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ORIGINAL ARTICLE

Age structure and growth of *Cyprinion tenuiradius* (Heckel, 1843) (Cyprinidae), in southern Iran

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ABSTRACT
The age structure and growth of Cyprinion tenuiradius (Heckel, 1843), in the Dalaki river (Bushehr province in southern Iran) were studied in samples caught from May 2014 to September 2014. The maximum total lengths were 171 mm in females (168) and 188 mm in males (156). Age determination based on scale and opercle readings shows that the population has 4 age classes. The growth of both sexes was isometric (b= 2.89 males, b= 2.93 females). The highest growth rate was observed between age 1 and 2 in both sexes. Growth parameters of the von Bertalanffy equation were computed for females and males as: L_∞ = 164.14, W_∞ =117.11, t_0 = -1.16, K= 0.189 and L_∞=168.16, W_∞=116.28, t_0=-1.14, K= 0.213 respectively.
Keywords; *Growth, Dalaki, Cyprinion tenuiradius, Age*

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INTRODUCTION

Cyprinion tenuiradius is a Cypriniformes order and Cyprinidae family. This species of freshwater fish is bentho pelagic and semi-tropical and is considered as an important species of carp. This species of diet has omnivorous that is widely distributed in southern Iran in the basin of the Helleh River, Dalaki, Shirin Rood and... But in general, Cyprinion genus of Cyprinidae family is distributed only in Asia. This genus has nine species of which five species have been reported in Iran. Their habitats live in parts of the rivers that have sandstone bedding and with a water velocity of about 1 m/s and a depth of 0.5 to 1 meter in depth, and they can be spawn in April and May [1].

Length and weight data are useful and standard information of fis sampling programs[2]. Such data are essential for a wide number of studies, for example estimating growth rates, age structure and other aspects of fish population dynamics. Study of the size structure (length frequency) in riverine fish reveals many ecological and life-history traits such as the river health, stock conditions and breeding period of fish. The size structure of a fish population at any point in time van be considered a snapshot that reflects the interactions of the dynamic rates recruitment, growth and mortality [3]. From length frequency distributions of fish there are methods to determine the ages [4], which together with the weight and abundance (catch per unit effort, CPUE) give details of the different disturbance regime of the rivers, breeding ground and breeding seasons, the general health of the stock, density and the status of species. Therefore, the size structure analysis is one of the most commonly used fisheries assessment tools.The present paper describes the age structure and growth of the *Cyprinion tenuiradius* in the Dalaky River in the south of Iran. We could not find any paper dealing with the age structure and growth of this species in Iran for comparison.

MATERIAL AND METHODS

Study area

The study area is located in the Dalaki watershed basin in the south of Iran ($28^0$42'- $30^0$20'N, $50^0$35'- 52^0 10'E). This basin includes the Dalaki and Shapour rivers and also the closed sub-basins of Persian Gulf,

Dasht Arjan and Kemarej plains. Near Borazjan city, the Dalaki and Shapour rivers join together and form the Helleh river, which flows into ther Persian Gulf between Bushehr and Genaveh cities.The climate of the study area is dry-warm. The habitat of *Cyprinion tenuiradius* consists of rochy-sandy bed (figure 1).

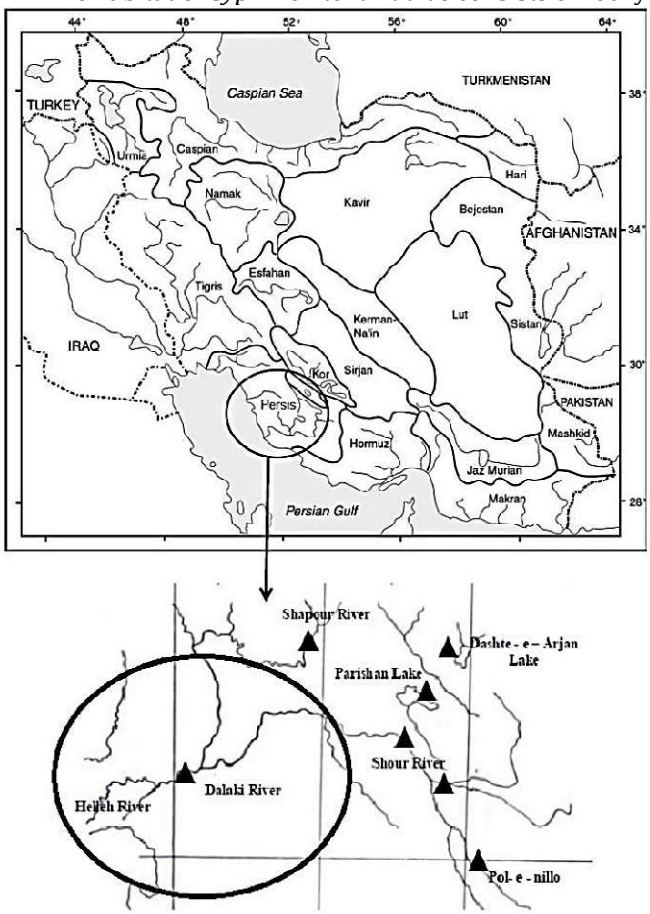

Figure 1; Geographical location of Dalaki rivers in the Persis basin of Bushehr Province

Methods

Sampling was carried out from May 2014 to September 2014 on every month. Samples were caught by gillnet (15m length and 2 m height) with 6,10,15 and 20mm mesh size, cast net with 10 mm mesh size. Samples were preserved in 10% formalin and were then transferred to the laboratory. In the laboratory each fish was measured and weighed to the nearest 1 mm and 0.01 g respectively.

To establish a length-weight relationship, the commonly used $w = aL^b$ was applied [5] where W = weight in grams, L = total length in mm and *a* and *b* are constants. The regression relation between length and weight was obtained by formula [4]: Ln W = Ln a + b Ln L. For age determination, the scale and opercle were used. Growth rings were read by microscope (X 40) and binocular (X10-20). The instantaneous growth rate was calculated by formula [4]: $G = \text{Log}(W_{(t+1)} / W_{(t)})$; $W_{(t)}$: Fish weight at age t, $W_{(t+1)}$: Fish weight at age t+1. We used von Bertalanffy growth curves to quantify growth patterns of females and males (Von Bertalanffy, 1938): $L_t = L\infty\ (1 - \exp\{-K\ [t - t_0]\})$. Where $L\infty$ is the theoretical asymptotic length, K is the body growth rate coefficient, and t_0 is the hypothetical length at age ziro [5]. We calculated von Bertalanffy curves using the age and length at captured speciemens.We also used the same function to estimate growth in weight: $W_t = W\infty\ (1 - \exp\{-K\ [t - t_0]\})^b$.

RESULTS

Five age classes, from 0 to 4, were determined by posterior body scale readings. Fish ranged in size from 30 to 171 mm total, weighing from 2 to 35 g total weight. The length of males ranged between 30 and 165 mm, and their weight between 3 and 32g. The length of females ranged between 35 and 170 mm, and their weight between 4 and 35 g. the averages are important, the ranges are less important. The length–weight relationship was calculated separately for both sexes and all fish (table 1). The exponent of the length–weight relationship was not significantly different between sexes (P> 0.05). An isometric growth

(based on Pauly test, 1984) between size and weight was observed for males, females and all individuals (table 1). The highest growth rate was observed between age 1 and 2 in both sexes (table 2).

Table 1; Length – weight relationship constants (a is the intercept, b the slope) for each sex and sexes combined

	a	b	S.E. (b)	R2	n	P=0.05
Males	0.0229	2.89	0.0113	0.97	332	P<0.05
Females	0.0221	2.93	0.0114	0.94	358	P<0.05
All fish	0.0223	2.91	0.01	0.93	785	P<0.05

Table 2; Instantaneous growth of the *Cyprinion tenuiradius* in the Dalaki and Helleh rivers.

Age classes	0-1	1-2	2-3	3-4
Males	-	0.52	0.47	0.34
Females	-	0.47	0.43	0.31
All fish	0.39	0.47	0.43	0.33

The oldest fish in this study was 4 years old, although such individuals were poorly represented. The Von Bertalanffy growth parameters calculated using the mean total length and total weight at ages were; Lt = 164.14[1-exp(-0.189(t+1.16))],Wt=117.11[1-exp(-0.189(t+1.16))]2.93 in females and Lt= 170.11[1-exp(-.213(t+1.12))] , Wt = 115.09 [1-exp (-.213 (t+1.12))]2.89 in males (table 3).

Table 3; Estimates of the von Bertalanffy growth parameters L∞, W∞, K and t0 for females, males and sexes combined of the *Cyprinion tenuiradius*

	L∞	W∞	K(yr-1)	t0(years)
Males	170.11	115.09	0.213	-1.12
Females	164.14	117.11	0.189	-1.16
All fish	168.16	116.28	0.198	-1.14

DISCUSSION

The cyprinids forms are very large and important family of fish and its members are distributed worldwide. The distribution areas of *Cyprinion tenuiradius* were reported as Iran, Iraq, Jordan and inland waters of Turkey [7, 8, 9, 10]. It is well known that sex ratio in the majority of species is close to one, but it varies considerably from species to species, differs from one population to another of the same species, and may vary from year to year in the same population [11]. In the present study, sex ratio was 1:0.92.. In early life stages, the rate of males was higher than that of females, but in later ages the rate of females was higher than that of males that is similar to other studies [12, 13].

The majority of samples in the population were in the first age group. Few studies have been carried out on the ecology and biology of the *Cyprinion tenuiradius* to be compared with this research, but some studies have been carried out on other species of Cyprinion such as *Cyprinion macrostomum* in the Dalaki River, that investigated length frequency distribution of this species [14, 15].

The oldest fish in this study was 4 years old, although such individuals were poorly represented (figure 2). The Von Bertalanffy growth curve indicated the females grew more rapidly than males (figure 3).This result is similar to other studies on other species [12, 16, 17]. Theoretical maximal length (170mm) and weight (117g) seem to be realistic scince the largest specimens sampled during the surveys were 164mm and 90g, respectively.

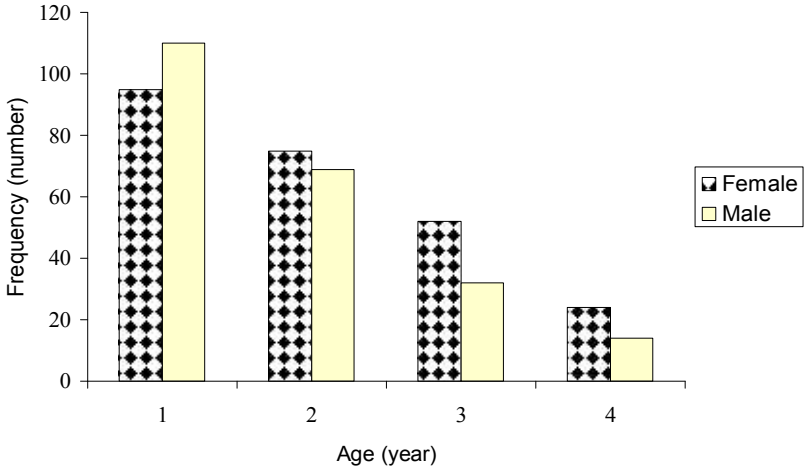

Figure 2; Age distribution of the *Cyprinion tenuiradius* from Dalaki River the two graphs should be combined to a single one

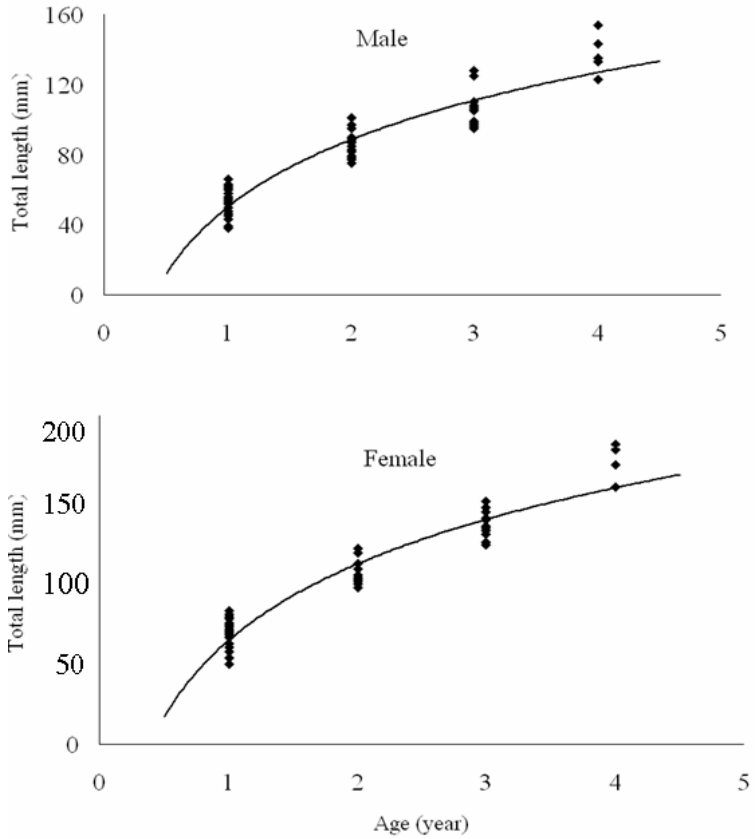

Figure 3; Von Bertalanffy length-at-age growth curves for male and female *Cyprinion tenuiradius* from Dalaki River

The growth of *Cyprinion tenuiradius* in Dalaki river is isometric (b=2.91) and female fish increase in weight at a more rapid rate than males (figure 4). The growth coefficient, K=0.198, indicates slow attainment of maximum size. Many factors, such as physicochemical and biological factors may affect the growth–rate in length and weight of fish directly or indirectly.

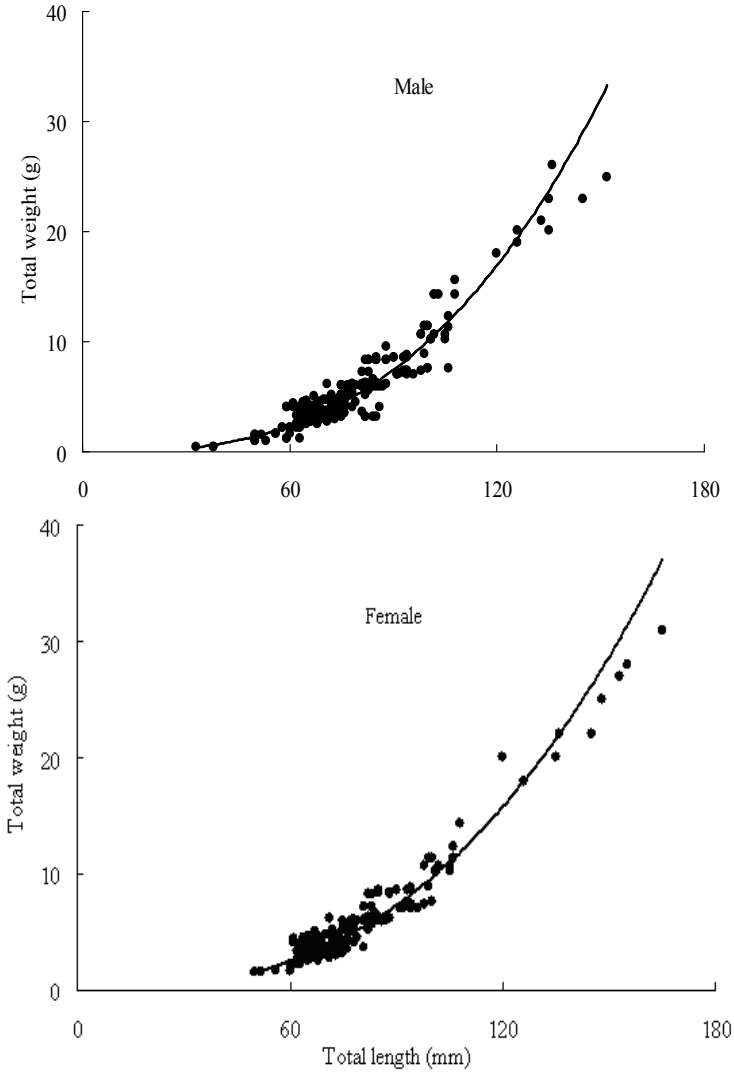

Figure 4; Relationship between total length (mm) and total weight (g) of tha *Cyprinion tenuiradius* from Dalaki River

Instantaneous growth rate also increased up to age 2 and then decreased with increasing age in both males and females. The instantaneous growth rate in females was more than that in males.

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