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Stomach Contents and Food Habits of Brown Trout (*Salmo trutta* L., 1758) in the Munzur Stream, Turkey

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Abstract: In the present study, biometric characteristics and stomach contents of *Salmo trutta* (L., 1758), captured from Munzur stream in Tunceli, Turkey were investigated between September 2007 and December 2009. It was calculated that the age range were between 1 and 5 years old. Captured fish were measured 19.5±5.9 cm, 113.55±100.22 g (n = 120), respectively. The condition factor of trout calculated 1.14±0.20 (n = 120). At the end of study, the rations in total organism number were Decapoda (43.59%), Trichoptera (19.21%), Haplotaxidae (18.59%), Ephemeroptera (10.36%), Odonate (2.74%), Coleoptera (2.74%), Clitellata (2.43%) and Diptera (0.3%), respectively. The results indicated that the fish feed basically on Arthropoda and Annelidae.

Key words: Munzur trout, *Salmo trutta*, Munzur stream, stomach content, fish, Turkey

INTRODUCTION

S. trutta is one of the most important fish species due to its aquaculture potential, economic value and wide consumer demand and *S. trutta* forms resident populations in the upper streams of rivers and occurs in North Africa, Europe, West Asia and Anatolia and it is an important potential species for recreational fishery.

Quality and quantity of food of receive from their environment is a result of the relationship between the environment and fish. In order to understanding of this relationship, it needs to be doing the analysis of the contents of the digestive system. Analysis of diet in fish provides us with indirect information about how it feeds, its possible interaction with other species (Smith *et al*., 1993).

Several studies have been performed relation with the diet of wild trout populations in different locations (Bridcut and Giller, 1993, 1995; Friberg *et al*., 1994; Fochetti *et al*., 2003; Ruginis, 2008). In the previous studies, it was stated that feeding was accomplished by visual foraging in Salmonids and three potential groups of brown trout food can be distinguished: Substrate associated prey, suspended drift and surface drift prey (Ruginis, 2008).

The present study aimed to provide information about stomach contents and feeding habits and it was also performed to describe age, growth, condition factors of *S. trutta* in Munzur stream.

MATERIALS AND METHODS

The present study was carried out in Munzur stream, three stations tributary of the river located at the latitude of 39°20'N, longitude of 39°07'E and altitude of 1269 m, the latitude of 39°21'N, longitude of 39°25'E and altitude of 1214 m 39°18'N, longitude of 39°22'E and altitude of 1141 m.

A total of 120 individuals of *S. trutta* were caught monthly at three selected sampling sites in Munzur stream between September 2007 and December 2009 using by electrofishing. All fish caught were immediately preserved in a plastic barrel containing 4% formalin solution for later analysis in the laboratory. For each fish total weight (g), fork length (cm) and sex were recorded. Operculums from each fish were taken for age determinations and age readings were performed. Captured fish were measured 19.5±5.9 cm, 113.55±100.22 g (n = 120), respectively. Following the removal of digestive tracts, stomachs were opened, stomach contents were flushed into a Petri dish. 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 Geldiay and Balik. Stomachs having no food items were recorded as empty stomachs.

Individual stomach fullness index was estimated according to the subjective scale Lebedev (Lebedev, 1946) which goes from 0 (Empty stomach) to 5 (0 = empty, 1 = 0-25%, 2 = 25-50%, 3 = 50-75%, 4 = 75-100%, 5>100% i.e., stomach extended). Subsequently, stomach contents were examined under a binocular microscope. Prey

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organisms were identified to the lowest possible order. The contribution of each food item to the diet was expressed as percentage numerical composition (Cn) and percentage frequency of occurrence (f) (Hyslop, 1980). Percentage numerical composition uses the formula (Hyslop, 1980). Stomach contents were analyzed under the microscope and quantified in accordance with occurrence method. Frequency of occurrence (fo) (Hynes, 1950; Hyslop, 1980; Bowen, 1983) and percentage weight (wt%) were examined for different length classes.

The Length-Weight Relationship (LWR) was estimated by using the equation:

$$W = aL^b$$

Where:
W = Weight (g)
L = Total length (cm)
a = Constant
b = Growth exponent

The values of the compiled growth exponent were used for the calculation of Condition Factor (CF).

$$CF = W*100/L^3$$

Where:
CF = Condition Factor
W = Total body weight (g)
L = Total length (cm)
b = Growth exponent

Statistical analysis: The differences in length and weight between males and females were tested with the two-way ANOVA test. Statistical analyses were performed with SPSS 14.0 software package and a significant level of 0.05 was accepted.

RESULTS AND DISCUSSION

Of the 120 stomachs examined, three were empty and therefore were not taken into account in later analyses. The analysis showed that brown trout consumed a wide diversity of food items but aquatic prey constituted the major part of its food. The occurrence of terrestrial prey in brown trout diet was very low. The latter component of the fish diet mainly consisted of Diptera and Clitellata.

Examination of the digestive system of fish at the end of eight different groups of organisms collected in the nutrient was found. Analyses of stomach contents showed that the trout feed basically on Arthropoda and Annelidae. In general, trout fed almost exclusively on arthropod invertebrates of aquatic and terrestrial origin but other prey (Annelids, microcrustacean and small amounts of plant particles) were also found in the diet composition (Table 1).

Table 1: Diet composition (% Fi: occurrence and % Cn: percentage numerical composition), values of brown trout in Munzur stream

Taxon	C_n (%)	F_i (%)
Aquatic invertebrates		
Decapoda	43.59	26.23
Haplotaxidae	18.59	19.67
Odonate	2.74	11.48
Coleoptera	2.74	9.83
Clitellata	2.43	3.28
Dipter	0.30	1.64
Terrestrial invertebrates		
Trichoptera	19.20	19.67
Ephemeroptera	10.36	13.11
Total	100.00	98.30

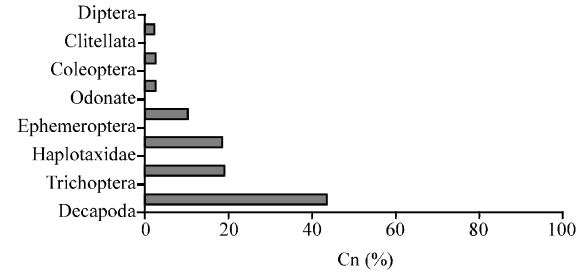

Fig. 1: Diet composition of the studied species by number (Cn%)

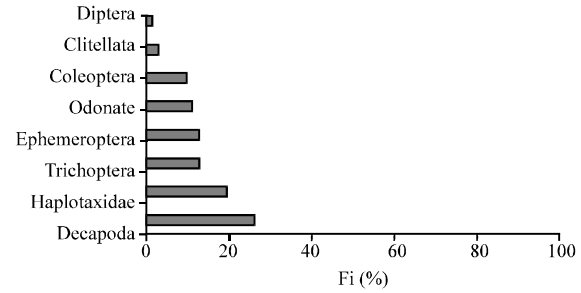

Fig. 2: Percentage frequency of occurrence (Fi%) of *S. trutta* in Munzur stream

At the end of study, the rations in total organism number were Decapoda (*Gammarus* sp.) (43.59%) represented the largest proportion of the diet, followed by Trichoptera (19.21%), Haplotaxidae (18.59%), Ephemeroptera (10.36%), Odonate (2.74%), Coleoptera (2.74%), Clitellata (2.43%) and Diptera (0.3%). Figure 1 shows the percentage of each prey in the total prey biomass in Munzur stream.

In addition, plant seeds and stones were rarely present in the stomach contents. According to percentage frequency of occurrence, the rations in total organism number were Decapoda (*Gammarus* sp.) (43.75%) represented the largest proportion of the diet followed by Trichoptera (19.67%), Haplotaxidae (13.11%), Ephemeroptera (13.11%), Odonate (11.48%), Coleoptera (9.83%), Clitellata (3.28%) and Diptera (1.64%), respectively (Fig. 2).

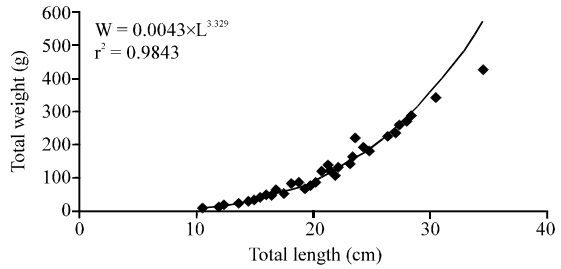

Fig. 3: Length-weight relationship

In the feeding intensity as an index of the stomach fullness, it could be stated that examination of 120 stomachs of *S.t. macrostigma* showed that 6.15% were completely empty.

The length-weight relationships were estimated as $W = 0.0043 \times L^{3.329}$ ($r = 0.9843$, $n = 120$) (Fig. 3). The high r values indicated a strong relationship between the two dimensions.

Five age groups were recorded from 1-5. About 2 years old fish dominated in the sample accounting for over 50% of the total aged fish. Older fish were poorly represented and the oldest female fish was 4 years old while the oldest male was 5 years old. There were also female fish at age 2 and 4.

The condition factor of trout was calculated 1.14±0.20 ($n = 120$). The condition factor of *S. trutta* in Munzur stream was investigated for age groups. The differences in length and weight between males and females were tested with the two-way ANOVA test. The differences in conditions between females and males in the different age groups were not significant ($p>0.05$).

Diet of *S. trutta* was based on aquatic macroinvertebrate arthropods and especially during the summer season, terrestrial organisms captured nearby or dropped onto the stream surface and both Annelidae and Arthropoda were the main food for brown trout in the streams (Bridcut and Giller, 1993, 1995; Friberg *et al*., 1994; Fochetti *et al*., 2003; Ruginis, 2008). In a study on food habits of *S. trutta*, Friberg *et al.* (1994) reported that Crustaceans (*Gammarus* sp.) are one of the dominant species in the macroinvertebrate community and the most important food source for trout. In a different study, Fochetti *et al.* (2003) reported that trout show a positive selection towards trichopteran prey in the River Nera and the choice of feeding mainly on trichopteran prey. Consistent with the result, analysis of data for *S. trutta* revealed that it mainly feeds on benthic organisms which consist of Annelidae and Arthropoda.

Ruginis (2008) has been found that Diptera, Araneida and Coleoptera as terrestrial invertebrates, contributed the greatest mass to the diet of brown trout. Similarly, this study showed that Diptera and Coleoptera contributed to the diet of *S. trutta* in Munzur stream.

Alp *et al.* (2003) reported condition factor ranges of 1.087, 1.132, 1.087, 1.173, 1.174, 0.890-0.960 and 1.052-1.174 in their *S. trutta* populations, respectively. In the present study, the mean condition factor was determinated as 1.14±0.20 and it was obtained a similar result from the other brown trout populations.

Arslan and Aras (2007) reported that age varied in age between 0 and 7 in brown trout populations. Alp *et al.* (2003) recorded higher than 7 years in Turkish inland waters. One 38 years old brown trout was recorded by Svalastog (1991) in Norway. Consistent with results of previous studies, age distribution of *S. trutta* in Munzur Stream was 1-5 years.

CONCLUSION

In this study, the results suggest that the diet of trout was based on the more available prey in the Munzur stream (Aquatic macro-invertebrate prey) and the major food of *S.t.* in Munzur stream were Annelids and Arthropodas. Changes occurred in food habits and stomach fulness of this species with habitat-dependent.

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