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Age and Growth of Kutum, *Rutilus frisii kutum* (Kamenskii 1901) in Tajan River (Southern Caspian Sea to Iran)

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Abstract: Age and growth of the Caspian Kutum, *Rutilus frisii kutum* were studied. In this study, 200 specimens (100 Females and 100 males) were collected using a gill and seine nets from March to May 2011 in Tajan River. Total length ranged from 37.1 to 54.7 cm and weights from 400 g to 1658.66 g. Age determination based on scale readings, showed that the population was composed of five age-groups. The highest and lowest age groups were 3^+ (57.4%) and 1^+ age groups (0%) in females and 2^+ (42.84%) and 6^+ (0%) in males. Instantaneous growth of the fish at the 3^+- 4^+ age groups were very much lower than the younger age groups. Length-weight relationship showed positive allometric for males as $W=0.0000005\times L^{3.47}$ ($R^2=0.97$) and a negative allometry model for female as $W=0.00005\times L^{2.73}$ ($R^2=0.93$).

Key words: Age · Growth · *Rutilus frisii kutum* · Caspian Sea

INTRODUCTION

The Caspian Sea is the largest inland water bodies with no connection to other seas and oceans. Bony fishes have been caught in the Iranian coastal waters of the Caspian Sea since 1927. In March and April, *Rutilus frisii kutum* species migrate from Iranian waters (southern part of Caspian Sea) into estuaries and rivers for spawning. This species has a life span of 9-10 years in southern part of Caspian Sea with males and females attaining sexual maturity between 2-3 and 3-4 years, respectively [1, 2]. Caspian Kutum constituted about 78% of bony fish harvest and about 76.6% of the whole income of fishermen in the 2008-2009 fishing season in the southern part of Caspian Sea [3]. Since 1982 due to reducing Caspian Kutum population and in order to restock this valuable species in Caspian Sea, Iranian Fisheries Organization (IFO) has been annually releasing up to 200 million fry (average weight, 1 g) into the rivers and estuaries that discharged into southern part of Caspian Sea [4].

This species is normally a medium-sized fish, typically reaching 45-70 cm in length, weighing up to 5 kg. It was once common and harvested commercially [5]. *R. f. kutum* is a short lived fast growing species. However, a decrease in catch resulted in the establishment of an artificial breeding program for restocking and enhancement of the stock.

Despite the economical and ecological importance of *R. f. kutum* in the Caspian Sea, there is little information available regarding its age and growth in the Caspian Sea. Such information is especially important because of the ecological changes that are occurring in the sea at present due to the appearance of *Mnemiopsis leidyi* in 1999 [6], as well as *R. f. kutum* artificial breeding. The aim of present study, to determine of population structure, age and growth of *R. f. kutum* in Tajan River discharged into southern part of Caspian Sea.

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Fig. 1: Map of the Iranian waters of the Caspian Sea, showing the fishing area

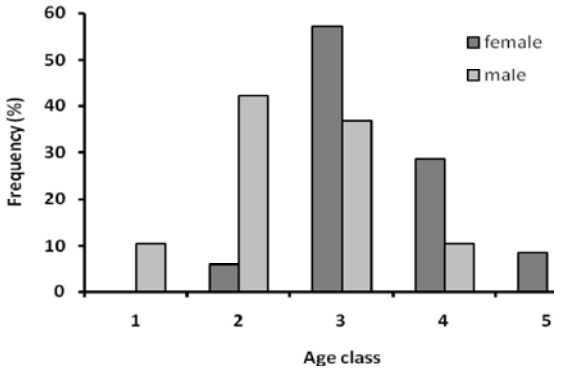

Fig. 2: Age class frequency in R. *f. kutum* in Southern part of Caspian Sea

MATERIALS AND METHODS

200 specimens (100 Females and 100 males) were collected from March to May 2011 in Tajan River from the southern part of the Iranian waters of the Caspian Sea (Figure 1). The trade catches of bony fish is commenced at this time of the year. Fresh samples of *R. f. kutum* were collected using a gill and seine nets (with a mesh size length 22mm).

Total length of captured fish was measured to the nearest 0.01 cm and weighted to the nearest 0.01 g [7].

Age was determined using scale reading [2]. Scales were taken from the middle of the body, behind the pectoral fins and above the lateral line. They were then placed in labeled envelopes and returned to the laboratories for reading and analysis. The scales were washed and placed in small covered Petri dishes with tap water. Then, the organic layers of scales were removed by rubbing and washing in tap water [8].

The relationship between length and weight was calculated using the exponential regression: $W= a\times L^b$ [9],where W is the total weight (g), L is the Total length (cm); a is the regression constant (intercept) and b is the regression coefficient (slope) that it is usually between 2 and 4.

The Fulton condition factor (CF) was determined for each fish using the following equation: $CF= (W/L^3) \times 100$ [7], where W is the total fish weight (g), L is the Total length (cm). The Instantaneous growth rate (G) was using the following equation:

$$G = \frac{\ln W_{(t+1)} - \ln W_{(t)}}{\Delta t} \qquad [10]$$

Where G: is natural logarithm of final weight to initial weight of the fish per unit of time.

The growth pattern (t) was using the following equation:

$$t = \frac{sd \ln L}{sd \ln W} * \frac{|b-3|}{\sqrt{1-r^2}} * \sqrt{n-2} \qquad [11]$$

Where Sd Lnx is standard deviation of the length natural logarithm (cm), Sd LnW is standard deviation of the natural logarithm weight (g), b is curve slope of the relationship between length and weight, R^2 is regression coefficient between length and weight and n is number of samples.

Data were statistically analyzed by Student test at α = 0.05 coefficient level, by SPSS16 software.

RESULTS

Age: Age determination, based on scale readings, showed that the population was composed of five age-groups. The highest and lowest age groups were 3^+ (57.4%) and 1^+ age groups (0%) in females and 2^+ (42.84%) and 6^+ (0%) in males (Figure 2).

Length and Weight Relationship: 200 specimens of *R. f. kutum* were totally collected and used for this study.100 of specimens were males and 100 were females. The sex ratio (males: females) in this study was 1:1. Total length and weight ranged from 42 to 54.7 cm and weights from 757:1658.66 g, respectively for females and from 37.1 to 51.7 cm and 400:1251 g for males (Table 1). A significant difference was found in the length and weight relationship between males and females in various months ($P<0.05$).

For both sexes of all individuals, the relationship between total length and body weight was described as: W = 0.00005 TL 2.73 (r 2 = 0.93, n = 100), for females and W= 0.0000005TL3.47 (r2= 0.97, n= 100) and for males

Table 1: Mean Total length (cm) and weight (g) for both sexes of *Rutilus frisii kutum* in Tajan River(southern Caspian Sea Iran)

		Age groups				
Sex		2^+	3^+	4^+	5^+	6^+
Female	TL(cm)	-	42.6	48.0	50.6	54.7
	W(g)	-	757	1062.6	1287.8	1658.66
Male	TL(cm)	37.1	44.1	44.4	51.7	-
	W(g)	400	756.12	788.28	1251	-

Table 2: Mean condition factor (CF), regression coefficient (r2), growth pattern (t) and parameters estimated for the linear relationship weight-length of *Rutilus frisii kutum* in Tajan River (southern Caspian Sea Iran)

			Parameters estimated		
Sex	CF	t	R^2	b	Log a
Famele	1.76	2.07	0.93	2.73	-9.90
Male	0.47	2.76	0.97	3.47	-14.53
Total	0.97	1.76	0.94	3.34	-13.71

Table 3: Instantaneous growth of *Rutilus frisii kutum* in Tajan River (Southern Caspian Sea to Iran)

Age	2^+-3^+	3^+-4^+	4^+-5^+	5^+-6^+
Female	----	0.339	0.192	0.253
Males	0.647	0.041	0.462	----
Total	0.637	0.202	0.316	0.267

(Table 2). There was significant difference between sexes in the slopes (b) of length–weight relationship ($P < 0.05$) We determined a positive allometry model in length-weight relationship for males and a negative allometry model for female.

Instantaneous Growth: Instantaneous growth of the fish at the 3^+-4^+ age groups were very much lower the than the younger age groups (Table 3).

DISCUSSION

In the present study, the TL for *Rutilus frisii kutum* ranged from 37.1 to 54.7 cm; the male's range was smaller than females. This difference could be attributed to variation in the ontogenetic development stages, as well as condition and maturity differences between sexes.

The relationship between total length and body weight was calculated for each sex. Values of the positive allometric coefficient (*b*) were 2.73 and 3.47 for females and males, respectively. In contrast, Belyaeva *et al*. [12] in former USSR (Union of Soviet Socialist Republic) reported a lower exponent of the Von Bertalanffy equation ($b = 2.98$) in one specimen of kutum (*R. frisii*). It is thus difficult to compare the values of previous studies with those in the literature, as the recent reported data are insufficient, especially new data in the southern part of the Caspian Sea.

Difference in length and age can vary with geographical location that is probably related to factors such as climate, trophic status and diet and exploitation. In our study, maximum total length and weight of *R. f. kutum* obtained 54.7 cm and 1658.66 g with age 6 years old. In contrast, Koliev [13] reported that the total length group and weight of 34-55cm and 658-2920 g of kutum for Kyzylagchskii Bay. At the present study, there was a decrease in total length and weight of *R. f. kutum* after three decades because all the fish were less than 60 cm. Ferid-Pak [14] noted that the length and weight of *R. f. kutum* of 67 cm and 7 kg for southern part of the Caspian Sea. This could be related to destruction of natural habitats, unsuccessful natural breeding, fishing pressure and artificial breeding. Valiopour and Khanipour [5] reported that an artificial breeding program was taken into account for several reasons including a decrease in catch during the 1960s and 1970s due to over fishing, loss of natural spawning grounds and environmental pollution. Similar reasons were observed in the present study. Difference in length-at age and growth were observed between the males and females of *R. f. kutum* in the southern Caspian Sea. Female fish often attain greater size than males, usually through a faster growth rate [15]. Subsequently, growth rate (length and weight) in females and males trended to decrease and the growth rate differed significantly between sexes. Male *R. f. kutum* grows fast in the third year of the life but, after that, grows more slowly than females [16].

Several factors might be responsible for this growth different between males and females, for example, physiological changes influenced by temperature changes, feeding regimes and productive cycles [17]. Hong-Jing and Cong-Xin [18], reported that there are several factors affecting growth rate such as shortage of food, deprivation cased by migration and changes of temperatures. In conclusion, our results showed that *R. f. kutum* in the southern Caspian Sea have a fast growth rate. This could be due to available food resources, sufficient temperature, salinity particularly brackish-water and freshwater in the southern coastal of the Caspian Sea.

The finding on age and growth of *R. f. kutum* from this research will help to elucidate the distribution with age of fish and their sustainable management.

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