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Length-weight relationship of Black Sea trout (*Salmo labrax*, Pallas 1811) inhabiting Ilgaz Stream Basin, Turkey

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Abstract

In the present study, the length-weight relationship of black sea trout (*Salmo labrax*) captured from the tributaries of the Ilgaz Stream was investigated. A total number of 36 individuals were captured during 2014-2015 and transported to the laboratory. Here, the length and weight values of the fish were measured and the age determination was performed. Afterward, the condition factor and length-weight relationship parameters were calculated. The age of the fish ranged between 1+ and 4+. The mean condition factor was found to be 1.30 ± 0.13 for all fishes. The total length of the fish ranged between 12.80 and 23.90 cm whereas the weight ranged between 20.52 and 203.46 g. The "*b*" value was calculated as 3.4 and the growth of the fish was determined to be isometric. It was inferred that the Ilgaz stream is rich in food and the black sea trout inhabiting the stream is well-nourished. The stream is a convenient source in terms of nutrition and future studies should explore other aspects of aquaculture to benefit from the source to grow fish.

Keywords: Ilgaz Stream, Length, *Salmo labrax*, Weight

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1. Introduction

Natural populations are required to be continuously monitored for sustainable fisheries management. Especially the length-weight relationship is extremely important in terms of fisheries biology and management (Garcia et al., 1989; Haimovici & Velasco, 2000). Length-weight relationship parameters (a and b) enable estimating fish weight from its length, computing the condition index, and comparing the morphology and life cycles of populations in different habitats (Petrakis & Stergiou, 1995). Moreover, these data are needed to determine growth, age, and length compositions in fish population studies (Kohler et al., 1995). In population dynamics studies, these essential data enable researchers to manage natural fish stocks more sustainably (Erzini, 1994; Petrakis & Stergiou, 1995; Haimovici & Velasco, 2000; Yeşilçiçek et al., 2015).

In the present study, the length-weight relationship of black sea trout (*Salmo labrax*) caught from the tributaries of Ilgaz Stream, an important water source for Kastamonu and Çankırı provinces, was investigated.

2. Material and Methods

In the study, *Salmo labrax*, naturally inhabiting tributaries of Ilgaz Stream, was used. The sampling was carried out using an electrofisher four times in different seasons (November 2014 - December 2015) from the locations specified in Table 1. The captured fish of both sexes were brought to the laboratory on the same day. Fork length, standard length, and total length parameters of the fish were determined with a length measuring board. Body length, dorsal fin, ventral fin, and head length were measured with a caliper and a 30-cm ruler. The weight of the fish was determined with a precision balance to the nearest 0.001 g. The age determination was conducted using the scales. The scales were taken from the area between the lateral line and the dorsal fin. The summer and winter bands were read after pre-treatments according to Nikolsky (1963) and Ambrose (1989).

Table 1. *Salmo labrax* sampling locations

Station No.	Station Name	Coordinates
1	Azgın Creek	41°05'13"N 33°38'48"E
2	Sarıpınar Creek	41°06'57"N 33°37'16"E
3	Kızıleller Creek-1	41°03'56"N 33°36'29"E
4	Kızılleler Creek-2	41°06'51"N 33°35'51"E
5	Obruk Creek-1	41°03'11"N 33°32'35"E
6	Obruk Creek-2	41°06'19"N 33°34'32"E
7	Ilgaz Stream	41°10'59"N 33°33'59"E

The condition factor (*K*) was calculated using the formula:

$$K = (W/L^3)100 \quad (1)$$

Length-weight relationships were computed with the formulas of Le Cren (1951):

$$W = aL^b \quad (2)$$

$$\log W = \log a + b \log L \quad (3)$$

Biomathematical calculations were conducted according to Karataş (1973) and Köksal (1985), mean and mean standard error values were computed using standard deviation formulas, and the logarithmic regression was calculated according to Aras et al. (1986).

3. Results and Discussion

All 36 individuals captured within the scope of the study were identified as *Salmo labrax*. Previous studies conducted in the region have accepted all trout inhabiting streams that disembogue into the Black Sea as *Salmo labrax* (Tortonese, 1954-55; Kuru, 1971; Aras, 1976; Çelikkale, 1994).

Age compositions of the captured 36 individuals ranged from 1+ to 4+. Of these, 6 were 1+ years old (16.7%), 25 were 2+ years old (69.4%), 4 were 3+ years old (11.1%) and 1 was 4+ years old (2.8%). Considering the age composition, the absence of old fish gave the impression that intensive fishing is carried out in the streams.

The length-weight measurements of the individuals examined according to their ages are presented in Table 2. The length and weight data obtained are consistent with the studies conducted on trout species in different water sources by Fry (1949), Geldiay (1968), Baltacı et al. (2007), Tanır and Fakıoğlu (2017), Yüksel et al. (2020). As can be understood from these, there does not appear to be any problem in the growth of the trout individuals examined in this study.

It is known that one of the most accurate indices of growth is the length-weight relationships. These are determined by the condition factor and regression curves. Condition factor values obtained in the study are given in Table 3.

Table 2. Measured length and weight values of the *Salmo labrax* individuals captured from Ilgaz Stream Basin according to their ages

Age	N	Mean TL ± SD (cm) (Min-Max)	Mean FL ± SD (cm) (Min-Max)	Mean Weight ± SD (g) (Min-Max)
1+	6	14.15 ± 0.97 (12.8-15.4)	13.52 ± 0.81 (12.3-14.5)	29.59 ± 6.50 (20.52-37.61)
2+	25	17.15 ± 1.16 (15.6-19.7)	16.60 ± 1.14 (14.9-19.1)	60.09 ± 12.94 (36.64-90.34)
3+	4	20.62 ± 1.25 (19.4-22.1)	20.05 ± 1.11 (19.0-21.5)	112.45 ± 25.24 (91.68-146.90)
4+	1	23.9	23.30	203.46

TL: Total length; FL: Fork length; SD: Standard deviation

Table 3. Calculated mean condition factor values of the *Salmo labrax* individuals captured from Ilgaz Stream Basin according to their ages

Age	Mean Condition Factor ± SD
1+	1.19 ± 1.15
2+	1.31 ± 0.11
3+	1.38 ± 0.07
4+	1.61
Mean (All individuals)	1.30 ± 0.13

SD: Standard deviation

There are several studies carried out to estimate length-weight relationships in trout species. Among these the condition factor was reported to be 1.087 in Madrek stream (Aras et al., 1986), 1.131 in Barhal Basin (Yıldırım, 1991), 1.173 in Yukarı Karasu basin (Nakipoğlu, 1992), 1.174 in Çatak Stream (Çetinkaya, 1996), 1.052 in Teke stream (Kocaman et al., 2004), 1.221 in Şehir Stream (Aykıt, 2011), 1.25 in Aksu Stream (Koca, 2011) and 1.19 in Munzur River (Yüksel et al., 2020). Our study results seem consistent with the general literature. The condition factor is an important parameter that provides information about the reproductive period of the fish and whether it is fattened. It differs by not only the morphology of the species but also by the environmental conditions, especially by the food availability. Therefore, slight variations in the condition factor are accepted as normal.

The length-weight relationship of the examined individuals is illustrated in Figure 1.

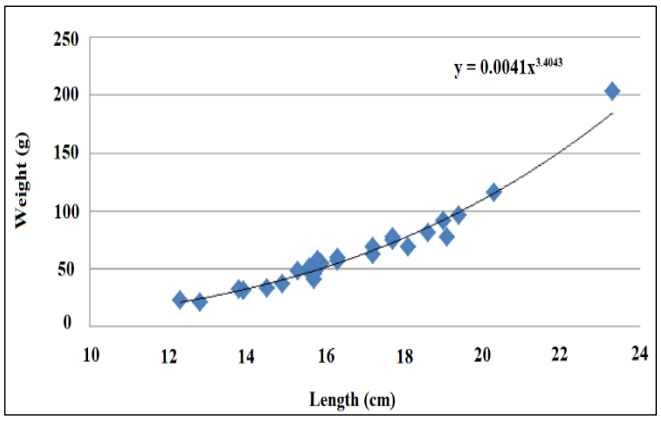

Figure 1. Length-weight relationship of the *Salmo labrax* individuals captured from Ilgaz Stream Basin

In the present study, according to the results obtained regarding the length-weight relationship, the "*b*" value was computed to be 3.4 and it was determined that there is a positive allometric growth. Aras et al. (1997) stated that the "*b*" value in the length-weight relationship of *S. macrostigma* varies between 2.3 and 4.0, but it is often reported as 3 and the growth is isometric. In another similar study, it was reported that this value was calculated as 3.07 in trout inhabiting the Çatak stream and the growth was found to be isometric (Çetinkaya, 1996). Alp et al. (2005) also reported isometric growth in trout captured from the Fırnız stream. On the other hand, Arslan et al. (2004) reported negative allometric growth in *S. trutta* during winter. Although the *b* value varies according to feed availability, reproduction, fish species, and habitat (Yüksel et al., 2020), the *b* value greater than 3.0 indicates the optimum growth conditions (Jisr et al., 2018). Therefore, according to these results, it was revealed that the research site is rich in food and fish are well-nourished. The condition factor values also support these results.

4. Conclusion

Studies on the Ilgaz stream, a very important water source for the region, are very scarce. In this context, it is necessary to know the status of the local fish population and the nutritional value of the water source for possible aquaculture practices. According to our results, it was concluded that the Ilgaz stream is a suitable habitat for the trout (*Salmo labrax*) inhabiting the stream and it is a convenient source in terms of nutritional value and growing capacity for aquaculture. Future studies should expand on all parameters regarding aquaculture to evaluate the fish farming potential in the stream.

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Conflict of interest

The authors declare that there is no conflict of interest.

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