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Research Article

Age, Growth and Diet Composition of the Resident Brown Trout, *Salmo trutta macrostigma* Dumeril 1858, in Fırnız Stream of the River Ceyhan, Turkey

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Abstract: It was aimed to describe some population charactersitics of *Salmo trutta macrostigma* from Fırnız Stream of the River Ceyhan. The age, growth, length-weight relationship and diet composition were investigated from May 2000 to February 2001. The ratio of male to female of 197 brown trout caught by electroshocker was 0.67:1.00 and their fork lengths varied from 8.0 to 48.5 cm and the majority of them were in the 11.0-17.0 cm length group. Total weights varied from 7.4 to 1441.0 g and age distribution ranged between 0 and 9. The length-weight relationships were estimated as $W = 0.0149*FL^{3.009}$ ($r = 0.994$) for males and $W = 0.0163*FL^{2.971}$ ($r = 0.995$) for females. The von Bertalanffy growth parameters were estimated as $L_\infty = 51.00$ cm, $k = 0.131$, $t_0 = -1.220$, $W_\infty = 2034.96$ g for males and $L_\infty = 72.75$ cm, $k = 0.097$, $t_0 = -0.910$, $W_\infty = 5421.51$ g for females.

The condition factor of 197 brown trout ranged from 1.13 to 1.85 and the differences between females and males in the same age groups were not significant ($P > 0.05$).

A total of 15 prey groups were identified in the diets of brown trout and most abundant were Coleoptera, Trichoptera, Ephemeroptera, Plecoptera, Malacostraca, Diptera, Acarii, Heteroptera, fish, fish eggs and plant seeds. According to the Index of Relative Importance (IRI%), five food items represented more than 99% of the total diet, with the most important being Gammarus sp. (43.96%), Nemoura sp. (18.85%), Hydropsychidae (13.44%), Isoperla sp. (12.83%) and an unidentified Diptera sp. (10.26%).

Key Words: *Salmo trutta macrostigma*, age, length, weight, condition, feeding

Ceyhan Nehri, Fırnız Çayı'nda Yaşayan Dağ Alabalığında, *Salmo trutta macrostigma* Dumeril 1858, Yaş, Büyüme ve Diyet Kompozisyonu

Özet: Ceyhan Nehri, Fırnız Çayı'ndaki *Salmo trutta macrostigma*'nın bazı populasyon özelliklerinin tanımlanması amaçlanmıştır. Yaş, büyüme, boy-ağırlık ilişkisi ve diyet kompozisyonu Mayıs 2000 ve Şubat 2001 tarihleri arasında incelenmiştir. Elektroşokerle yakalanan 197 adet alabalıkta erkeklerin dişilere oranı 0,67:1,00 ve çatal boylar 8,0-48,5 cm arasında değişmiş ve çoğunluğu 11,0-17,0 cm boy grubunda yer almıştır. Total ağırlıklar 7,4-1441,0 g, yaş kompozisyonu ise 0 ile 9 arasında değişmiştir. Boy- ağırlık ilişkileri erkeklerde $W = 0,0149*FL^{3,009}$ ($r = 0,994$), dişilerde ise $W = 0,0163*FL^{2,971}$ ($r = 0,995$) olarak hesaplanmıştır. Von Bertalanffy Büyüme parametreleri erkekler için $L_\infty = 51,00$ cm, $k = 0,131$, $t_0 = -1,220$, $W_\infty = 2034,96$ g, dişiler için ise $L_\infty = 72,75$ cm, $k = 0,097$, $t_0 = -0,910$, $W_\infty = 5421,51$ g şeklinde hesaplanmıştır.

İncelenen 197 adet alabalıkta kondisyon faktörü 1,13 – 1,85 arasında değişmiş ve aynı yaş grubunda erkek ve dişler arasında istatistiki açıdan önemsiz bulunmuştur ($P > 0,05$).

Alabalıkların diyetlerinde toplam 15 adet besin çeşidi tesbit edilmiş ve bunların en çok Coleoptera, Trichoptera, Ephemeroptera, Plecoptera, Malacostraca, Diptera, Acarii, Heteroptera, balık, balık yumurtası ve bitki tohumu gruplarına ait oldukları görülmüştür. Kısmi Önemlilik Indeksine (% IRI) göre 5 besin organizması grubunun toplam diyetin % 99 undan fazlasını oluşturduğu tesbit edilmiştir. En önemli besin organizmaları; Gammarus sp. (% 43,96), Nemoura sp. (% 18,85), Hydropsychidae (% 13,44), Isoperla sp. (% 12,83) ve cinsi teşhis edilemeyen bir Diptera sp. (% 10,26) dir.

Anahtar Sözcükler: *Salmo trutta macrostigma*, yaş, boy, ağırlık, kondisyon, beslenme.

Introduction

Salmo trutta macrostigma is distributed in North Africa, South Europe, west Asia and Anatolia. This subspecies occurs in the upper streams of rivers and it was reported in the streams of the River Çoruh (1,2), Çatak Stream in the River Tigris (1,3), Handere, Çelebiçay, Işıklıpınar, Ayazmadere, Kırsealanı and Sütuvençay streams in the Kaz Mountains (4), Pülümür, Munzur, Haydarhacı and Tohma streams in the River Euphrates (5,6), streams of Keklik, Tortum, Tekederesi and Lake Tortum in Erzurum (5,7), Ecemiş Stream in the River Seyhan (8), streams of the River Aras (2), Kazan, Aksicim, Papuç, Palabıyık, Değirmen, Sivriler, Kozlu, Rezve, Velika and Çilingöz streams in the Thrace (= Trakya) region (9), Manavgat, Alara and Aykırıçay streams in Antalya, Beşkonak, and Zindan streams in Isparta (10), and Akdere and Fırnız streams in the River Ceyhan (6,11) in Turkey.

In combination with illegal methods and heavy fishing pressure, reduced spawning success caused by pollution of streams, degradation of spawning habitats, river damming and interspecific competition with introduced rainbow trout has caused a decline in the stocks or extinction of native trout populations in Turkey. However, studies related to *S. t. macrostigma* are limited to general taxonomic determinations and research about its growth, reproduction and feeding biology. Although the River Ceyhan system has undergone great changes in its morphology and ecology, brown trout populations in this river basin have not been described well enough. Reproduction biology of brown trout in Fırnız Stream was described in a previous study (12) but there is no information about its growth and feeding biology. Age, length, length-weight relationships and condition factors of *S. t. macrostigma* in Turkey were reported by Geldiay (4), Aras (2), Aras et al. (13), Nakipoğlu (14), Küçük et al. (15) and Çetinkaya (3) but there is only one study available on its feeding and diet composition (3). In addition, biological characteristics such as growth, reproduction and feeding of S. t. labrax in the Black Sea Region of Turkey were investigated by Yıldırım (16) and Tabak et al. (17).

This study was performed to describe age, growth, condition factors and feeding biology of brown trout, *S. t. macrostigma*, in Fırnız Stream of the River Ceyhan.

Materials and Methods

The present study was carried out in Fırnız Stream, an upper tributary of the River Ceyhan located at the latitude of 37° 45' N, longitude of 36° 39' E and altitude of 730 m. The catchment area of Fırnız Stream is about 178.5 km^2 and its flows vary from 1500 to 5500 l/s. Fırnız Stream is 12 km long and merges with Tekir Stream (11,12). They form Guredin Stream and it runs into Menzelet Reservoir. After the construction of Suçatı Dam in 1999 on Guredin Stream the direct connection between Fırnız Stream and Menzelet Reservoir was cut (Figure 1). Fish fauna of Fırnız Stream was represented by *Salmo trutta macrostigma* Dumeril 1858, *Capoeta damascina* Valenciennes 1842 (= *Capoeta capoeta angorae* Hanko 1924), *Phoxinellus* sp., *Garra rufa* Heckel 1843, *Nemacheilus angorae* Steindachner 1897, *Nemacheilus* sp. and *Blennius (Salaria) fluviatilis* Asso 1801 (11).

A total of 197 individuals of *S. t. macrostigma* was caught monthly at three selected sampling sites in Fırnız Stream between May 2000 and February 2001 using an electroshocker (a portable Honda generator with 1000 W and 120 V on AC output). All fish caught were immediately preserved in a plastic barrel containing 4% formalin solution for later analysis. For each fish total weight (g), fork length (cm) and sex were recorded and a few scales from each fish were taken for age determinations and age readings were performed according to Chugunova (18). Following the removal of digestive tracts, stomachs were opened, stomach contents were flushed into a Petri dish and the total contents were weighed. Stomach contents flooded with distilled water were examined under a stereoscopic microscope. Contents were sorted and prey items were identified to the lowest feasible taxonomic units using the identification keys given by Edmondson (19), Demirsoy (20) and Geldiay and Balık (21). Food items were damp dried on paper towels and the number of individuals and total weight of each prey were recorded. Stomachs having no food items were recorded as empty stomachs.

Length-weight relationships were calculated applying the regression analysis of fork length (x) to total weight (y) of each fish using the equations ln W = a+b*ln FL; q = exp^{-a} and W = q*FL^{b}, where "W" is the total weight, "FL" is the fork length, and "a" and "b" are the intercept and slope estimated in the regression (22).

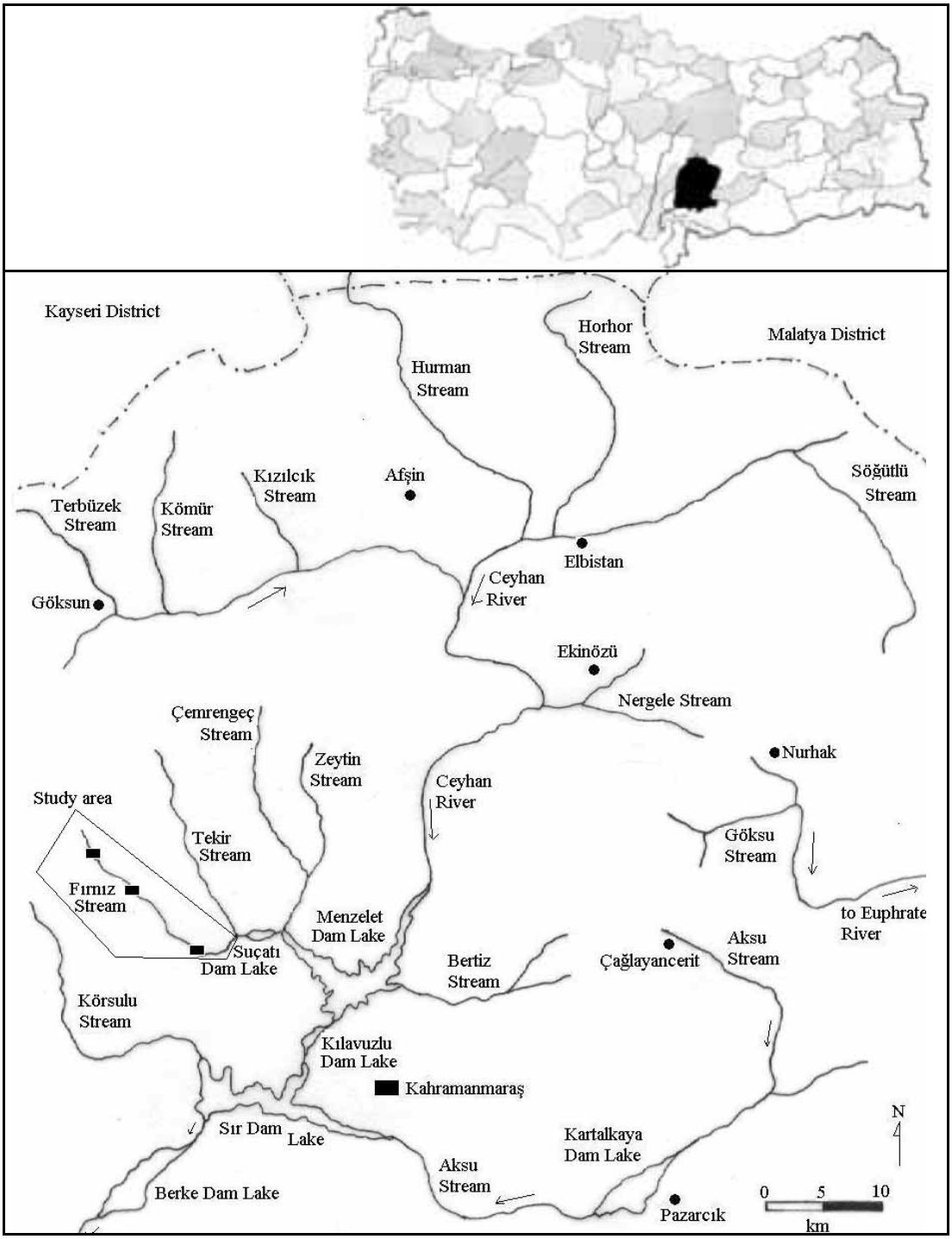

Figure 1. The map of the study area and working stations

Growth parameters, L_∞, k and t_0, were found using FISAT software package (23), and von Bertalanffy growth equations were formed for males and females using the equation $L_{(t)} = L_\infty*[1-\exp^{(-k*(t-t_0))}]$, where L_∞ is the average asymptotic length, k the growth coefficient which determines how fast the fish approaches L_∞, and t_0

the hypothetical age for $L_{(t)}$ = 0 cm. Condition factors of brown trout were estimated by the equation $C = (W/FL^3)*100$ by using body weights (g) and fork lengths (cm).

The ratio of males to females was tested with X^2- test and the differences in length and weight between males and females were tested with the one-way ANOVA and t-test (24).

Dietary importance of food categories were determined using the modified index of the relative importance: IRI = (N%+W%)*%FO (25,26), where %FO is the percentage of frequency of occurrence of stomach in which a food item occurred to the total number of stomach containing food items, N% is numeric percentage of individuals of a food item to the total number of food items in the stomach, and W% is the percentage of weight of a food item to the weight of the total stomach contents.

Results

Length and weight frequencies and age distribution

Of the 197 *S. t. macrostigma* examined in the study, 79 were males and 118 females. The ratio of males to females was 0.67:1.00 and this is significantly different from 1:1 ratio ($P < 0.05$).

S. t. macrostigma ranged from 8.0 to 48.5 cm, with a mean fork length of 16.25 ± 0.447 cm (Table 1). The majority of the samples were comprised by 11.0-17.0 cm in length group (60.41%) (Figure 2a). Total weights of the examined brown trout varied from 7.4 to 1441.0 g, with a mean weight of 98.8 ± 11.670 g (Table 1). Of the total samples, 49.2% (n: 97) were less than 50 g in weight, 26.4% (n: 52) were between 50 and 100 g, 14.2% (n: 28) between 100 and 200 g, 3.1% (n: 6) between 200 and 300 g and 6.8% (n: 13) were greater than 300 g in weight.

Table 1. The fork lengths (cm) and total weights (g) in the age groups of *S. t. macrostigma* from Fırnız Stream of the River Ceyhan.

Age group	Sex N	FL (cm)	Min-Max	SE	W (g)	Min-Max	SE
0	M : 1	9.00			11.5		
	F : 4	9.27	8.0-10.0	0.437	11.37	7.4-13.9	1.42
	M+F : 5	9.22	8.0-10.0	0.343	11.40	7.4-13.9	1.100
1	M : 43	11.89	9.3-14.4	0.202	26.67	11.9-43.1	1.331
	F : 40	11.76	8.7-14.9	0.223	25.88	9.6-45.8	1.426
	M+F : 83	11.82	8.7-14.9	0.150	26.29	9.6-45.8	0.968
2	M : 21	16.45	13.9-20.3	0.291	70.68	43.7-111.2	3.904
	F : 43	15.97	13.5-16.6	0.230	63.8	37.8-102.1	2.556
	M+F : 64	16.13	13.5-20.3	0.183	66.1	37.8-111.2	2.164
3	M : 10	21.19	18.6-24.5	0.645	145.0	101.4-187.7	9.477
	F : 16	20.74	18.2-24.3	0.471	136.9	90.7-193.5	7.985
	M+F : 26	20.91	18.2-24.5	0.376	140.0	90.7-193.5	6.050
4	M : 2	25.95	25.9-26.0	0.530	260.8	256.0-265.0	4.808
	F : 7	26.99	24.7-29.1	0.680	292.1	227.5-378.0	24.141
	M+F : 9	26.76	24.7-29.1	0.542	285.2	227.5-378.0	19.02
5	M : 1	29.50			384.0		
	F : 3	31.20	29.6-32.8	0.924	433.1	333.0-490.1	50.189
	M+F : 4	30.77	29.5-32.8	0.780	420.8	333.0-490.1	37.545
6	F : 2	35.25	35.0-35.5	0.250	662.0	658.0-666.0	4.002
	M+F : 2	35.25	35.0-35.5	0.250	662.0	658.0-666.0	4.002
7	M : 1	34.00			674.0		
	F : 2	38.50	37.5-39.5	1.000	835.0	828.0-842.0	7.000
	M+F : 3	37.00	34.0-39.5	1.607	781.3	674.0-842.0	53.821
9	F : 1	48.50			1441		
	M+F : 1	48.50			1441		
	M : 79	15.12	9.0-34.0	0.545	71.8	11.5-674.0	2.473
Σ	F : 118	17.01	8.0-48.5	0.643	116.9	7.4-1441	8.681
	M+F : 197	16.25	8.0-48.5	0.447	98.8	7.4-1441	11.670

Nine age groups were recorded from 0 to 9 (Figure 2 b). One and two-year-old fish dominated in the sample, accounting for over 74% of the total aged fish. Older fish were poorly represented and the oldest female fish was nine years old, while the oldest male was seven years old. There were also no female fish at age 8, and no male fish at age 6 or 8.

Length-weight relationships

The length-weight relationships were estimated as $W = 0.0149*FL^{3.009}$ ($r = 0.9939$, $n = 79$) for males and $W = 0.0163*FL^{2.971}$ ($r = 0.9945$, $n = 118$) for females.

The high r-values indicated a strong relationship between the two dimensions. In both sexes the regression coefficient $b \approx 3$ implied that growth was isometric (Figure 3).

Growth characteristics

The fork lengths and total weights in the age groups of male and female *S. t. macrostigma* are given in Table 1. The differences in length between males and females in the same age groups were not statistically significant ($P > 0.05$).

The growth parameters that describe growth in length were found as $L_\infty = 51.00$ cm, $k = 0.131$, $t_0 = -1.220$ for males and $L_\infty = 72.75$ cm, $k = 0.097$, $t_0 = -0.910$ for females. Using these parameters von Bertalanffy growth models of *S. t. macrostigma* were described as $L_{(t)} = 51.01 *[1 - e^{(-0.131 * (t + 1.220))}]$ for males and $L_{(t)} = 72.75 *[1 - e^{(-0.097 * (t+0.910))}]$ for females and growth curves were formed (Figure 4). From the length-weight relationships and the estimated L_∞, the asymptotic weights (W_∞) were calculated as 5421.51 g and 2034.96 g, respectively, for females and males.

Condition factor

The condition factor of *S. t. macrostigma* in Fırnız Stream was investigated for age groups (Table 2). The differences in conditions between females and males in the same age groups were not significant ($P > 0.05$).

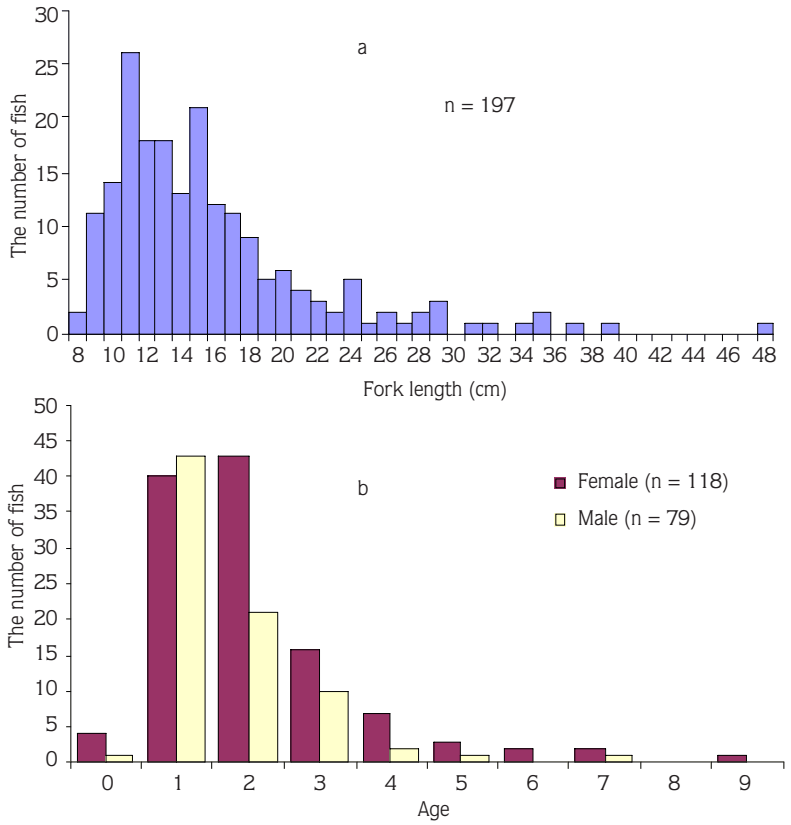

Figure 2. Length and age frequency distributions of *S. t. macrostigma* in Fırnız Stream of the River Ceyhan. a) Length frequency distribution, b) Age frequency distribution.

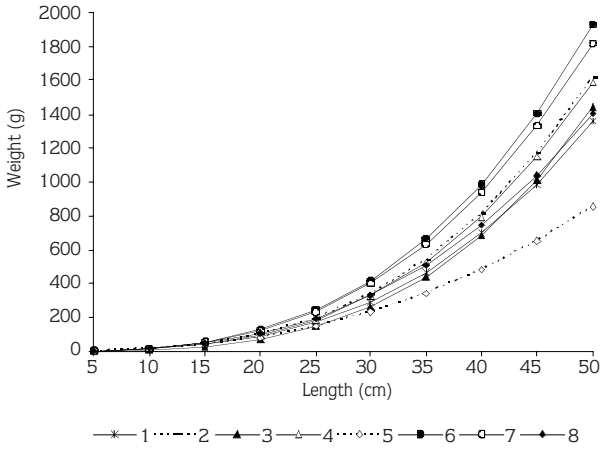

Figure 3. The comparisons of length-weight relationships of the brown trout in different regions. 1. Madrek Stream [W = $0.0105*FL^{3.008}$] (13); 2. Çatak Stream [W = $0.0098*FL^{3.07}$] (3); 3. Sea ecotypes of *S. t. labrax* [W = $0.0031*TL^{3.334}$] (17); 4. Stream ecotype of *S. t. labrax* [W = $0.0084*TL^{3.106}$] (17); 5. Tekederesi Stream [W = $0.034*FL^{2.59}$] (7); 6. Fırnız Stream for males [W = $0.0149*FL^{3.009}$] (Present study); 7. Fırnız Stream for females [W = $0.0163*FL^{2.971}$] (Present study); 8. River Acheloos in Greece [W = $0.0194*TL^{2.86}$] (30).

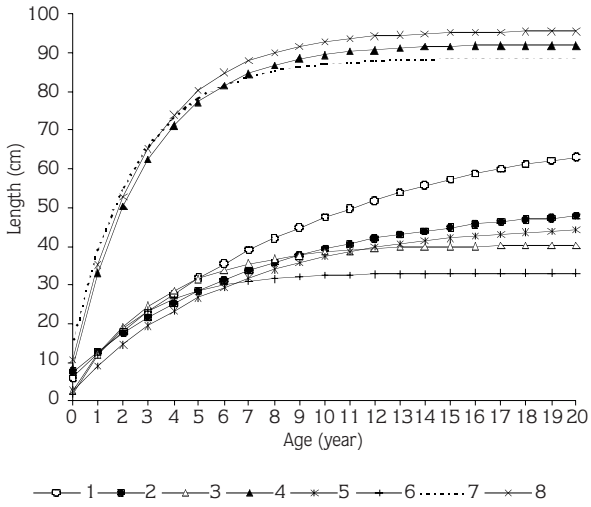

Figure 4. Von Bertalanffy growth curves for brown trout and the comparisons with the present results. 1. Fırnız Stream for females [$L_{(t)} = 72.75*[1-exp^{(-0.097*(t+0.91))}]$], (Present study); 2. Fırnız Stream for males, [$L_{(t)} = 51.01*[1-exp^{(-0.131*(t+1.22))}]$], (Present study); 3. Stream ecotype of *S. t. labrax* [$L_{(t)} = 40.52*[1-exp^{(-0.286*(t+0.24))}]$] (17); 4. Sea ecotype of *S. t. labrax* [$L_{(t)} = 92.05*[1-exp^{(-0.346*(t+0.279))}]$], (17); 5. Sea trout, *S. t. trutta*, in Vebre River in France [$L_{(t)} = 45.90*[1-exp^{(-0.161*(t+0.38))}]$], (31); 6. Sea trout, *S. t. trutta*, in Singerna River in Italy [$L_{(t)} = 33.0*[1-exp^{(-0.389*(t+0.152))}]$], (31); 7. Sea trout, *S. t. trutta*, in Gudenaa River in Denmark in the Baltic [$L_{(t)} = 88.6 * [1-exp^{(-0.388*(t+0.50))}]$], (31); 8. Sea trout, *S. t. trutta*, in Reda River in Poland, in the Baltic [$L_{(t)} = 95.5*[1-exp^{(-0.344*(t+0.34))}]$], (31).

In both sexes the highest condition factor was determined on 1st November 2000 (1.609 ± 0.015). In the other months condition factors fluctuated similarly.

Diet composition

The prey groups identified in the diets and Relative Importance Indices of the resident Brown trout in Stream Fırnız are shown in Table 3.

A total of 11.89% (n: 22) stomachs analysed were empty. As shown in Table 3, Gammarus sp. were present in 93 (50.27%) stomachs, Hydropsychidae in 97 (52.43%) stomachs, Nemoura sp. in 96 (51.89%) stomachs, an unidentified Diptera sp. in 69 (37.30%) stomachs and Isoperla sp. in 53 (28.65%) stomachs.

During the study, 2166 individual preys were counted from 185 brown trout examined and their total wet weight was 71.51 g. By individual, the most representative prey was Gammarus sp. (n: 909; 41.97%), Nemoura sp. (n: 401; 18.51%), an unidentified Diptera sp. (n: 347; 16.02%), Hydropsychidae (n: 254; 11.73%), and Isoperla sp. (n: 205; 9.47%). By weight, of the 71.51 g biomass, 19.62 g were composed of Gammarus sp. (27.44%), 18.65 g of Isoperla sp. (26.08%), 10.12 g of Phoxinellus sp. (14.15%), 7.38 g of Nemoura sp. (10.33%) and 15.75 g were composed of other food items (22.02%).

According to the percent of the Index of Relative Importance (IRI%), five food items represented more than 99% of the total diet, with the most abundant being Gammarus sp. (43.96%), Nemoura sp. (18.85%), Hydropsychidae (13.44%), Isoperla sp. (12.83%) and an unidentified Diptera sp. (10.26%).

Discussion

The sex ratio of *S. t. macrostigma* was reported as 0.54:1.00 (19 M:35 F) in Tekederesi Stream (7) and 2.46:1.00 (27 M:11 F) in Çatak Stream (3). In the present study, the sex ratio of brown trout in Fırnız Stream was 0.67:1.00 (79 M:118 F) and this differed from the ratio of 1:1 ($X^2 = 3.86 > X^2_{(1,\ 0.05)} = 3.84$). Maitland and Campbell (27) mentioned that the number

Table 2. The condition factors in different months and in the age groups of *S. t. macrostigma* from Fırnız Stream of the River Ceyhan.

The condition factors for the age groups					The condition factors for different months				
Age group	Sex	:N	Mean	Min-Max	SE	Date	Sex	:N	Mean	Min-Max	SE
0	M	:1	1.578			31 May	M	:4	1.410	1.28-1.49	0.050
	F	:4	1.405	1.33-1.46	0.029		F	:2	1.391	1.32-1.47	0.076
	M+F	:5	1.440	1.33-1.58	0.041		M+F	:6	1.404	1.28-1.49	0.037
1	M	:43	1.521	1.08-1.77	0.020	27 June	M	:2	1.423	1.34-1.50	0.081
	F	:40	1.526	1.36-1.71	0.014		F	:10	1.476	1.35-1.66	0.027
	M+F	:83	1.523	1.08-1.77	0.012		M+F	:12	1.467	1.34-1.66	0.025
2	M	:21	1.563	1.23-1.85	0.032	20 Sep.	M	:8	1.542	1.13-1.85	0.072
	F	:43	1.541	1.32-1.76	0.017		F	:18	1.441	1.26-1.67	0.026
	M+F	:64	1.548	1.23-1.85	0.016		M+F	:26	1.472	1.13-1.85	0.029
3	M	:10	1.525	1.13-1.76	0.060	01 Nov	M	:12	1.651	1.52-1.78	0.025
	F	:16	1.503	1.31-1.79	0.035		F	:27	1.590	1.37-1.79	0.018
	M+F	:26	1.511	1.13-1.79	0.031		M+F	:39	1.609	1.37-1.79	0.015
4	M	:2	1.493	1.46-1.53	0.037	30 Nov	M	:9	1.434	1.33-1.53	0.022
	F	:7	1.469	1.29-1.63	0.047		F	:16	1.449	1.28-1.61	0.030
	M+F	:9	1.474	1.29-1.63	0.037		M+F	:25	1.444	1.28-1.61	0.021
5	M	:1	1.496			08 Dec.	M	:2	1.605	1.50-1.72	0.110
	F	:3	1.414	1.26-1.57	0.085		F	:6	1.527	1.34-1.63	0.043
	M+F	:4	1.434	1.26-1.57	0.062		M+F	:8	1.547	1.34-1.72	0.040
6	F	:2	1.512	1.47-1.55	0.041	01 Jan.	M	:27	1.556	1.35-1.77	0.020
	M+F	:2	1.512	1.47-1.55	0.041		F	:22	1.561	1.40-1.76	0.016
7	M	:1	1.715				M+F	:49	1.545	1.35-1.77	0.013
	F	:2	1.470	1.34-1.60	0.127	13 Feb.	M	:15	1.659	1.23-1.72	0.031
	M+F	:3	1.552	1.34-1.72	0.110		F	:17	1.534	1.37-1.71	0.023
9	F	:1	1.263				M+F	:32	1.530	1.23-1.72	0.019
	M	:79	1.534	1.13-1.85	0.016		M	:79	1.534	1.13-1.85	0.016
Σ	F	:118	1.512	1.26-1.77	0.013		F	:118	1.512	1.26-1.77	0.013
	M+F	:197	1.521	1.13-1.85	0.010		M+F	:197	1.521	1.13-1.85	0.010

of males in migrating trout populations was more abundant than females. The sex ratio of *S. t. labrax* in the Black Sea Region was reported as 0.76 M : 1.00 F (509 males for 668 females) for stream ecotype and 0.49 M: 1.00 (123 males for 251 females) for sea ecotype (17). The sex ratio of the fish populations changes in the spawning season, life stage of the fish, spawning ground and migration. The males remain longer in the spawning ground because males spawn to sperm gradually. The females usually leave the spawning grounds more rapidly (28). In the present study, the samples were collected from the downstream and midstream of the tributary so the majority of the males may be at the upper stream. The females were greater in number than the males between June 27th and December 8th but the males became dominant in January and they were nearly equal in February. In the early life stage (age 1) the rate of males was higher than that of females, but at later stages the rate of females was higher than that of males. In the freshwater fish the number of males in the early life stages becomes higher than that of females, but in the upper ages the rate of males decreases (28).

Aras et al. (29) reported that the studies on age and growth of *S. t. macrostigma* were limited and the oldest fish reported was eight years old. As shown in Table 4, the oldest fish was reported from Çatak Stream and its length at eight years old was 39.0 cm (3). Brown trout examined in the present study were bigger than those in the River Çoruh (2) and Çatak Stream populations (3) while they were smaller than those in Gürün Gökpınar (30). They were similar in body size to the brown trout inhabiting the streams of the Kaz Mountains (4). Nine years old was the oldest age in the present study for *S. t. macrostigma* and a fork length of 48.5 cm was the

Table 3. Food items and their relative importance index in the diet composition of *S. t. macrostigma* from Fırnız Stream of the River Ceyhan. (FO: Frequency of occurrence of a certain food item; N: The number of a certain food item; W: The weight of a certain food item; IRI: Index of the Relative Importance of a certain food item.)

Diet composition	FO	%FO	N	%N	W (g)	%W	IRI	%IRI
Coleoptera								
Acilius sp.	1	0.54	1	0.05	0.001>	0.001>	0.03	0.001>
Trichoptera								
Hydropsychidae	97	52.43	254	11.73	6.16	8.62	1066.6	13.44
Ephemeroptera								
Ephemerella sp.	6	3.24	10	0.46	0.50	0.70	3.76	0.05
Plecoptera								
Nemoura sp.	96	51.89	401	18.51	7.38	10.33	1496.50	18.85
Isoperla sp.	53	28.65	205	9.47	18.65	26.08	1018.40	12.83
Malacostraca								
Gammarus sp.	93	50.27	909	41.97	19.62	27.44	3489.00	43.96
Mysid sp.	1	0.54	1	0.05	0.05	0.07	0.06	0.001>
Diptera								
Dipter sp.	69	37.30	347	16.02	4.15	5.81	814.08	10.26
Acarii								
Hydroacari	1	0.54	1	0.05	0.001>	0.001>	0.03	0.001>
Heteroptera								
Notonecta sp.	1	0.54	1	0.05	0.09	0.13	0.09	0.001>
Fish								
Blennius sp.	1	0.54	3	0.14	0.60	0.83	0.53	0.01
Salmo trutta	2	1.08	4	0.18	3.28	4.59	5.16	0.07
Phoxinellus sp.	4	2.16	5	0.23	10.12	14.15	31.08	0.39
Other items								
Brown trout eggs	3	1.62	6	0.28	0.27	0.38	1.07	0.01
Plant seeds	1	0.54	1	0.05	0.17	0.24	0.15	0.001>
Total	442		2166		71.51		7937.8	

biggest body size for *S. t. macrostigma* (Table 4). In previous studies, the size of *S. t. macrostigma* was reported as 30-40 cm (Table 4). The total length of *S. t. macrostigma* in Acheloos River in Greece varied from 5.0 cm to 31.0 cm (31). The length of the *S. t. labrax* in the streams of the Black Sea region varied from 6.0 cm to 39.4 cm and their mean length was reported as 15.39 cm (17). According to the age groups, the lengths of brown trout in the present study were found to be smaller than those of the *S. t. labrax* in the streams of the Black Sea region. This is probably due to subspecies differentiation, water temperature of the habitats and food abundance. Alp et al. (12) reported that the first spawning in brown trout in Fırnız Stream occurred at length 18-20 cm for females and 16-18 cm for males. In the present study, *S. t. macrostigma* ranged from 8.0 to 48.5 cm, with a mean fork length of 16.25 cm (Table 1) and the majority of the samples were in the 11.0-17.0 cm length group (60.41%) (Figure 2a). According to this result, there is a high fishing pressure on the *S. t. macrostigma* population because the majority of the samples are represented by juveniles.

The exponent "b" in the length-weight relationships of *S. t. macrostigma* varied from 2.3 to 4.0 and it was generally reported as about 3 and growth was isometric (29). In the present study, the exponent "b" was found to be 2.971 for females and 3.009 for males and these "b" values were agreement with the above exponents "b". Length-weight relationships in the present study were compared with the other length-weight relations from the different region (Figure 3) and total weights at the same length in *S. t. macrostigma* in Fırnız Stream were higher than those of the other populations.

Table 4. Some parameters in age, growth, length-weight relationships and condition factor of different *Salmo trutta* populations.

Author	Study area	Subspecies	Sex	Sex ratio	Age	b	L_∞	K	t_0	Condition	Length (cm)	Weight (g)
Present study	Fırnız Stream	*S. t. macrostigma*	M	0.67/1.00	0-7	3.009	51.01	0.131	-1.220	1.534 FL	9.0-34.0 FL	11.5-674.0
			F		0-9	2.971	72.75	0.097	-0.910	1.512 FL	8.0-48.5 FL	7.4-1441.0
Çetinkaya (3)	Çatak Stream	*S. t. macrostigma*	M+F	2.45/1.00	1-8	3.070				1.174 FL	8.4-39.0 FL	6.7-756.0
Geldiay (4)	Kaz Mountains	*S. t. macrostigma*	M+F		0-5	1.8-3.5					5.6-38.0 FL	
Yüksel and												
Kocaman (7)	Tekedere Stream	*S. t. macrostigma*	M+F	0.54/1.00	1-5	2.590				1.052 FL	9.0-24.1 FL	8.3-124.5
Aras et al. (13)	Madrek Stream	*S. t. macrostigma*	M+F		0-4	3.008				1.087 TL	Mean: 20.07	Mean: 80.73
Nakipoğlu (14)	Karasu Basin	*S. t. macrostigma*	M+F			2.892				1.173		
Küçük et al. (15)	Köprüçay Stream	*S. t. macrostigma*	M+F		1-4						12.0-24.0 FL	20-180
Klossa-Kilia (30)	Acheloos River	*S. t. macrostigma*	M			2.86					5.0-31.0 TL	
			F			2.82					9.0-29.0 TL	
Yıldırım (16)	Barhal Basin	*S. t. labrax*	M+F		1-4	3.000				1.132	Mean: 14.65	Mean: 40.33
Tabak et al. (17)	Stream ecotype	*S. t. labrax*	M+F	0.76/1.00	0-4	3.106	40.52	0.286	-0.241	0.890 TL	6.0-39.4 TL	1.99-677.2
Tabak et al. (17)	Sea ecotype	*S. t. labrax*	M+F	0.49/1.00	0-8	3.334	92.05	0.346	-0.279	0.960 TL	11.7-99.0 TL	13.4-16200.0

The von Bertalanffy growth parameters for *S. t. macrostigma* could not found in the literature. However, in order to give an idea, they were compared with the growth parameters of the other subspecies, *S. t. labrax* and *S. t. trutta*, of the same species, *Salmo trutta*. The growth parameters of sea trout, *S. t. labrax* and *S. t. trutta*, were reported (17,32). Asymptotic length in the present study (L_∞ = 51.01 cm for males and 72.75 cm for females) was higher than that of the stream ecotype of *S. t. labrax* in the Black Sea region (17) and *S. t. trutta* in Vebre River in France and Singerna River in Italy (32) but it was smaller than that of the sea ecotype of *S. t. labrax* (17) and *S. t. trutta* in the Gudenaa River in Denmark in the Baltic and the Reda River in Poland in the Baltic (32). The "k" values, which determine how fast the fish approaches asymptotic length, varied from 0.120 to 0.420 for the stream ecotype of *S. t. labrax*. In the present study "k" value was estimated as 0.131 for males and 0.097 for females and they were higher than that of the stream ecotype of *S. t. labrax* (17). The von Bertalanffy growth curves in the present study were compared with the growth curves of *S. t. labrax* and *S. t. trutta* from different regions (Figure 4). Growth of *S. t. macrostigma* in the present study was higher than that of the stream ecotypes of the other trout populations while it was smaller than that of the sea ecotypes.

The condition factor for *S. t. macrostigma* in the different population ranged from 1.052 to 1.174 (2,3,30) (Table 4). In the present study condition factor varied from 1.129 to 1.853. According to total length, the mean condition factor in the present study was estimated as 1.329 ± 0.011. Condition factor is related to length and weight of the fish. As shown in Figure 3, in the present study, total weights at the same lengths were higher than those of the other populations and so condition factors in the present study were higher than those of the other populations.

Most of the preys in the stomachs of *S. t. macrostigma* in Fırnız Stream were benthic organisms. Lehane et al. (33) reported that most important food items of brown trout in a stream in Ireland were Ecdyonurus sp., Hydropsychid sp., Baetis sp., Protonemura sp. and Gammarus sp. The most frequent prey items of brown trout in Çatak Stream in Turkey were reported to be Tricoptera (in 17 stomachs, 70.83%), Ephemeroptera (in 14 stomachs, 58.33%) and Gammarus sp. (in 11 stomachs, 45.83%) (3). In our study Tricoptera, Diptera, Plecoptera and Gammarus sp. were the most frequent prey items but according to the percent of the relative important index (IRI%) Gammarus sp. and Plecoptera consist of more than 70% of the total food. Stream-dwelling salmonids can adjust their feeding behaviour in response to changes in the abundance of prey (34,35) and can also use benthic preys (36-38). There may be some variations in the feeding patterns of salmonids in the wild, and brown trout chiefly feed on the most available prey items (38).

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