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Age and Growth Characteristics of Himri Barbel (*Barbus luteus* Heckel, 1843) in Orontes River, Turkey

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Abstract: In this study, the age and growth of Himri Barbel (*Barbus luteus* Heckel, 1843) were determined based on specimens collected from Orontes River-Turkey, during the period from February 2004 to January 2005. This population comprised 7 age groups of males and 9 of females. The male and female ratio was 1:1.26 (M:F). Total length-weight relationship was estimated as $W = 0.0129TL^{2.986}$ for females, $W = 0.0125TL^{3.003}$ for males. Growth parameters of the von Bertalanffy equation were computed for females and males as: $L_{\infty} = 38.77$, $W_{\infty} = 714.23$, $k = 0.300$, $t_0 = -1.69$ and $L_{\infty} = 40.32$, $W_{\infty} = 819.35$, $k = 0.247$, $t_0 = -1.58$, respectively. Maximum observed age was 9, suggesting that the species is long-lived.

Key Words: Himri Barbel, *Barbus luteus*, Age, Growth, Orontes River

Sarıbenli (*Barbus luteus* Heckel, 1843) Balığının Asi Nehrindeki (Türkiye) Yaş ve Büyüme Özellikleri

Özet: Bu çalışmada, Asi nehrinden avlanan Sarıbenli (*Barbus luteus*) balığının Şubat 2004 - Ocak 2005 tarihleri arasındaki yaş ve büyüme özellikleri belirlenmiştir. Populasyon, erkek bireylerde 7, dişi bireyler ise 9 yaş grubunu kapsamaktadır. Erkek-dişi birey oranı 1:1,26 (E:D) olarak bulunmuştur. Toplam boy-ağırlık ilişkisi dişiler için $W = 0,0129TL^{2,986}$, erkekler için ise $W = 0,0125TL^{3,003}$ denklemleriyle tahmin edilmiştir. Von Bertalanffy büyüme parametreleri dişilerde: $L_{\infty} = 38,77$, $W_{\infty} = 714,23$, $k=0,300$, $t_0 = -1,69$ ve erkeklerde $L_{\infty} = 40,32$, $W_{\infty} = 819,35$, $k = 0.247$, $t_0 = -1,58$ olarak tespit edilmiştir. Gözlenen en büyük yaş 9 olup, türün uzun yaşayan bir tür olduğu düşünülmektedir.

Anahtar Sözcükler: Sarıbenli, *Barbus luteus*, Yaş, Büyüme, Asi Nehri

Introduction

The Himri Barbel, *Barbus luteus* (Heckel, 1843), is a member of Cyprinidae and endemic to the Mesopotamian and Orontes River. It is also known as *Carasobarbus luteus* according to Karaman (1971) from the Euphrates in Turkey. This fish is highly valued as it is in high demand as food. A few studies have been carried out on the biology of this species in Iraqi (i.e. lower) part of Mesopotamia (Epler et al., 1996; Szypula et al., 2001;

Epler et al., 2001), in Syria (Al-Hazza, 2005), and in Turkey (Şevik and Hartavi, 1997; Bozkurt, 1998; Yalçın et al., 2004).

Overexploitation of natural stocks and the deteriorated environmental conditions have resulted in a marked decline of Himri Barbel in the wild population, so these kinds of investigations should be carried out periodically. The purpose of the present investigation was to determine seasonal changes in biological parameters in Himri in Orontes River.

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Materials and Methods

This study was performed in Orontes River, Turkey (Figure 1). Specimens (n = 431) were collected within the period from February 2004 to January 2005. Fish samples were caught by gill nets of 12-34 mm and by cast nets of 12-22 mm mesh sizes. The captured fish were transported in ice to the laboratory for analysis.

The samples obtained were measured to the nearest 0.1 cm total length (TL) and weighted to the nearest 0.1 g. The commonly used length-weight relationships $W = aL^b$ was applied (Ricker, 1975), where W is the weight (g), L the total length (cm), and a and b are constants. Differences of the slopes of the length-weight regressions between sexes were detected by analysis of covariance (ANCOVA). Growth was expressed in terms of the von Bertalanffy equation: $L_t = L_{\infty}[1 - \exp(-k(t-t_0))]$. The von Bertalanffy plots were used to estimate the growth

parameters (Sparre and Venema, 1992). We also used the same function to estimate growth in weight: $W_t = W_{\infty}[1 - \exp(-k(t-t_0))]^b$.

Age was determined by scale reading. Scales (10-25 scales) were removed by a lancet from the posterior part of the body (below rear dorsal fin base to lateral line) (Hussein, 1986), and cleaned in a 10% solution of NaOH. Since its spawning season ranges from May to July in the region (Yalçın et al., 2004), this period was assumed as birth day. Scales were examined under the reflected light of a binocular microscope (magnification 10 and 20) by 3 independent readers for corroboration. Sex in mature specimens was easily determined with naked eye, but microscopic examination was used for differentiating sex in juveniles. The sex ratio was tested by the chi-square test to indicate whether there was a deviation from a 1:1 ratio.

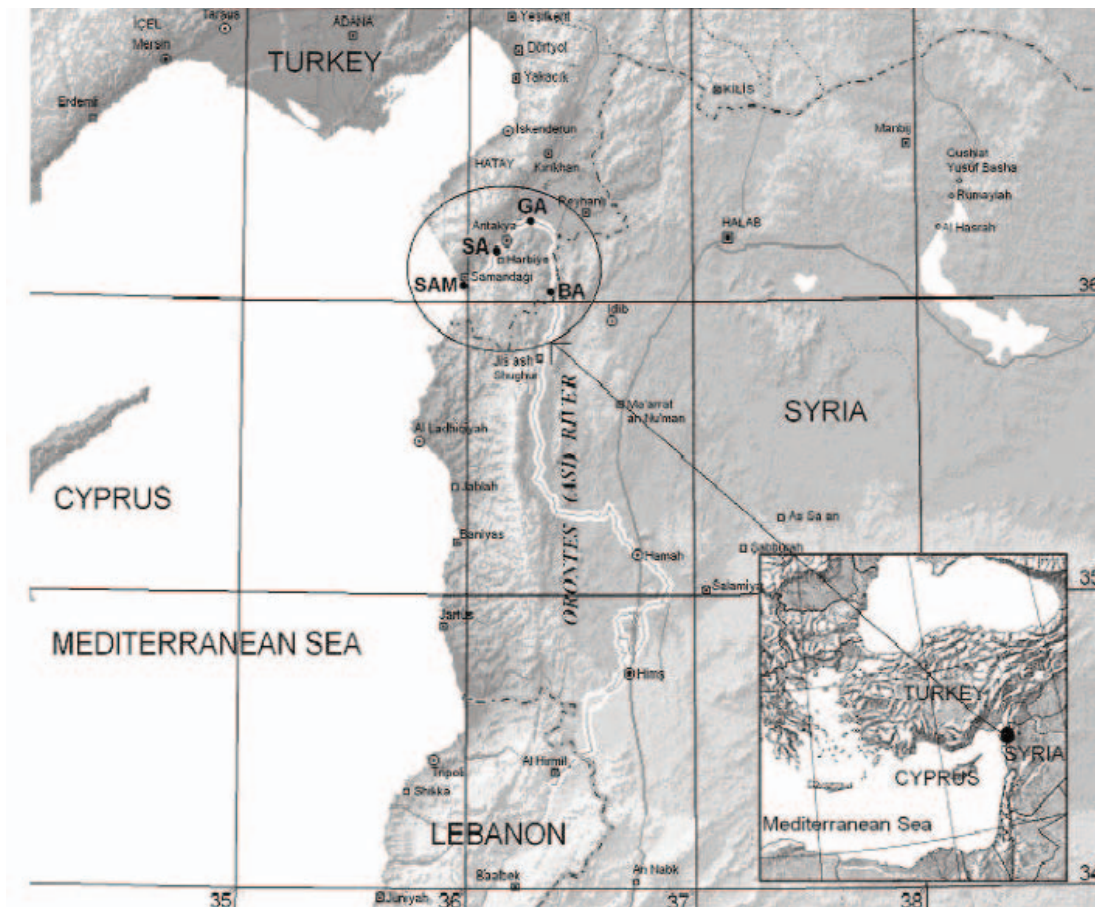


Figure 1. Map showing the study area.

Results

Age composition, sex distribution and growth

Nine age classes, from 1 to 9, were determined by posterior body scale readings. The age and sex distributions of examined samples and the age-length key for the Himri Barbel are given in Table 1 and 2. The third age group was dominant in the population. Modal age for all fish was 3 (34.65%), followed by 2 (27.85%), 4 (12.71%), 1 (12.06%), 5 (8.55%), 6 (1.75%), 7 (1.32%), 8 (0.66%), and 9 (0.4%). Since the mesh size was large (12-34 mm), the zero age group fish were not represented in the samples. The Himri Barbel can be considered as long-lived considering the oldest male was estimated to be 7 years old and the oldest female 9 years old. The growth curve fitted by length at the age data is given Figures 2, 3, and 4. The sex rate of the population was 1:1.26 (M:F).

Length-weight relationship

The length-weight relationship was calculated separately for both sexes and all fishes (Table 3). The exponent of the length-weight relationship was not significantly different between sexes ($P > 0.05$), neither was it significantly different from the value 3 ($P > 0.05$), and ranged between 2.986 (♀) and 3.003 (♂), which means an isometric growth pattern. Based on length-weight regressions, an average 15 cm TL male is 42.53 g, and for female it is 41.91 g.

The von Bertalanffy growth curves

The von Bertalanffy growth parameters calculated using the mean total length and total weight at ages were; $L_t = 38.77.[1-\exp(-0.300(t+1.69))]$, $W_t = 714.23.[1-\exp(-0.300(t+1.69))]^{2.986}$ in females and $L_t = 40.32.[1-\exp(-0.247(t+1.58))]$, $W_t = 819.35.[1-\exp(-0.247(t+1.58))]^{3.003}$ in males, respectively (Table 4).

Discussion and Conclusion

It is well known that the 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 (Nikolsky, 1963). 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. This situation was similar to that reported by Al-Hazza (2005). Generally, it is reported that in freshwater fish, the ability of hatching out for males is higher compared to females, but in upper age classes the rate of males is becoming lower and lower, and the rate of females becomes quiet dominant in a population (Yıldırım et al., 2002). The majority of samples in the population were in the third age group. This situation was also reported by Yalçın et al. (2004), which was observed in the same habitat in 1997.

Table 1. Age and sex distribution of *Barbus luteus* from Orontes River.

Age Groups	All Samples		Male		Female		P = 0.05
	N	N%	N	N%	N	N%	
I	49	11.37	17	8.90	32	13.33	P < 0.05
II	116	26.91	66	34.55	50	20.83	P < 0.05
III	151	35.03	77	40.31	74	30.83	P > 0.05
IV	57	13.23	22	11.52	35	14.58	P < 0.05
V	37	8.58	7	3.66	30	12.50	P < 0.05
VI	10	2.32	1	0.52	9	3.75	P < 0.05
VII	6	1.39	1	0.52	5	2.08	P < 0.05
VIII	3	0.70	-	-	3	1.25	-
IX	2	0.46	-	-	2	0.83	-
All Groups	431	100	191	44.32	240	55.68	

Table 2. Age-length key for Himri Barbel in Orontes River based on the scale readings.

Length group (TL,cm)	Age (Years)									Total
	I	II	III	IV	V	VI	VII	VIII	IX	
7.5 - 8.4	1									1
8.5 - 9.4										-
9.5 - 10.4	2									2
10.5 - 11.4	10									10
11.5 - 12.4	18									18
12.5 - 13.4	15	5								20
13.5 - 14.4	6	23								29
14.5 - 15.4	3	22								25
15.5 - 16.4		17	9							26
16.5 - 17.4		19	19							38
17.5 - 18.4		18	8							26
18.5 - 19.4		13	19	2						34
19.5 - 20.4		5	25							30
20.5 - 21.4		4	21	1						26
21.5 - 22.4		1	14	15						30
22.5 - 23.4			20	4						24
23.5 - 24.4			15	12	1					28
24.5 - 25.4			3	10	6					19
25.5 - 26.4			5	10	8					23
26.5 - 27.4				2	11					13
27.5 - 28.4				1	9					10
28.5 - 29.4						4				4
29.5 - 30.4				1	1	2	3	1		8
30.5 - 31.4					1	1	1			3
31.5 - 32.4					1					1
32.5 - 33.4					1	1			1	3
33.5 - 34.4										-
34.5 - 35.4							1			1
35.5 - 36.4								1		1
36.5 - 37.4								1		1
37.5 - 38.4							1		1	2
Total(<i>n</i>)	55	127	158	58	39	8	6	3	2	456
%	12.06	27.85	34.65	12.71	8.55	1.75	1.32	0.66	0.44	100

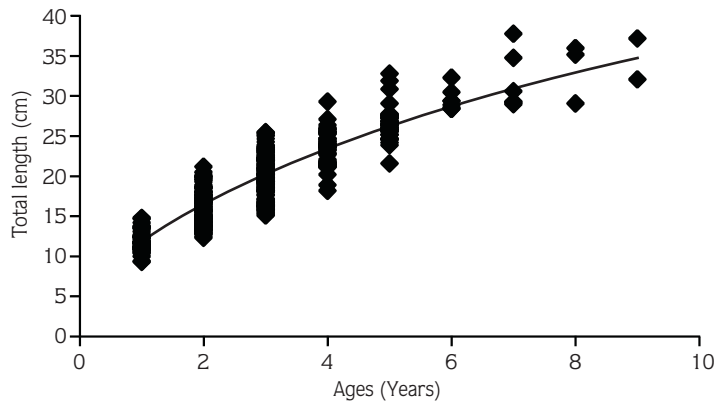


Figure 2. The von Bertalanffy growth curve for all fish fitted by length at age data.

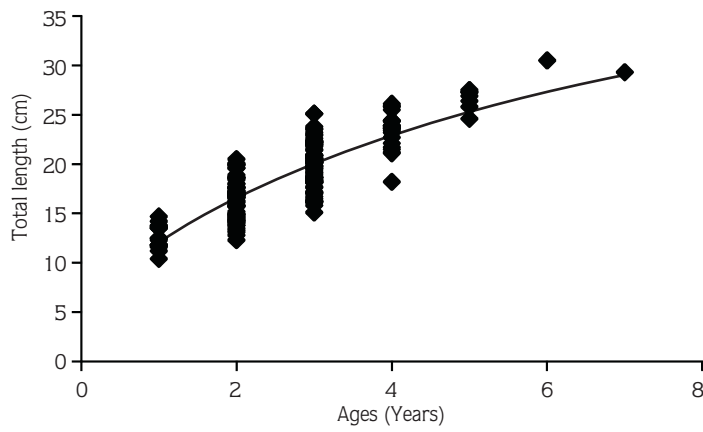


Figure 3. The von Bertalanffy growth curve for males fitted by length at age data.

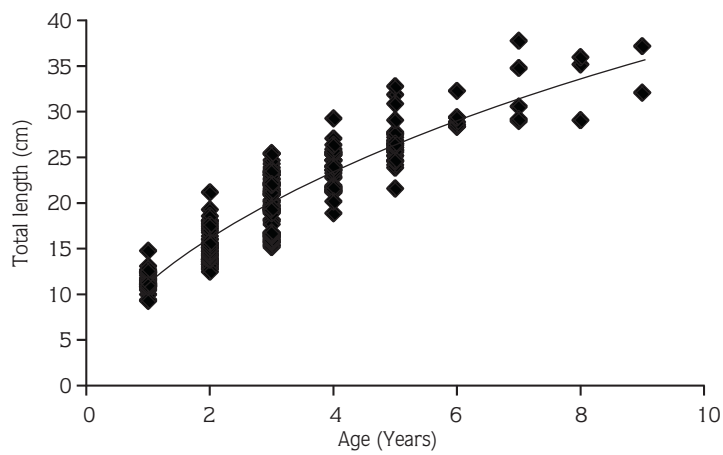


Figure 4. The von Bertalanffy growth curve for females fitted by length at age data.

Table 3. Length-weight relationship constants (*a* is the intercept, *b* the slope) for each sex and sexes combined.

	n ^a	<i>a</i>	<i>b</i>	S.E.(<i>b</i>)	R ²	P = 0.05
Females	240	0.0129	2.986	0.0147	0.992	P < 0.05
Males	191	0.0125	3.003	0.0120	0.975	P < 0.05
All Fish	431	0.0129	2.988	0.0176	0.986	P < 0.05

n^a: Number of speciesTable 4. Estimates of the von Bertalanffy growth parameters L_{∞} , W_{∞} , k , and t_0 for females, males, and sexes combined of the Himri Barbel.

	L_{∞}	W_{∞}	$k(\text{yr}^{-1})$	$t_0(\text{years})$
Females	38.77	714.23	0.300	-1.69
Males	40.32	819.35	0.247	-1.58
All Fish	39.32	750.40	0.282	-1.64

Compared to other *Barbus* species from the same basin, the Himri Barbel is smaller than *B. plebejus* (Ünlü et al., 1990; Yıldırım et al., 2002), *B. grypus*, and *B. xanthopterus*, but similar to *B. sharpeyi* (Szygula et al., 2001). The slopes of the length-weight regression lines were similar in males (3.003) and females (2.986). This value ranges between 2.5 and 3.5 according to species, sex, age, sexual maturity of fish, season and fish feeding (Ricker, 1975). Additionally, changes in weight are relatively greater than changes in length, due to the approximately cubic relationship between length and weight.

Theoretical maximal length (39.32 cm) and weight (750.40 g) seem to be realistic, since the largest

specimens sampled during the surveys were 37.20 cm and 674.17 g, respectively. These parameters were different from the findings of Al-Hazza (2005) who reported the asymptotic length-weight for *B. luteus* as $L_{\infty} = 56.92$ cm and $W_{\infty} = 1395.36$ g. Differences noted in growth may be attributed to variation in habitat, temperature, and possibly, differences in feeding habits (Yıldırım et al., 2002). This may be occurred due to the overexploitation of natural stocks by over fishing and the deteriorated environmental conditions.

The growth of Himri Barbel in Orontes River is isometric ($b = 2.988$) and male fish increase in weight at a more rapid rate than females (Table 2), similar to those inhabiting Eupharate River in Syria (Al-Hazza, 2005).

The growth coefficient, $k = 0.282$, indicates slow attainment of maximum size. The estimated k -value (0.110 yr^{-1}) for *B. luteus* from Syria (Al-Hazza, 2005) appears to be low, because of the high asymptotic calculated length of their data.

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