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The Investigation Growth Models of *Capoeta capoeta Gracilis* (Keyserling, 1861) in 5 Streams of Gorganroud River Basin, Northern Iran

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Abstract: In this study intra-basin variation of growth model of *Capoeta capoeta gracilis* (Keyserling 1861) in 5 streams of the Gorganroud basin (southeast Caspian Sea) were investigated. A total of 1500 specimens caught between April-May 2010 and 2011 by electro-shocking. Total length, total weight, sex and *b*-value were determined. Total length and total weight ranged between 4.1 and 20 cm and 0.81 and 108.34 g in Pishkamer and Tilabad streams respectively. The growth models estimated for sexes, separately. Value of b ranged from 2.90 for males of Pishkamer and Tilabad to 3.13 for females of Chelchai. Growth model was positive allometric (b>3) for more of females. But males had different growth models. In fact comparing b-value between streams can aid in the identification of factors contributing to growth model of the populations. The most direct explanation is that basin comprises different types of habitats that differ in their general environmental conditions. This reflects a change in body form with population. This variation suggests different growth strategies for the populations.

Key words: *B*-Value · Allometric · Habitats

INTRODUCTION

Capoeta genus belongs to the Cyprinidae family [1] and it is represented in Iran by about 10 species, *Capoeta capoeta gracilis* one of the subspecies of the genus *Capoeta*, is a widely distributed and predominant taxon in the south Caspian basin in north of Iran [2] from the coldest region in the west to the most tropical region in the east of the basin [3]. Although *C. c. gracilis* is an important taxon for sport [2] inland water fishing (in some rivers it comprises 33% of captured fishes), aquaculture [4] zoogeography [5] there is limited information available on its ecology, reproductive characteristics or life history and variation in growth model of different populations in the south Caspian Sea basin in Iran. According to the IUCN (International Union for Conservation of Nature) classification, the species is listed in the category "LC" (Least Concern) [2].

The aim of present study was to investigate growth models of *Capoeta capoeta gracilis* in 5 streams of Gorganroud River basin, a contribution to knowledge of growth pattern, population structure and population management.

MATERIALS AND METHODS

1500 specimens *C. c. gracilis* were caught by electro-shocking (D.C. at 110-220 V., 50 Hertz frequencies and one anode) in 5 streams of Gorganroud River basin at (Zarrin-Gol, Tilabad, Chelchai, Dough and Pishkamer). Sampling was done twice per stream during the spawning period (April-May) in 2010 and 2011. All fish specimens were immediately preserved in 10% formaldehyde solution and transferred to laboratory. Length-weight relationships were estimated from the allometric formula, $W= aL^b$ where W is the total weight (g), L the total length (cm) and a and b the parameters to be estimated [6]. Parameters *a* and *b* of L-W relationships were estimated by linear regression analysis. *b* is numeral between 2 and 4. Confidence intervals were calculated for the slops *b* to see if

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these were statistically different from 3, allometric ranges (b>3 positive allometry and b<3 negative allometry) or agree with 3 (b=3 isometric range). Sex was determined by examination of the gonad tissue either with eye or with the aid of a binocular. Growth pattern was estimated using Pauly's modified t-test [7].

$$t = \frac{S_d L_n X}{S_d L_n Y} \times \frac{|b-3|}{\sqrt{1-r^2}} \times \sqrt{n-2}$$

RESULTS

Total 1500 fish examined, 975 were males and 525 females. The overall ratio of male to female (M: F) was 1.86:1. Maximum and minimum total length and total weight were 4.1 and 20 cm and 0.81 and 108.34 g in Pishkamer and Tilabad streams respectively.

Relationships between total weight and total length of the fish were calculated separately for each stream, for males, females and sexes combined (Table 1).

Significant differences obtained from the statistical comparison of length-weight relationships between males and females and same sexes from different streams (ANCOVA, P<0.05). Value of b ranged from 2.90 for males of Pishkamer and Tilabad to 3.13 for females of Chelchai. Growth models were positive allometric (b>3) for more of females and it was different allometric for males (Figures 1-5).

In the Dough stream growth models of *C. gracilis* were positive allometric for females and population (b>3). Pauly's modified t-test shown isometric for males (b=3).

Examination of specimens caught in the Pishkamer stream showed that growth model of *C. c. gracilis* for males was negative allometric (b<3). Although allometry coefficient for females and population were higher than 3 (b>3) while result of Pauly's test shown that growth models were isometric (b=3).

In the Chelchai stream although value of *LWR* was higher than 3 (b>3) for female and population and lower than 3 (b<3) for male but the result Pauly's test shown that growth models were isometric (b=3). Given the results in the Tilabad Stream showed that the b-value estimates were different among the males, females and population. Growth models were negative allometric for males and positive allometric for females and it was isometric for population. Based on the results on the examination of specimens in the Zarrin-Gol Stream revealed that growth models were positive allometric form for males and population but result of Pauly's test shown that growth model was isometric for female (b=3).

Table 1: Descriptive statistics and estimated parameters of weight-length relationship for *C. c. gracilis*, in 5 streams of Gorganroud basin, southeast Caspian Sea

			Total length (cm)		Total weight (g)	
Stream	Sex	N	Min-Max. (Mean ± SD)	Min-Max. (Mean ± SD)	b (confidence interval)	R^2
Dough	Male	194	5.2-14.2 (10.68±2.12)	1.66-39.13 (17.44±8.94)	2.98[3] (2.93-3.03)	0.98
	Female	101	5.2-17.7 (10.61±3.88)	1.71-78.32 (22.54±22.84)	3.11[1] (3.07-3.15)	0.99
	Total	295	5.2-17.7 (10.66±2.84)	1.66—78.32 (19.18±15.36)	3.06[1] (3.03-3.09)	0.99
Pishkamer	Male	219	5.6-14.2 (9.47±1.76)	2.2-35 (11.37±6.25)	2.90[2] (2.83-2.96)	0.97
	Female	129	4.1-12.8 (8.12±2.10)	0.81-27.13 (7.82±5.81)	3.06[3] (2.99-3.13)	0.98
	Total	348	4.1-14.2 (8.97±2.00)	0.81-35 (10.06±6.32)	3.00[3] (2.96-3.04)	0.98
Tilabad	Male	225	5.4-16.8 (10.56±2.90)	2.02-59.18 (18.28±14.09)	2.90[2] (2.86-2.93)	0.99
	Female	120	4.2-20 (9.24±3.79)	0.85-108.34 (16.53±24.65)	3.12[1] (3.00-3.23)	0.97
	Total	345	4.2-20 (10.10±3.29)	0.85-108.34 (17.68±18.42)	3.00 [3](2.96-3.05)	0.98
Zarrin-Gol	Male	114	5.9-13.7 (10.12±2.07)	2.43-29.78 (13.97±7.20)	3.05[1] (2.97-3.11)	0.99
	Female	126	4.2-14.1 (9.28±3.01)	0.87-33.14 (12.59±10.01)	3.04[3] (3.01-3.08)	0.99
	Total	240	4.2-14.1 (9.68±2.61)	0.87-33.14 (13.25±8.80)	3.05[1] (3.02-3.08)	0.99
Chelchai	Male	223	5.9-11.2 (8.99±1.36)	2.64-19.58 (10.41±4.26)	2.95[3] (2.85-3.04)	0.95
	Female	49	5.2-11 (8.34±1.75)	1.62-19.43 (8.97±5.39)	3.13[3] (2.98-3.27)	0.97
	Total	272	5.2-11.2 (8.88±1.45)	1.62-19.58 (10.15±4.51)	3.01[3] (2.92-3.08)	0.96

[1]Positive allometric growth. [2] Negative allometric growth. [3] Isometric growth

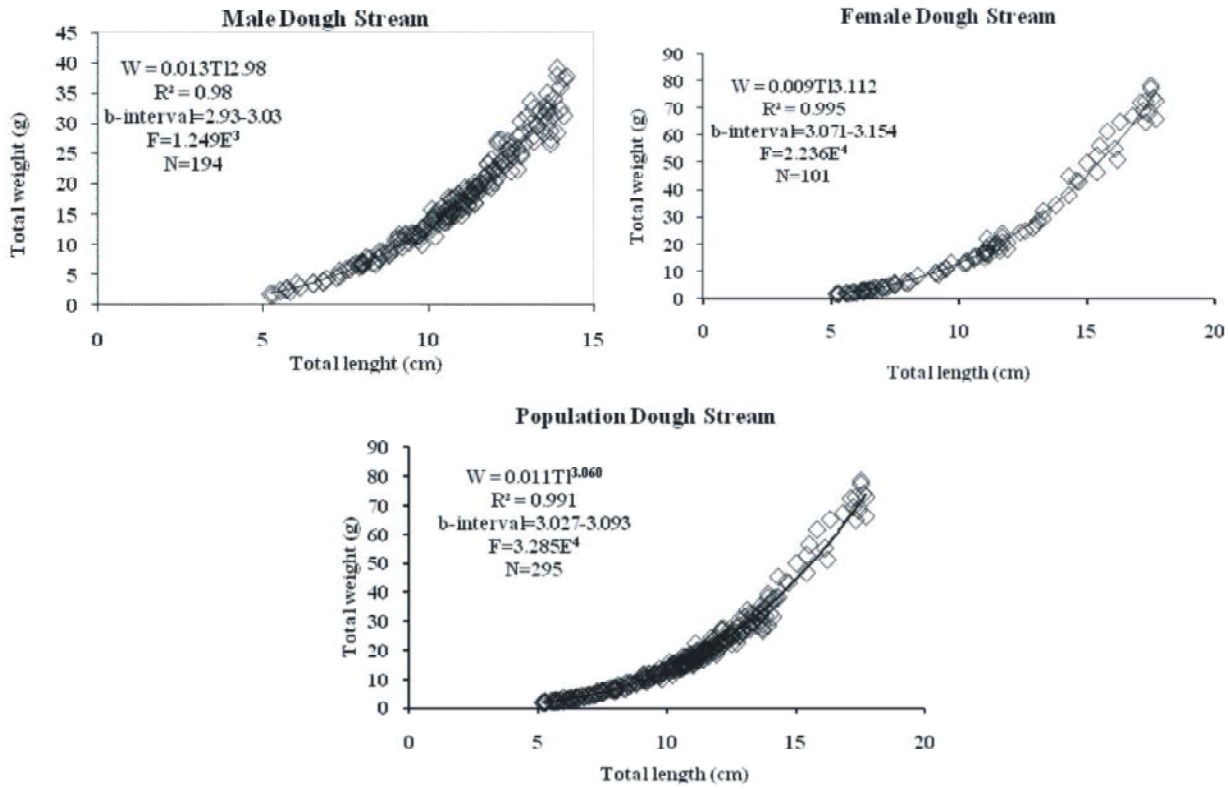

Fig. 1: Length-weight relationships of *C. c. gracilis* for males, females and population of the Dough Stream

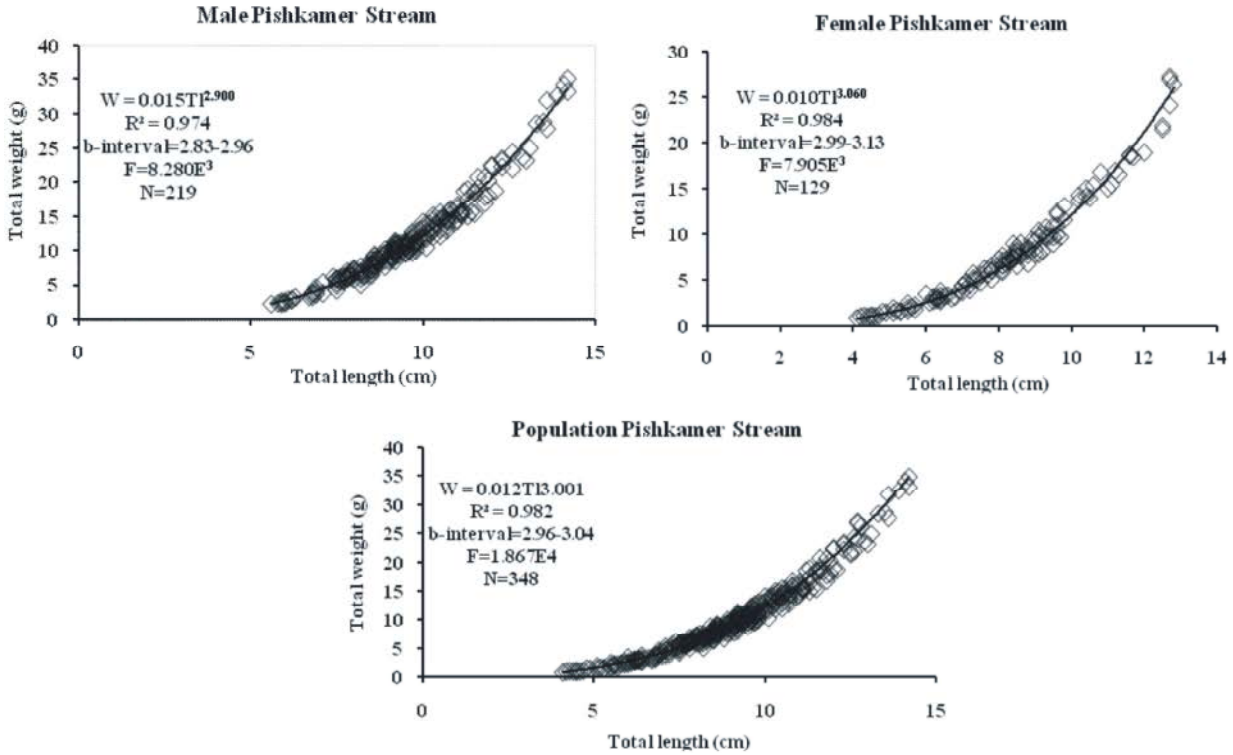

Fig. 2: Length-weight relationships of *C. c. gracilis* for males, females and population of the Pishkamer Stream

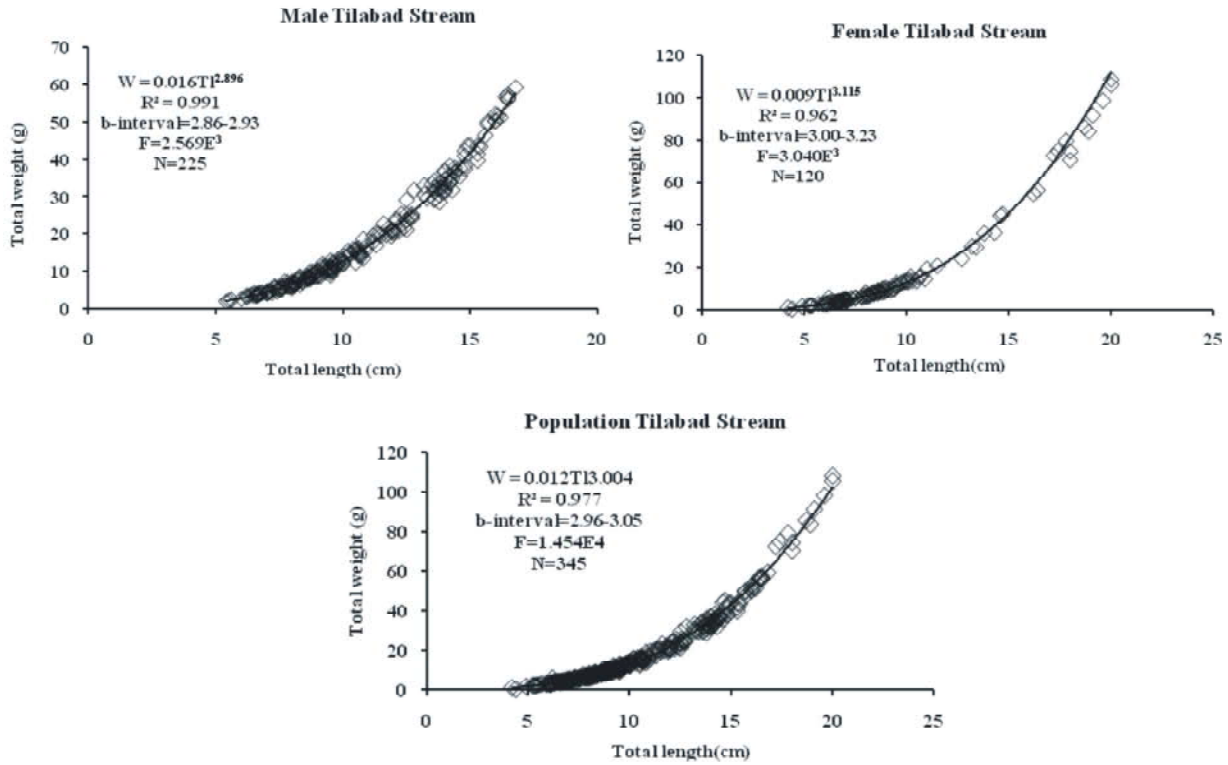

Fig. 3: Length-weight relationships of *C. c. gracilis* for males, females and population of the Tilabad Stream

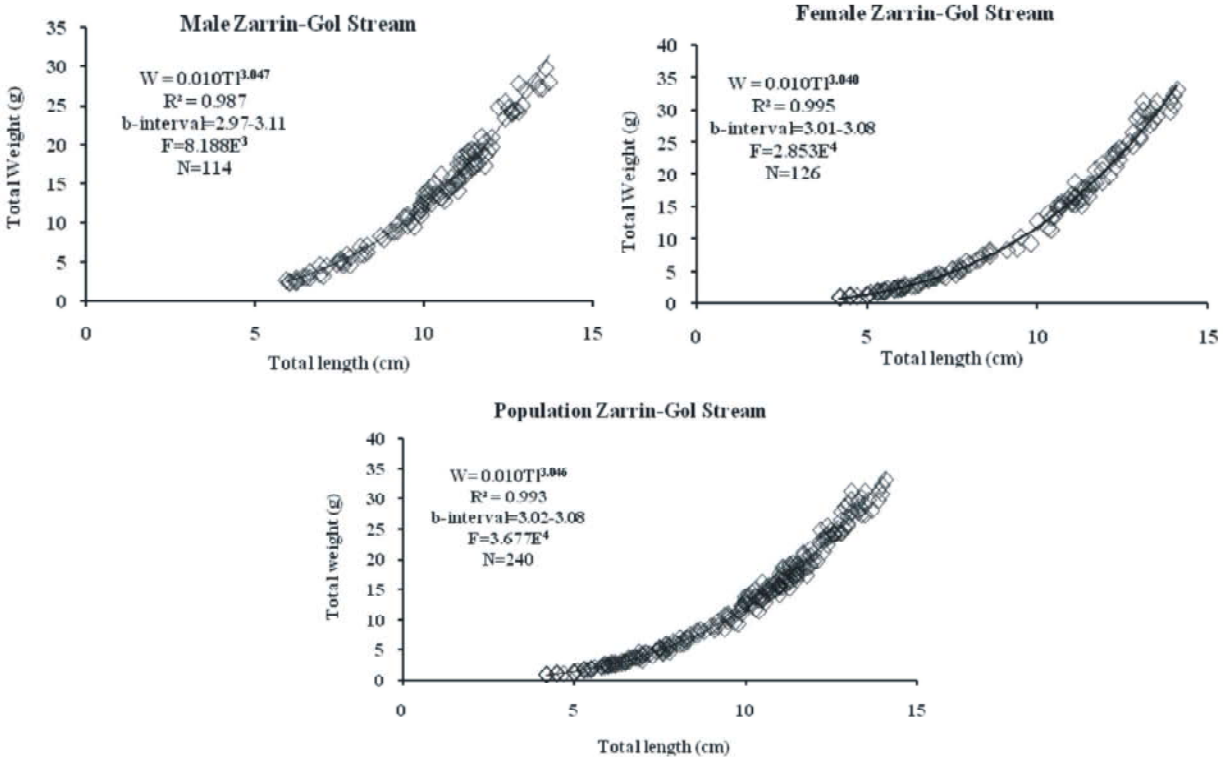

Fig. 4: Length-weight relationships of *C. c. gracilis* for males, females and population of the Zarrin-Gol Stream

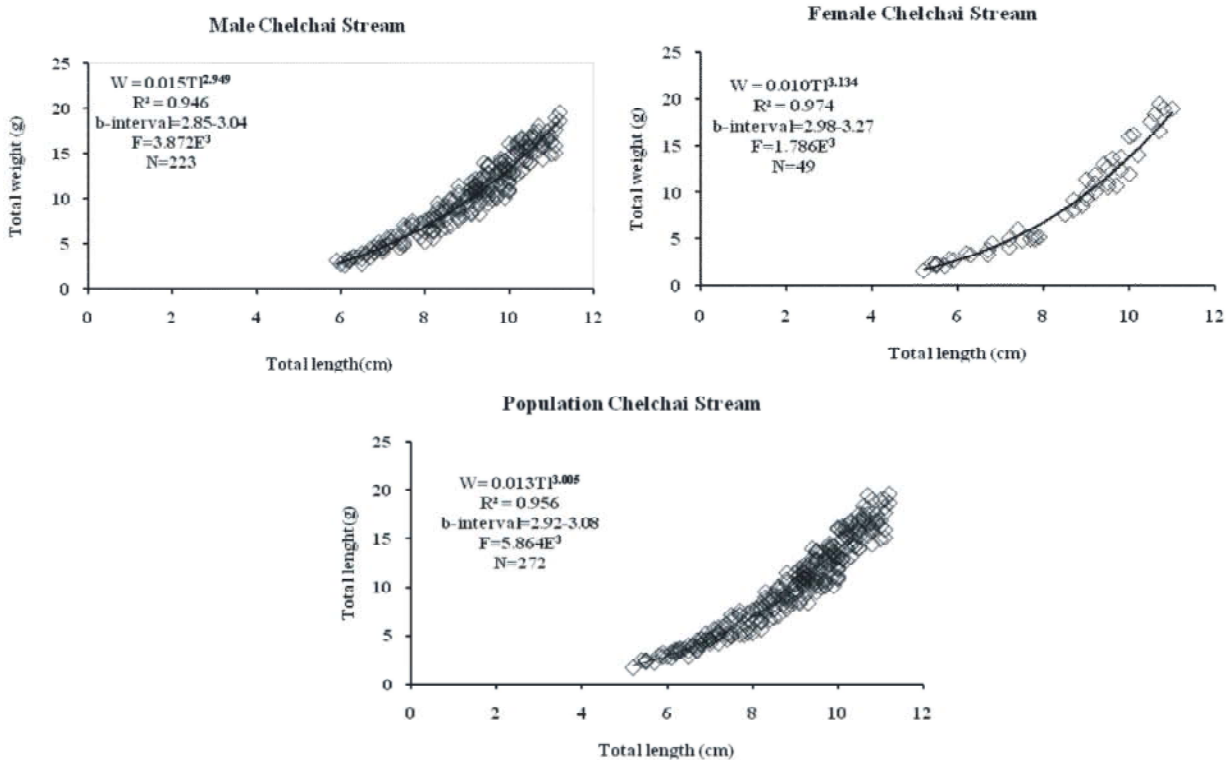

Fig. 5: Length-weight relationships of *C. c. gracilis* for males, females and population the Chelchai Stream

DISCUSSION

In the studied population, males were dominant in all streams the total sex ratio was 1.86:1. Rezaee *et al*. [8] reported sex ratio for *C. c. gracilis* 1.5:1 in Madarsoo stream. Abdoli *et al*. [9] reported sex ratio for *C. c. capoeta* 1:0.54 in Yasalegh Stream. Turkmen *et al*. [10] reported sex ratio for *C. c. umbla* 1.3:1 and explained the sex ratio changes during spawning. The males remain there longer or because the males shed mature sperm gradually.

Maximum and minimum total length and total weight were different from those reported earlier in the Gorganroud basin. Patimar *et al*. [11] reported maximum total length and total weight of *C. c. gracilis* were 25 cm and 194 g in Tilabad and Chelchai respectively and minimum total length and weight were 4.30 cm and 0.87 g in Chelchai Stream. It was reported that variations in fish growth in length and weight can be explained as an adaptive response to different environmental condition such as temperature and the quantity and quality of food [12] and fish growth is an indeterminate plastic process that can change considerably in response to environmental factors [13].

Abdoli *et al*. [9] reported *b*-value of the length-weight regression were not significantly different between sexes (*b*=3.052, males; *b*=3.050, females) and growth models of *C. c. capoeta* were isometric. Patimar *et al*. [11] reported all specimen of *C. c. gracilis* had negative allometric growth (*b*<3). The differences in growth model may have result from differences in the ecological conditions, such as water temperature, food availability flow. Moreover, parameters of the *LWR* relationship are influenced by many factors such as season, habitat, gonad maturity, diet and stomach fullness [14].

Comparing *b*-value between streams can aid in the identification of factors contributing to growth model of the populations. It causes a reflection in body. This reflects a change in body form with population. In this study there were different growth models between streams. This difference may be attributed to different types of habitats that differ in their general environmental conditions. The variation in the *b* exponent of *Capoeta capoeta gracilis* is interpreted as variation in growth pattern of fish. This variation suggests different growth strategies for the populations.

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