regression analysis has shown that fish length had a highly significant correlation with weight ($P < 0.001$).

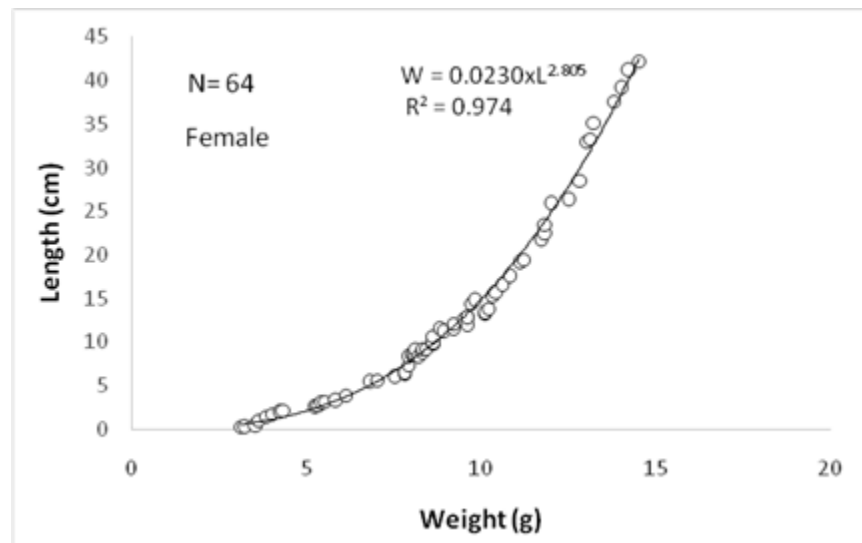


Figure 2. Length-weight relationship of *G. turcica* for females in Asi River

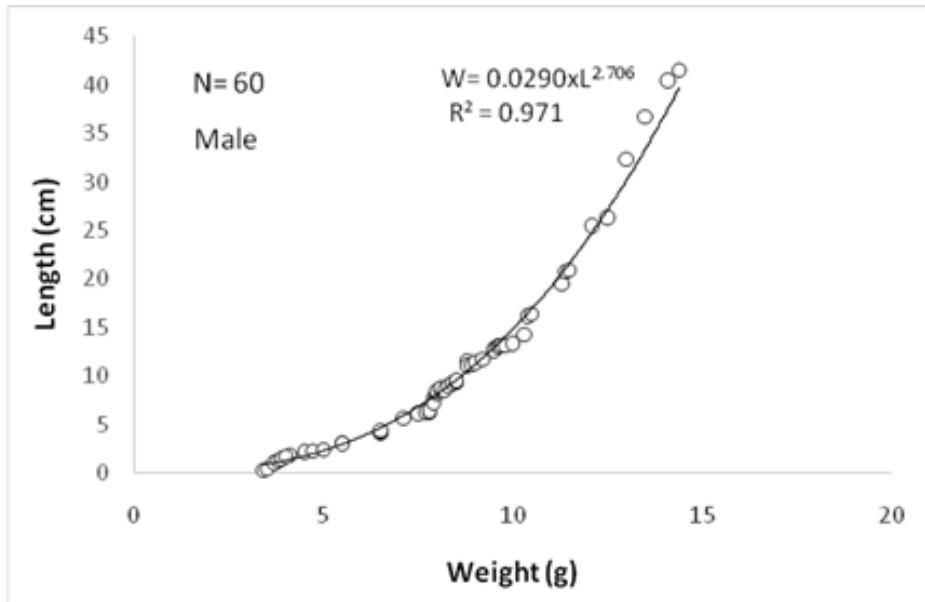


Figure 3. Length-weight relationship of *G. turcica* for males in Asi River

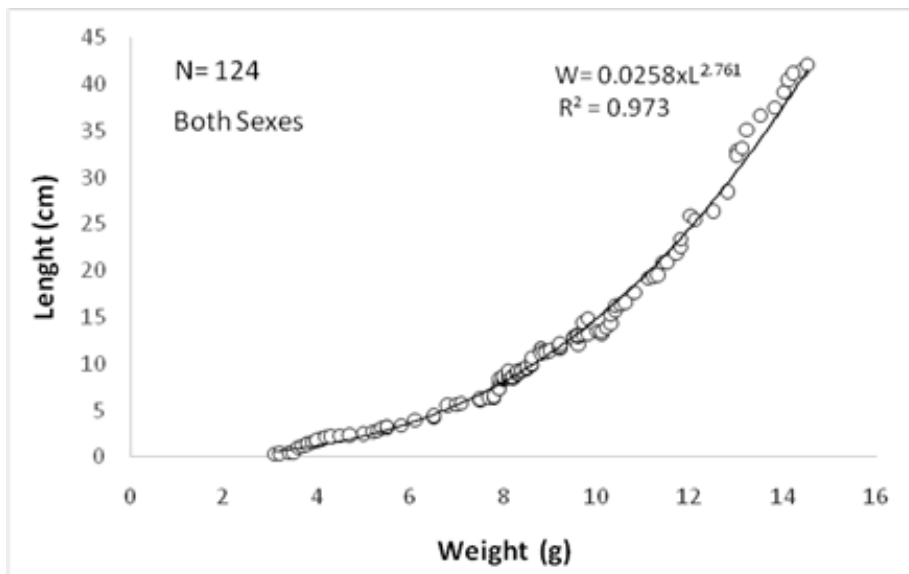


Figure 4. Length-weight relationship of *G. turcica* for both sexes in Asi River

In this study was determined that the condition factor (CF) for *G. turcica* population varied between 1.583 for females and 1.622 for males. The condition factor (CF) was calculated as 1.601 for both sexes (Table 3).

Table 3. Condition factor of *Garra turcica* in Asi River

Sex	N	Condition Factor		
		Average \pm SD	Min.	Max
Females	64	1.583 \pm 0.42	0.990	2.730
Males	60	1.622 \pm 0.46	0.960	2.770
Both Sexes	124	1.601 \pm 0.31	0.960	2.770

Discussion

To date, there is no available data on length-weight and condition data of *G. turcica* in Turkey. However, only a few studies are conducted on the growth features (Kırankaya et al., 2008; Patimar et al., 2010; Pazira et al., 2013; Aslan et al., 2021; Çiçek et al., 2021) and length-weight relationships for *G. rufa* by differ researchers (Esmaili & Ebrahimi 2006; Gerami et al., 2013; Hamidan & Britton, 2013; Keivany & Zamani-Faradonbe, 2017).

In the present study, the parameter b of length-weight relationships was significantly different from 3 ($p < 0.05$). The allometric exponent b of females was greater than males. Present data suggested that *G. turcica* from Asi River showed negative allometric growth for both sexes (Table 2).

In previous years, in terms of morphological features and, it is seen that there is a similarity between *G. turcica* and *G. rufa*, which are accepted as synonyms of *G. rufa* since there is not much difference in terms of population dynamics parameters. Therefore, the presented data for this study were compared with the length-weight studies conducted for *G. rufa* in previous years (Table 3).

Most of the previous studies of *G. rufa* (Abedi et al., 2011; Birecikligil & Çiçek, 2011; Hamidan & Britton, 2013; Gerami et al., 2013; Ergüden, 2016; Çiçek et al., 2021) have shown positive allometric growth. However, b coefficient in this study shows negative allometric growth, similar to a few studies (Pazira et al. 2013; Segherloo et al., 2015, Keivany & Zamani Faradonbe 2017; Aslan et al., 2021) of results from Tigris Basin, Persian Gulf Basin, Zohrer River, Iran and Murat River, Turkey (Table 4). These differences can be attributed to a combination of several factors such as; gender, species, numbers of examined individuals, the size range of fish used and seasonal effects (Moutopoulos & Stergiou, 2002).

The average condition factor values were found to range between 1.583 and 1.622 for females and males. Besides, the condition factor (CF) was calculated as 1.601 for both sexes. According to the result, the condition factor of *G. turcica* in Asi River drainage indicated that the fish were above average condition.

As a result, since the condition factor value in this study was higher than 1, it may be deduced that the suitable environmental conditions for *G. turcica* in the Asi River. Similarly, average condition factor values for *G. rufa* reported for both sexes as 1.218 from Cholvar River, Iran by Gerami et al. (2013), and as 1.240 from Euphrates River Basin, Turkey by Çiçek et al. (2021). Çoban et al. (2012) stated condition factor values change according to nutrition condition of the environment, age and stress condition, and the reproduction activity of the fishes. Besides,

Blackwell et al. (2000) reported a high condition factor implies that the environmental conditions are quite suitable for a given fish population.

In this study, the data did not represent a whole year. Thus, these calculated length-weight and condition parameters should be considered to represent only for 2017-2018 fishing season. Tesch (1971) reported the length-weight relationship in fishes is affected by many factors, including season, gonad maturity, diet, habitat, sampling, and preservation techniques. These factors were not taken into account for this study.

Table 4. A comparison of the length-weight relation parameters *Garra rufa* in various geographical areas

Locality	Country	N	Length Intervals (cm)	Length Type	a	b	R ²	Reference
-	Iran	291	2.9-13.0	TL	0.01190	3.139	0.984	Esmaeili, & Ebrahimi (2006)
Euphrates and Orontes Rivers	Turkey	161	7.6-13.9	TL	0.00750	3.149	0.996	Bircikligil & Cicek (2011)
Armand Stream	Iran	364	2.9-15.1	TL	0.00630	3.112	0.993	Abedi et al. (2011)
Cholvar River	Iran	535	-	TL	0.00005	3.196	-	Gerami et al. (2013)
Mujib Basin	Jordan	20	3.0-7.2	SL	0.0150	3.150	0.950	Hamidan & Britton (2013)
Dalaki River	Iran	224	3.0-17.1	TL	0.00223	2.910	0.930	Pazira et al. (2013)
Seyhan Reservoir	Turkey	33	2.8-14.1	TL	0.0860	3.202	0.994	Erguden (2016)
Tange haft River	Iran	27	-	TL	0.00005	2.740	0.950	Segherloo et al. (2015)
Beshar River	Iran	21	-	TL	0.00002	2.860	0.930	
Mazoo River	Iran	19	-	TL	0.00001	2.990	0.990	
Palangan River	Iran	51	-	TL	0.05	2.950	0.980	
Sirvan River	Iran	27	-	TL	0.01	3.000	0.970	
Kheirabad River	Iran	70	-	TL	0.00002	2.960	0.980	
Gamasiab River	Iran	10	-	TL	0.00001	3.190	0.980	
Ghalate River	Iran	31	-	TL	0.00001	3.160	0.990	
Cheshme gerdab River	Iran	12	-	TL	0.00001	3.080	0.990	
Maroon River	Iran	12	-	TL	0.00001	3.140	0.970	Segherloo et al. (2015)
Dashte chenir River	Iran	17	-	TL	0.00001	3.020	0.990	
Kheirak-Shekarak River	Iran	20	-	TL	0.00002	2.820	0.980	
Tange feryab River	Iran	47	-	TL	0.00002	2.860	0.980	

Zohreh River	Iran	0	3.0-7.2	TL	0.0012	2.720	0.980	Keivany & Zamani Faradonbe (2017)
Merzimen Stream, Euphrates River	Turkey	65	2.9-16.8	TL	0.0124	2.988	0.969	Çiçek et al. (2021)
Murat River	Turkey	22	5.1-15.5	TL	0.0605	2.316	0.935	Aslan et al. (2021)
Asi River	Turkey	124	3.10-14.5	TL	0.0258	2.761	0.973	This study

Although *G. turcica* is usually as widespread and locally abundant in the Asi River Basin, this species may be affected and decreased from large parts of the Asi drainage due to habitat destruction and water abstraction. Unfortunately, many threats are still not considered due to not enough substantial evidence for this species. Up to date, *G. turcica* is not included in the IUCN Red List, as it has been identified as a new species. If no action is taken due to many ongoing threats (pollution, habitat loss and water abstraction, etc.), this species may probable expected to decline for Asi River in the future slowly. Therefore, it is crucial to determine a conservation status for this species as soon as possible.

This study was carried out to assess the length-weight relationship and condition factor of *G. turcica* in Asi River. The present results will be useful in managing and conserving for this species in the River basin. Besides, this data will be contributed to FishBase and helpful in future fisheries research.

Conflict of interest

The author declare that no conflict of interest pertaining to the publication of this manuscript.

Ethical approval

For this study is ethical approval not required.

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