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SOME BIOLOGICAL FEATURES OF TENCH (*Tinca tinca*, L., 1758) INHABITING SIDDIKLI DAM

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Abstract: The length–weight relationship, length–length relationship and the condition factor values of Tench, *Tinca tinca* (L., 1758) inhabiting the Sıddıklı Dam was described in this study. A total of 102 specimens captured between September 2015 and August 2016 were used to conduct this study. For each individual, the total length (TL), fork length (FL) and standard length (SL) as well as body weight were measured. Sex composition was determined as 49.02 % female, 43.14 % male and %7.84 undetermined sexes. The overall sex ratio showed no significant difference from the expected value of 1:1. Total length and weight of all specimens ranged from 5.9 to 38.6 cm and from 2.4 to 783.24 g, respectively. The length-weight relationships of females and males were W = 0.0068*TL3.232 (R^2 = 0.991) and W = 0.0084*TL3.157 (R^2 = 0.997), respectively. Weight increased positive allometrically with the total length for both sexes (b> 3, P< 0.001). The mean condition factor values of female and male were 1.305 and 1.330, respectively. This study brought the first data about the species in the Sıddıklı Dam to the literature.

Keywords: Length-weight relationship, Condition factor, *Tinca tinca*, Sıddıklı Dam

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1. Introduction

Tench (*Tinca tinca* (L., 1758)) is a freshwater fish of Tincidae family included Cypriniformes group (Kottelat and Freyhof, 2007). It is really hard to determine the original distribution model in continental Europe as stocking operations were done in European scale during centuries. However, it has been assumed as a native species in most of Europe. There are no natural distribution areas in Ireland, Scandinavia, Western and Southern Greece, and the Eastern Adriatic basin. It naturally spreads in regions from east of Asia to the Western Yenisey drainage south of 60° North latitudes. It has also been reported in North and South Africa, Tasmania, Australia, New Zealand, India, North America, Chile and many other regions (Kottelat and Freyhof, 2007). Besides it has been reported in North and South Africa, Tasmania, Australia, New Zeeland, India, North America, Chile and many other areas (Kottelat and Freyhof, 2007).

Tench fish deploying initially in Black Sea coasts and also Thrace, Central Anatolia and Mediterranean basin in our country has an economic significance (Geldiay and Balık, 2007). The species quite resisted to lower oxygen levels is important ecologically. They typically live in shallow lakes having intense plant cover (vegetation) and in still water. They generally spend winter as bogged down. They spawn (lay) in areas in fresh water having intense plant cover. They can live up to age 20. The Tench reaching sexual maturity between the ages 2-6 carries out reproductive activity between May and September. Detritus, adults of the species feeding with herbal and zoological materials adopt the feeding strategy mostly on molluscs (Kottelat and Freyhof, 2007). Length-weight relationship is a commonly used parameter in fishing management and giving information about biology of fish population (Bolger and Connoly, 1989). This parameter that bases mathematical relationship between length and weight of the fish can change during lifecycles of the species (Le Cren, 1951). Condition factor can be used to indicate the biological condition of a fish and even to determine sub-populations of a species (Wootton, 1998; Jones, 2002). It is also the reflection of relationship of fish welfare with biotic and abiotic environment (Keyombe et al., 2017). These parameters are needed to analyze the data is necessary for species protection biology and to make healthy comparison with other populations.

There aren't any researches about this species in Sıddıklı Dam. This study is conducted for the purpose of not only to expand the scientific knowledge about the species but also to be a source to other researches. In this study it is aimed to determine *Tinca tinca*'s length-weight relationship and condition factor.

2. Materials and Methods

2.1. Study Area

Sıddıklı Dam (Figure 1) located in nearby Sıddıklı Küçükboğaz Village in 40 km west of Kırşehir was built for watering purposes. The surface area of Sıddıklı Dam is 1.65 km². Thanks to the dam, 4945 ha of agricultural land is irrigated. In addition, fishing activities are carried out economically in the Sıddıklı Dam (Anonymous, 2008).

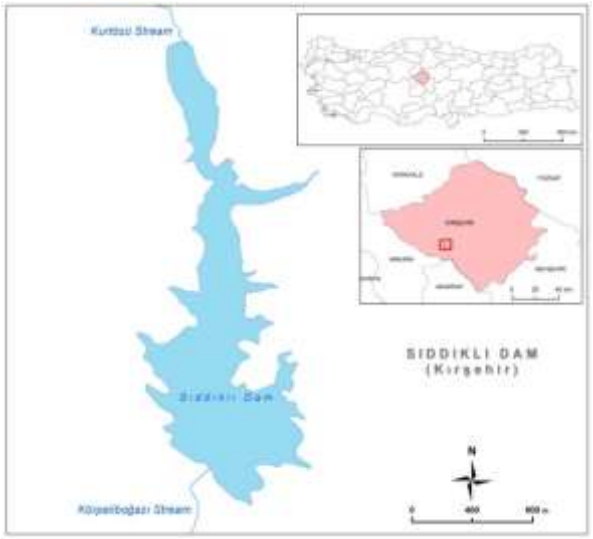

Figure 1. The location of Sıddıklı Dam.

2.2. Sampling

Fish samples were collected monthly from different parts of the Sıddıklı Dam using gill nets (25×25, 30×30, 35×35, 40×40, 45×45, 50×50, 55×55, 60×60, 65×65, 70×70, 75×75 and 80×80 knot to knot) between September 2015 and August 2016. A total of 102 *Tinca tinca* samples were obtained during the study.

The total, fork and standard lengths of each fish were measured with an accuracy of 0.1 cm and their weights were weighed using a digital scale with an accuracy of 0.01 g. Sex determination was made by macroscopic examination of the gonads.

2.3. Statistical Analysis

Whether there was a deviation from the expected value (1:1) in the sex ratio was checked with the chi-square (x^2) test. The following formula (equation 1) is used for length-weight relationship.

$$W = a \times L^b \quad (1)$$

In this formula, W is body weight (g), L is total length (cm), a is the intersection point and b is the slope (Bagenal and Tesch, 1978). The b coefficient obtained from the length-weight relationship was used to determine the growth type of the fish. Whether fish growth was isometric (b = 3) or allometric (b > 3, b < 3) was estimated by Student's t-test (Zar, 1999). Fulton's condition factor was calculated using the formula (equation 2) below (Ricker, 1975).

$$K = 100 \times \frac{W}{L^3} \quad (2)$$

In addition, relationships between TL vs FL, FL vs SL, and SL vs TL were determined separately according to females, males, and overall samples.

3. Results

Of the total amount of the 102 Tench obtained, 50 (49.02%) were female, 44 (43.14%) were male, and 8 (7.84%) were unidentified sex. The female: male ratio was determined as 1.00:0.88. It was determined that this ratio did not show a significant deviation from the expected 1:1 ratio (x^2=0.383, P>0.05). The total length of the examined fish varied between 5.9 - 38.6 cm. The highest number of specimens were in the length groups of 10.0-14.9 cm (56.7%) (Figure 2).

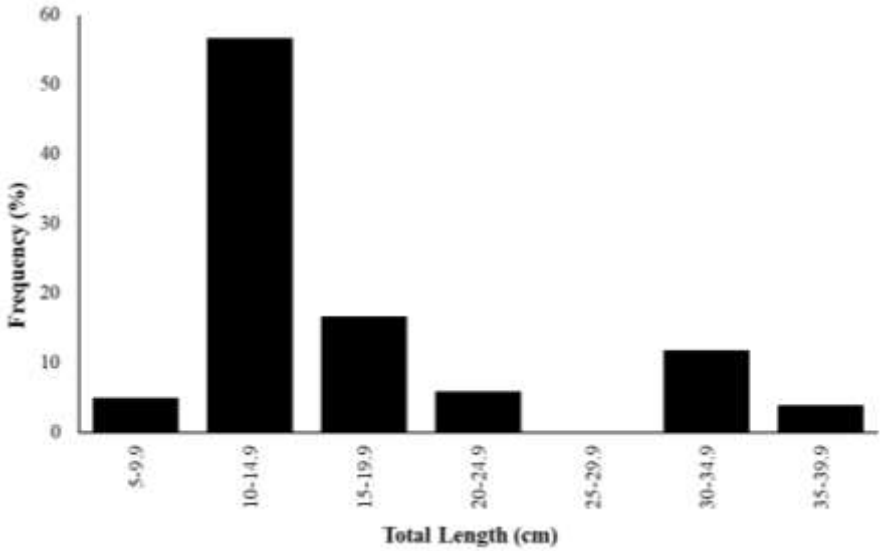

Figure 2. Length-frequency distribution of Tench inhabiting Sıddıklı Dam.

The weights of the fish ranged between 2.4-783.24 g. 76.5% of the samples weighed less than 100 g (Figure 3).

The b value of the length-weight relationship was determined as 3.232, 3.157 and 3.177 in females, males and all individuals, respectively. Very strong relationships were found in the length-weight relationship (Figure 4). According to the t-test results, the b value was different from 3 in females, males and all individuals (t-test, b>3, P<0.001). It can be stated that the species performed a positive allometric growth in the Sıddıklı Dam.

The average condition factor of *T. tinca* inhabiting Sıddıklı Dam was found to be 1.305 in female individuals, 1.330 in male individuals and 1.308 in all individuals. The difference between the average condition factor values of female and male individuals was not statistically significant (t-test, P> 0. 05).

The relationships between total, fork and standard length in *T. tinca* individuals are shown in Table 1. It was determined that there were strong linear relationships between different length types (R^2> 0.993, P< 0.001).

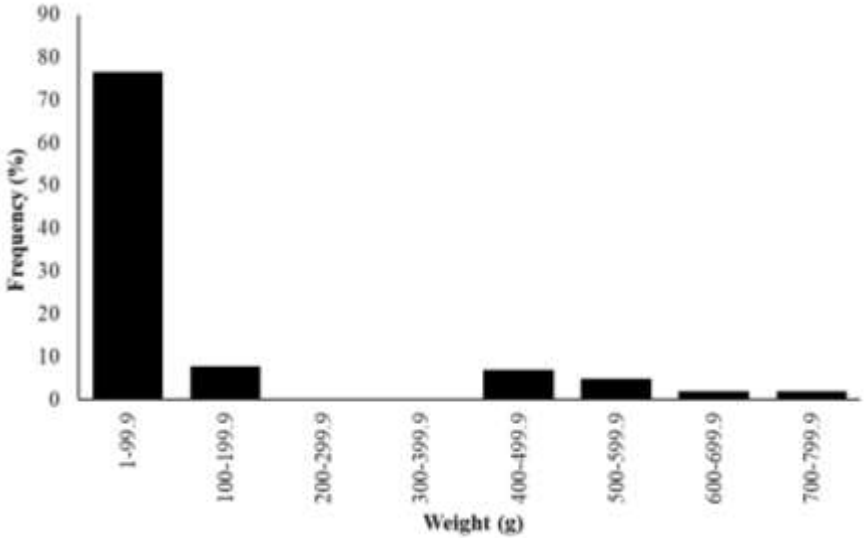

Figure 3. Weight-frequency distribution of Tench inhabiting Sıddıklı Dam.

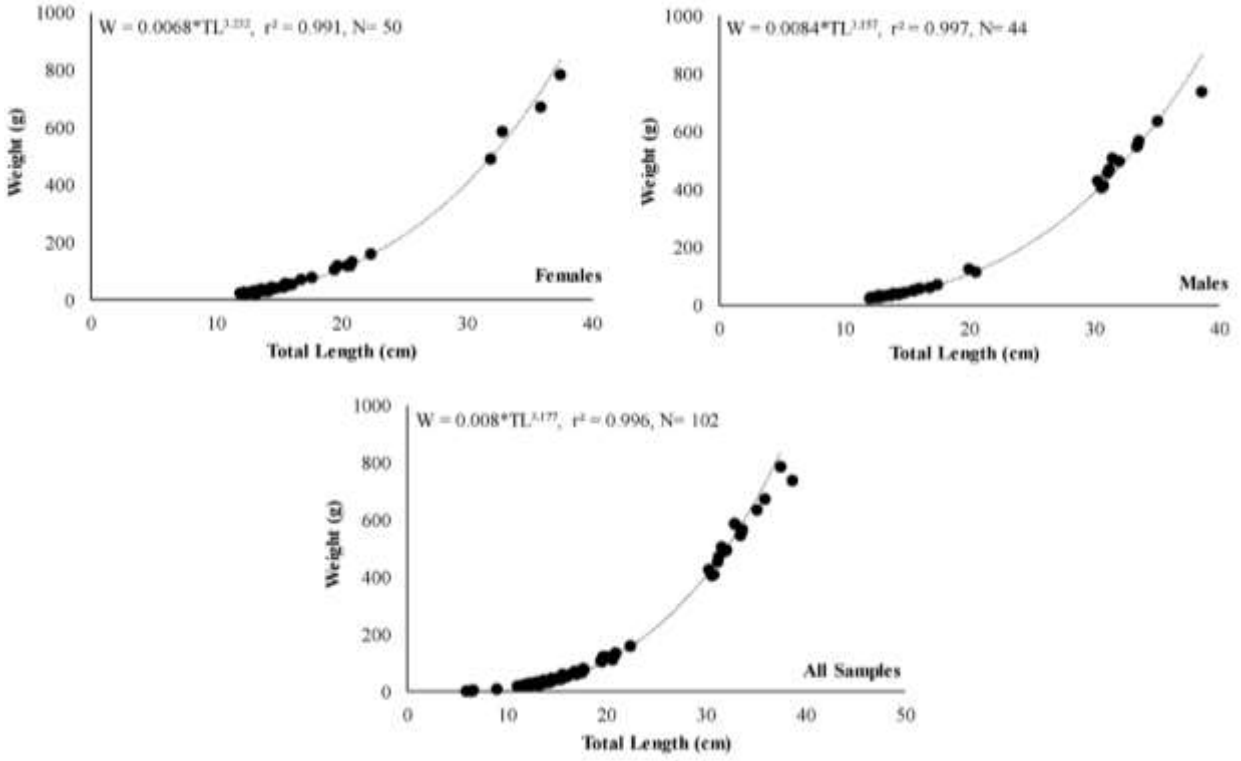

Figure 4. Length-weight relationship of Tench inhabiting Sıddıklı Dam.

Table 1. Length-length relationship parameters of Tench inhabiting Sıddıklı Dam.

Sex	N	Equation	a	b	R^2
Female	50	TL= a + bFL	0.1977	1.0289	0.998
		TL= a + bSL	0.352	1.1863	0.997
		FL= a + bSL	0.177	1.1509	0.995
Male	44	TL= a + bFL	0.1730	1.0289	0.999
		TL= a + bSL	0.445	1.1804	0.997
		FL= a + bSL	0.271	1.1468	0.996
All Samples*	102	TL= a + bFL	0.1865	1.0288	0.993
		TL= a + bSL	0.3322	1.1866	0.997
		FL= a + bSL	0.1540	1.1525	0.996

*Including non-sexed samples, N= sample size, a, b and R^2: the parameters of length-weight relationships.

4. Discussion

In this study, some biological characteristics of *T. tinca* species inhabiting Sıddıklı Dam were determined. The sex ratio (Female/Male) of the strain did not differ from the expected 1:1 ratio. Although the proportion of males is found to be higher in some studies (Ergüden and Göksu, 2010), the expected proportional equality has been reported in the literature in general. (Altındağ et al., 1998; Altındağ et al., 2002).

Considering the length distribution of the species, the minimum length value reported in the existing literature was obtained in this study. In addition, it may be an indication that the size distribution is in a very wide range and that the findings obtained in this way reflect the various biological periods of the fish. Possible reasons for the differences in length distributions in the literature (Table 2) are sampling times, hunting methods, size types used and differences in growth according to habitats. In order to make healthier comparisons, age-length data should be obtained.

Table 2: Length-weight relationship parameters and average condition factor values for tench reported from different studies.

Reference	Habitat	Sex	Length Distrubition (cm)	b	R^2	Growth Type	K
Altındağ et al., 1998	Kesikköprü Dam Lake	F+M	15.4-41.4	3.17	0.97	I	1.95
Altındağ et al., 2002	Bayındır Dam Lake	F+M	15.2-34.7	3.17	-	-	1.55
Balık et al., 2009	Beyşehir Lake	F+M	9.0-37.0	2.99	0.99	I	1.51
Şanlı Benzer et al., 2009	Hirfanlı Dam Lake	F+M	17.9-34.2	2.93	-	-	1.09
Ergüden and Göksu, 2009	Seyhan Dam Lake	F+M	11.0-26.5	2.78	0.97	-	-
Ergüden and Göksu, 2010	Seyhan Dam Lake	F+M	12.0-29.0	2.51	0.98	A (-)	1.58
Yılmaz et al., 2010	Hirfanlı Dam Lake	F+M	13.9-30.0	3.15	0.97	A (+)	1.65
Moradinasab et al., 2012	Anzali Wetlands	F+M	15.0-26.5	2.53	0.90	A (-)	1.60
Kırankaya et al., 2014	Hirfanlı Dam Lake	F+M	13.8-33.9	3.10	0.99	A (+)	1.58
Saylar et al., 2014	Hirfanlı Dam Lake	F+M	20.5-34.5	2.41	0.84	-	1.49
Saylar et al., 2018	Asartepe Dam Lake	F+M	19.0-42.9	3.05	-	A (+)	1.68
This Study	Sıddıklı Dam	F+M	5.9-38.6	3.17	0.99	A (+)	1.30

I= isometric, A (+)= positive allometric, A (-)= negative allometric, F= female, M= male, K= Fulton's condition factor, b and R^2: the parameters of length-weight relationship.

In this study, strong relationships were determined between the length and weight of the species. a and b values were obtained from this relationship. The b value indicates the shape of the fish according to the conditions it is in. Although it is known that the b value varies between 2.5 and 3.5 in many fish species (Erkoyuncu,

1995), it has also been stated that it varies between 2 and 4 (Tesch, 1971). The b value of Tench was determined as 3.177 in this study. When we look at the literature, it is seen that the b value of the species is generally above 3 and exhibits allometric growth. The species generally exhibited positive allometric growth in the Sıddıklı Dam and surrounding habitats. On the other hand, in some habitats, the b value was found to be less than 3 and showed negative allometry or isometric growth (Table 2). These differences may have been caused by the number of samples, length-weight distributions, sampling time, size type used and ecological conditions of the environments. In addition, the length-weight relationship in fish varies depending on factors such as nutritional adequacy, feeding rate, gonad development and breeding period (Bagenal and Tesch, 1978).

According to the values of Fulton's condition factor, it is seen that the species cannot effectively benefit from the nutritive capacity of the Sıddıklı Dam. Having lower condition values compared to the literature may be an indicator of this (Table 2). A low condition factor may be related to predation pressure, competition for nutrients, or habitat capacity.

Length conversions are very useful for comparing the results of different studies with each other. In this study, conversions of total length-fork length, total length-standard length and fork length-standard length were determined. A high correlation coefficient has been obtained, and researchers will benefit from these data in future studies using different length types.

4. Conclusion

As a result, it can be said that the species has a positive allometric growth pattern in Sıddıklı Dam and its fatness level is lower compared to other habitats. In terms of the future of the species, its biology should be investigated in more detail and various measures should be taken in particular for the Sıddıklı Dam. In addition, the findings of this study will be a source for future studies.

Author Contributions

The percentage of the author contribution is present below. The author reviewed and approved final version of the manuscript.

	O.Y.	R.Y.
C	55	45
D	60	40
DCP	50	50
DAI	45	55
L	40	60
W	60	40
CR	50	50
SR	70	30

C=Concept, D= design, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. The laboratory procedures were approved by the Local Animal Care and Ethics Committee of Kırşehir Ahi Evran University (Approve number: 68429034/05, Approve date: June 15, 2015).

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