

Population Age, Sex Structure and Growth of *Aphanius danfordii* (Boulenger, 1890) to Sirakaraağaçlar Stream, Turkey

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Abstract: In this research, population structure of the species *Aphanius danfordii* found in Sirakaraağaçlar stream has been studied. During the research, sex, age, weight and length composition of 452 fishes has been examined and length-weight relationship and Von Bertalanffy growth function has been calculated. Female-male sex proportion has been calculated as 1.06:1.00, length-weight relationship and Von Bertalanffy growth function has been calculated as $W = 0.0139 L^{3.1641}$, $L_t = 5.149 (1 - e^{-5.945(t-0.502)})$ and $W_t = 2.483 (1 - e^{-5.945(t-0.502)})$.

Key words: *Aphanius danfordii*, population structure, growth, Sirakaraağaçlar stream, Sinop, Turkey

INTRODUCTION

Turkey has created an environment with its zoogeographic location that many sub-cultures are found by enabling environments to be formed, the ecological factors of which differ from each other. When the first evolution periods of the world are considered, all the living things were evaluated within specific classes and the fishes moving from sea to fresh waters were examined under the name secondary fresh-water fishes. The oldest secondary fresh-water fish species known in Anatolia are the species which belong to type *Aphanius*.

In the latest taxonomic studies carried out on *Aphanius* sp. which are defined 14 species that belong to 6 species and 4 subspecies occur in Anatolia, *Aphanius asquamatus*, *A. mento*, *A. anatoliae*, *A. fasciatus*, *A. danfordii*, *A. villwocki* and sub-species are *A. anatoliae anatoliae*, *A. anatoliae splendens*, *A. anatoliae sureyanus*, *A. anatoliae transgrediens* (Wildekamp *et al.*, 1999; Hrbek *et al.*, 2002; Hrbek and Wildekamp, 2003).

Aphanius danfordii is endemic in Turkey that widely known as Killifish. In several studies, this species has been defined as *A. danfordii* however, it has been synonymized as *A. chantrei* by Wildekamp *et al.* (1999). *A. danfordii* could live in freshwater to lightly brackish water with exception of some algae, these habitats lack submerged vegetation and feed on crustaceans, insect larvae and some plankton species (Aksiray, 1987; Frenkel and Goren, 2000; Demirsoy, 1999; Hrbek and Meyer, 2003).

In the several studies carried out on *Aphanius* sp. (Homski *et al.*, 1994; Frenkel and Goren, 2000) it has been indicated that these fishes may have bio-indicator features due to high tolerance they have for organic and inorganic pollutions and low amount of O₂. Moreover,

research of the bio-ecologic characteristics of the species belonging to *Aphanius* type which has a prominent place in respect of biological diversity in Anatolia is important for living resources to be protected.

For this reason, various biological characteristics of the species *Aphanius danfordii* living in Sirakaraağaçlar stream found in Sinop-Aklıman area has been examined.

MATERIALS AND METHODS

Study area: Sirakaraağaçlar stream is located in Sinop-Aklıman zone of occupation in the north of Turkey (42°21' 24"N-35°1'5"E) (Fig. 1). Total length of the stream with two is 3.2 km. Its average depth is 1.5 m and maximum depth is 2.5 m. While its bottom part is of muddy structure, the part of the stream which opens to sea is of sandy structure. In periods of heavy raining, the areas around the stream used for agriculture turn into marsh due to large amount of water flow. Water heat change is between 5-26.1°C and salinity is between 0-4 ppt for a year. Apart from *A. danfordii*, fish species of the stream are *Pleuronectes* sp., *Gobius minutus*, *Gobius niger*, *Neogobius melanostomus*, *Cyprinus carpio*, *Gasterosteus aculeatus*.

Fish samples have been collected from Sirakaraağaçlar stream through the landing-net of 30 cm diameter and 2.5 m length with a 1 mm mesh size. *A. danfordii* samples caught have been first divided into two groups as female and male in the sampling area according to their morphological structures and have been carried to the laboratory for examination.

Physical and chemical parameters of the study area were measured at average depth of 75 cm. The age was determined from scales taken from the part between dorsal

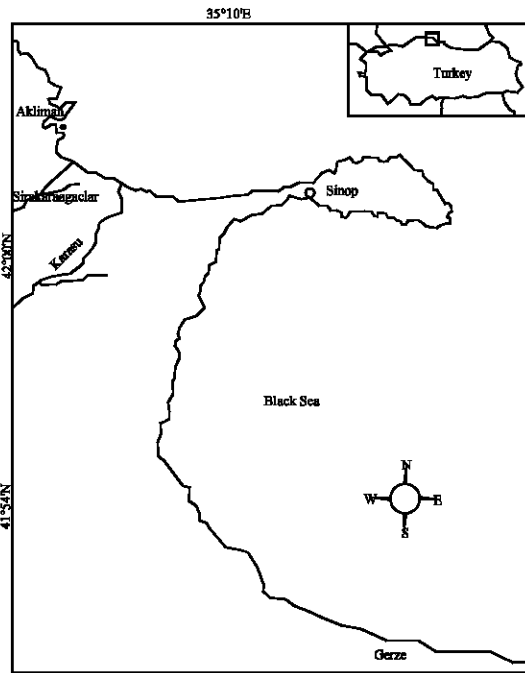


Fig. 1: Study area (Siraykaraagaclar stream)

fin and pectoral fin close to dorsal. Total Lengths (TL) of fishes were measured by scale and total weights were recorded with a digital scale to the nearest 0.001 g.

The relation between weight and total length was established by the exponential regression equation $W = a \times L^b$ where W is the weight in g, L is length in cm, a and b is the parameters to be established. Age-length relationship was calculated through the Von Bertalanffy growth function $L_t = L_{\infty} (1 - e^{-K(t-t_0)})$ and age-weight relationship was calculated through Von Bertalanffy growth function $W_t = W_{\infty} (1 - e^{-K(t-t_0)})^b$ (Erkoyuncu, 1995).

Statistical importance controls were made with t-test. $p < 0.05$ confidence limit was taken as a basis. (Duzgunes *et al.*, 1995; Uyanik and Bat, 2004).

RESULTS AND DISCUSSION

Age and sex composition: It has been determined that 66.37% of 452 *A. danfordii* species caught between the dates 2005 June-May 2006 from Sirakaraagaclar stream in Sinop-Akliman zone of occupation belong to 0⁺ age group, 31.86% of them belong to 1⁺ and 1.77% of them belong to 2⁺ age group.

About 51.55% of the total *A. danfordii* population represents female fishes while 48.45% of them represent male fishes. Female-male proportion of the fishes within the population was found out to be 1.064:1.00 ($p > 0.05$). Composition of the age groups within the population and their sex proportions are shown in the Table 1.

Table 1: Age and sex composition of *A. danfordii* population

Age	Female		Male		Female + Male		Female:Male
	N	N%	N	N%	N	N%	
0 ⁺	143	31.64	157	34.73	300	66.37	0.91:1.00
1 ⁺	84	18.58	60	13.27	144	31.86	1.40:1.00
2 ⁺	6	1.33	2	0.44	8	1.77	3.00:1.00
Total	233	51.55	219	48.44	452	100.00	1.06:1.00

Table 2: Sirakaraagaclar stream age-total length (cm) composition in *A. danfordii* population

Age	Female		Male		Female+Male	
	N	TL±SE (Min.-Max.)	N	TL±SE (Min.-Max.)	N	TL±SE (Min.-Max.)
0 ⁺	143	2.82±0.052 (1.8-4.4)	157	2.93±0.047 (1.9-4.2)	300	2.88±0.035 (1.8-4.4)
1 ⁺	84	4.28±0.046 (3.2-5)	60	3.97±0.042 (3.0-4.8)	144	4.13±0.035 (3.0-5)
2 ⁺	6	4.78±0.083 (4.4-5)	2	4.6±0.030 (4.2-4.8)	8	4.69±0.088 (3.9-5)

Length composition: Total Lengths (TL) of the fishes were which belong to the species *Aphanius danfordii* taken from Sirakaraagaclar stream range from 1.8-5 cm. It has been found out that this length composition changes between 1.9-5 cm for female while it was changes between 1.8-4.8 cm for male (Table 2). Approximately 80% of the samples are comprised of individuals within 2-4 cm length group (Table 3).

Weight composition: Weights of the fishes were which belong to the species *Aphanius danfordii* taken from the study area changes between 0.09 and 2.6 g. It has been found out that this weight composition changes between 0.2 and 2.6 g for female fishes and it changes between 0.09 and 1.8 g for male fishes according to ages (Table 4). Approximately, 72% of the samples are comprised of individuals within 0.2-1 g weight group (Table 5).

Length-weight relationship: In the population made up of 452 *Aphanius danfordii* individuals caught from the study area, length-weight relationship of individuals was exponentially and logarithmically examined and the coefficients and equations obtained were shown in Fig. 2-4. According to Von Bertalanffy growth functions, age-length relationship was calculated to be $L_t = 5.149 (1 - e^{-5.945(t-0.502)})$ and when the obtained data was generally examined, the difference between measured length and length values calculated through growth functions was found to be not significant ($p > 0.05$).

According to Von Bertalanffy growth functions, age-weight relationship was calculated to be $W_t = 2.483 (1 - e^{-5.945(t-0.502)})^{3.1641}$ and the difference between measured weight and the weight calculated through growth functions was found to be not significant ($p > 0.05$).

Table 3: Sirakaraagaclar stream length composition in *A. danfordii* population

Length class (TL, cm)	Class value (TL, cm)	Female		Male		Female + Male	
		N	N %	N	N %	N	N %
1.80-2.19	1.99	12	2.65	10	2.21	22	4.87
2.20-2.59	2.39	53	11.72	47	10.40	100	22.12
2.60-2.99	2.79	35	7.74	18	3.98	53	11.73
3.00-3.39	3.19	14	3.09	44	9.73	58	12.83
3.40-3.79	3.59	29	6.42	36	7.97	65	14.38
3.80-4.19	3.99	24	5.31	46	10.18	70	15.49
4.20-4.59	4.39	38	8.41	15	3.32	53	11.73
4.60-4.99	4.79	26	5.75	3	0.66	29	6.41
5.00-5.39	5.19	2	0.44	-	-	2	0.44
Total	-	233	51.53	219	48.45	452	100.00

Table 4: Sirakaraagaclar stream age-weight (g) composition in *A. danfordii* population

Age	Female		Male		Female + Male	
	N	W±SE (Min.-Max.)	N	W±SE (Min.-Max.)	N	W±SE (Min.-Max.)
0*	143	0.43±0.03 (0.11-1.64)	157	0.43±0.03 (0.11-1.38)	300	0.46±0.02 (0.11-1.64)
1*	84	1.44±0.05 (0.59-2.37)	60	1.13±0.03 (0.52-1.73)	144	1.31±0.03 (0.52-2.37)
2*	6	2.05±0.16 (1.69-2.67)	2	1.68±0.09 (1.58-1.77)	8	1.96±0.13 (1.58-2.67)

Table 5: Sirakaraagaclar stream weight composition (g) in *A. danfordii* population

Weight class (W, g)	Average weight (W, g)	Female		Male		Female + Male	
		N	N %	N	N %	N	N %
0.09-0.34	0.21	90	19.91	69	15.27	159	35.18
0.35-0.59	0.47	22	4.87	43	9.51	65	14.39
0.60-0.85	0.72	21	4.65	30	6.64	51	11.28
0.86-1.11	0.98	20	4.42	37	8.19	57	12.61
1.12-1.37	1.24	19	4.20	27	5.98	46	10.18
1.38-1.63	1.50	25	5.53	11	2.43	36	7.96
1.64-1.89	1.76	24	5.31	2	0.44	26	5.75
1.90-2.15	2.02	8	1.77	-	-	8	1.77
2.16-2.41	2.28	3	0.66	-	-	3	0.66
2.42-2.67	2.54	1	0.22	-	-	1	0.22
Total	-	233	51.54	219	48.45	452	100.00

In this study the species *A. danfordii* that found in Sirakaraagaclar stream were investigated and the female:male proportion was found to be 1.064:1.00 ($p>0.05$). This value is close to the proportion of 1.00:1.00 desired to exist in nature. Moreover this proportion is similar with *A. mento* and *A. iberus* (Delgado *et al.*, 1988) but differs from female-male proportion (0.64:1.00) in the study made by Guclu *et al.* (2007) in the lake of Burdur on the species *A. anatoliae sureyanus* and the female-male proportion (2.44:1) in the study made by Leonardos and Sinis (1999) in Mesolongi and Etoligon lagoon (Greece) on the species *A. fasciatus*. And also, it has been stated that proportion of female individuals in *A. fasciatus* population increase from the end of spring until the beginning of summer and the survival rates of female individuals are more than that of male individuals (Leonardas and Sinis, 1998). Length, weight and age relationships of *A. danfordii* individuals found in Sirakaraagaclar stream show that the lengths of these fishes are small and the populations is comprised of young individuals.

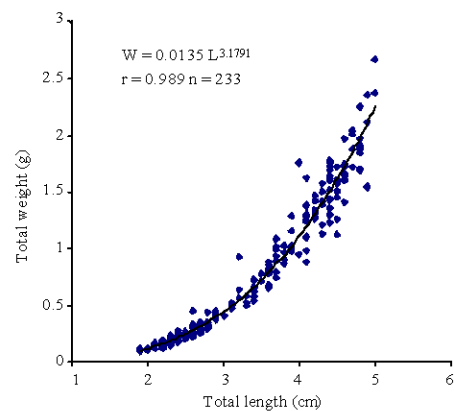


Fig. 2: The total length-weight relationships of *A. danfordii* from the Sirakaraagaclar stream (female)

Leonardos and Sinis (1999) determined *A. fasciatus*, in Mesolongi and Etoligon lagoon (Greece), that the longest female fish is of 70.65 mm and the longest male fish is of 68.12 mm. In the study made by Keivany and

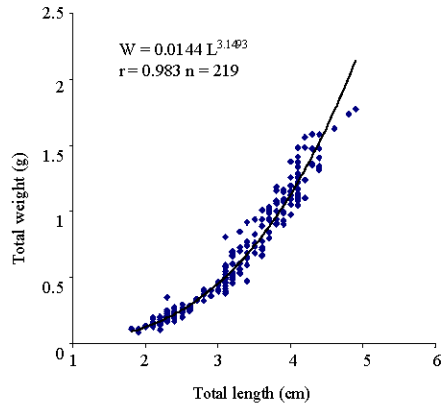


Fig. 3: The total length-weight relationship of *A. danfordii* from the Sirakaraagaclar stream (male)

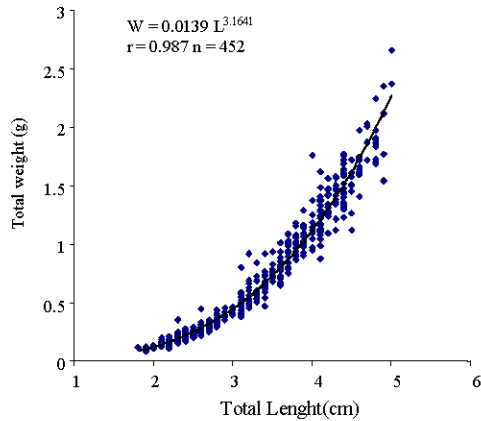


Fig. 4: The total length-weight relationship of *A. Danfordii* from the Sirakaraagaclar stream (female-male)

Soofiani (2004) on the species *A. vladykovi*, maximum value recorded for female is 76 mm and for male is 58 mm. In the study made in Kirkgoz spring (Turkey) on the population of *A. mento*, it has been found out that the longest female fish is of 87.8 mm and the longest male fish is of 74.4 mm.

Body weights determined in *A. danfordii* individuals change between 0.09 and 2.6 g. Body weights of the fish samples obtained in the study made by Guclu on the species *A. mento* changes between 0.09 and 17.56 g. Weights in *A. fasciatus* individuals change between 65.0-4598.9 mg (Leonardos and Sinis, 1999).

Keivany and Soofiani (2004) determined maximum weight as 7.10 g for female fishes and 3.70 g for male fishes in the individuals which belong to the species *A. vladykovi*. The differences between the lengths and weights of fishes are owing to they belong to different

species and they live in different environments. The age of *A. danfordii* from Sirakaraagaclar stream ranged from 0-2 and the individuals in age group 0 contain 66.37% of population. The age of *A. iberus* from Guadalquivir stream (Delgado *et al.*, 1988) and from La Rubina lagoon (Berthou and Amich, 1992) ranged from 0-2 and the age of *A. vladykovi* from Modar-Dokhtar spring (inland of Iran) (Keivany and Soofiani, 2004) ranged from 0-2. However, in the study made by Guclu *et al.* (2007) in the lake of Burdur on the species *A. anatoliae sureyanus*, it has been stated that there are individuals within the age group 0-4 and ages within the *A. fasciatus* population from Mesolongi and Etolikon lagoon in the west of Greece ranged from 0-6 age group (Leonardos and Sinis, 1999).

As a result of the examination of *A. mento* population spreading in Kirkgoz Spring, individuals between the age group 0-7 has been found out. According to Nikolsky (1980), age composition in a population is of wide range as the indication of adequate level of nutrient status of that water system.

In the study, b value within the total length-weight relationship of *A. danfordii* individuals were determined 3.1641. This result shows that *A. danfordii* individuals in Sirakaraagaclar stream have an isometric growth. The relationship total length-weight of *A. danfordii* species correlation coefficient $r = 0.987$. In this study relationship ($r = 0.987$) is similar to *A. fasciatus* ($r = 0.976$) (Koutrakis and Tsikliras, 2003), *A. iberus* ($r = 0.987$) (Andreu-Soler *et al.*, 2006), *A. iberus* ($r = 0.992$) (Verdiell-Cubedo *et al.*, 2006), *A. fasciatus* ($r = 0.990$) (Gaygusuz *et al.*, 2006). But it differs from *A. vladykovi* (Keivany and Sofiani, 2004), *A. mento* ($r = 0.865$) (Guclu and Kucuk, 2008).

CONCLUSION

As a result, Sirakaraagaclar stream is one of the most suitable habitats for the species *A. danfordii* to reproduce and survive. Although, owing to it is among the endemic fish species and has a prominent place for biological diversity is very important with regard to living resources.

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