

Some Biological Aspects of the Bleak, *Alburnus mossulensis* in the Southern Reaches of Euphrates River, Iraq

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ABSTRACT-- Occurrence, length-weight relationship, age, growth, sex ratios, size at first maturity, GSI and fecundity of *Alburnus mossulensis* caught from the south reaches of Euphrate river in Iraq were investigated. Fish were collected monthly from November 2013 and October 2014 using electrofishing. The species constituted 48.3% of the total catch. Fish lengths of 7.0 to 12.0 cm dominated the population. Total length–weight relationship was found to be $W = 0.003 L^{3.087}$ for immature, $W = 0.004 L^{3.027}$ for males and $W = 0.002 L^{3.193}$ for females. The mean relative condition factor was 1.05 for immature, 0.99 for male and 1.06 for female. Reading of scales indicated that the maximum age was four years. The von Bertalanffy growth equation was $L_t = 20.4(1 - e^{-0.35(t+0.277)})$. Sex ratio was 1:1.7 male to female. The mean value of L_{m50} was 8.0cm for both sexes. The peak of GSI was in January for both sexes. The spawning period began in February. Absolute fecundity for *A. mossulensis* varied from 1119 to 5022 eggs.

Keywords-- Bleak, growth, condition, reproduction, Euphrates River

1. INTRODUCTION

The bleak, *Alburnus mossulensis* Heckel, 1843, locally known as “Semnan tuyel” in Iraq, a cyprinid that is endemic and widely distributed in the Tigris-Euphrates basin in Turkey and Iraq, and their adjacent basins in Iran [1, 2, 3]. *A. mossulensis* may be a synonym of *Alburnus sellal* (or *Chalcalburnus sellal*) which is found in the Orontes and Quwaiq river basins, therefore the species was identified incorrectly as *A. sellal* in Iraq [2]. It is found widely from the Shatt al Arab River and its tributaries, the southern marshes, rivers such as the Tigris, Euphrates, Diyala, Little Zab, Great Zab, Rawanduz as well as smaller rivers and streams, lakes such as Tharthar, Habbaniyah and Razzazah, and reservoirs such as Al Haditha Dam Lake on the Euphrates River, Iraq [4, 2].

Epler *et al.* [5] found it to be the second most dominant species of fish (identified as *Alburnus sheitan*) in lakes Habbaniyah, Tharthar and Razzazah, comprising 10% of all fish collected. The species formed 4.9, 4.5 and 10.7% from the total populations of Al-Hawizeh, Chybayish and East Hammar marshes, respectively [6, 7, 8]. Although this species has not economical value as commercial fish, it is consumed as food by local people.

The perusal of literature indicate that lots of work has been done on the length weight relationship, age, growth and reproduction of *A. mossulensis* at various waters, in Turkey [9, 10, 11, 12] and in Iran [13, 14, 15]. A few studies have been carried out on the biology of this species in Iraqi [16, 17, 18], but no work has been done on the biology of this species in the Euphrates River.

The present study aims to determine the occurrence, length- weight relationship, condition factor, age, growth pattern and reproduction of *A. mossulensis* in southern Euphrates River from November 2013 to October 2014.

2. MATERIALS AND METHODS

The study area is located in the lower reaches of the Euphrates River, and more specifically, in the Chybaish region, eastern Al- Nasiriyah Province, Iraq (Fig. 1). Fish sampling was carried out using boat electrofishing (D.C. at 300–400 V, 3–5 A) from the Euphrates River (30°56', 30°57' N; 47°05', 48°00'E), the width of the river in this region is 750m and 2–4m deep, and from the Umbazona branch, which is one of the branches of the Euphrates River were built to feed the Chybaish marsh. The Umbazona branch is approximately 1.5km long, 6m wide and 2m deep in the mid-section. The relative abundance (%) of the species was calculated from the equation: $ni/N * 100$ [19], where, ni = number of individuals of the species and N = total fish catch.

Specimens were immediately transported to the laboratory on crushed ice for subsequent analysis. Total length and total weight were measured for each fish to the nearest 0.1 cm, and 0.01 g, respectively. Five to ten scales were extracted from the left side of each fish between the lateral line and the dorsal fin base and stored in labeled envelopes. Scales were cleaned with warm water and placed between two glass slides [20].

The regression equation for the length–weight relationship was calculated separately for immature, males and females using the exponential regression: $W = a L^b$ [21], where W is the total weight (g), L is the total length (cm), a is the intercept of the regression and b is the regression coefficient (slope). Deviation of the allometric coefficient b from the theoretical value of isometric growth ($b = 3$) was tested with Student's t -test. The relative condition factor (K_n) was determined in terms of sex and months using the following formula: $K_n = W'/W$ [21], where W' = the observed weight and W = the calculated weight.

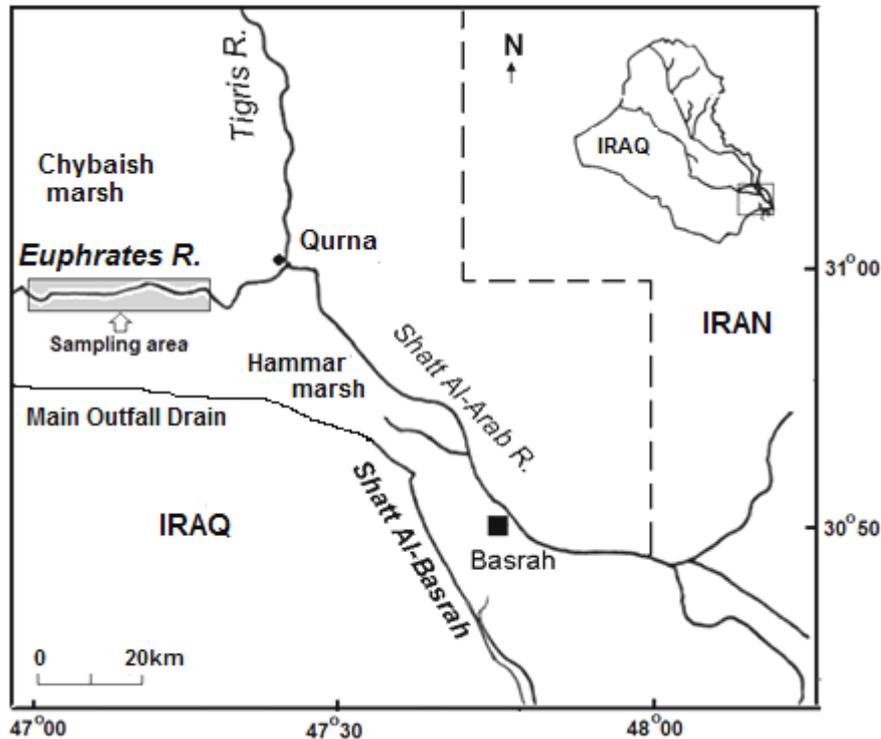


Figure (1): Map of southern of Iraq, showing the location of sampling area

Scale reading was carried out using Projectina microscope (Type 4014 BK-2) with a magnification of 10x. From the magnified image, the radius of each annulus and the edge of the scale were measured. The relationship between length of fish on capture (L) and scale radius (S) was calculated from the equation: $L = a + b S$ [22], where a is the intercept (the correction factor) and b is the slope of the regression line. Total length at age was determined using the following equation [22]: $L_n = a + S_n/S (L - a)$, where L_n is the length of the fish at age 'n', a is the correction factor, S_n is the radius of the annulus 'n', S the scale radius and L is the length at the time of capture.

The theoretical growth in length was analyzed by means of the von Bertalanffy equation: $L_t = L_\infty (1 - e^{-K(t - t_0)})$, where L_t is the fish length at age t , L_∞ is the asymptotic fish length, K is the growth coefficient and t_0 is the theoretical age when the fish was at zero length. The equation parameters were estimated following the graphic method [23]. The parameter (ϕ), the growth performance index, was calculated as $\log_{10} K + 2 \log_{10} L_\infty$ [24].

Sex in mature specimens was easily determined with naked eye, but microscopic examination was used for differentiating sex in immature fish after dissection the fish. The Chi-squared test was used to show whether the sex proportions deviated significantly from 1:1 ratio. The mean size at first maturity was taken as that at which 50% of individuals were mature. The gonado-somatic index (GSI) for each sex was calculated using the equation [25]:

$$GSI = \text{Weight of gonad} / \text{Total body weight} \times 100$$

Ovaries selected from 20 ripe females of the different length groups were weighed to the nearest 0.01 g and placed in Gilson's fluid to calculate total fecundity using the gravimetric method [26]. Regression between fecundity and total length was calculated from the formula: $F = aL^b$, where F is the fecundity, L is the total length (cm), a is the intercept and b is the slope of the regression line.

Statistical analyses were carried out with SPSS 13 software package and a significance level of 0.05 was adopted.

3. RESULTS

3.1 Relative abundance

The relative abundance of *A. mossulensis* was fluctuated from 23.9% in November to 80.4% in July (Fig. 2), with an overall value being 48.3% of the total catch. *A. mossulensis* was the dominant species in the study region for five months, February, May, July, August and October.

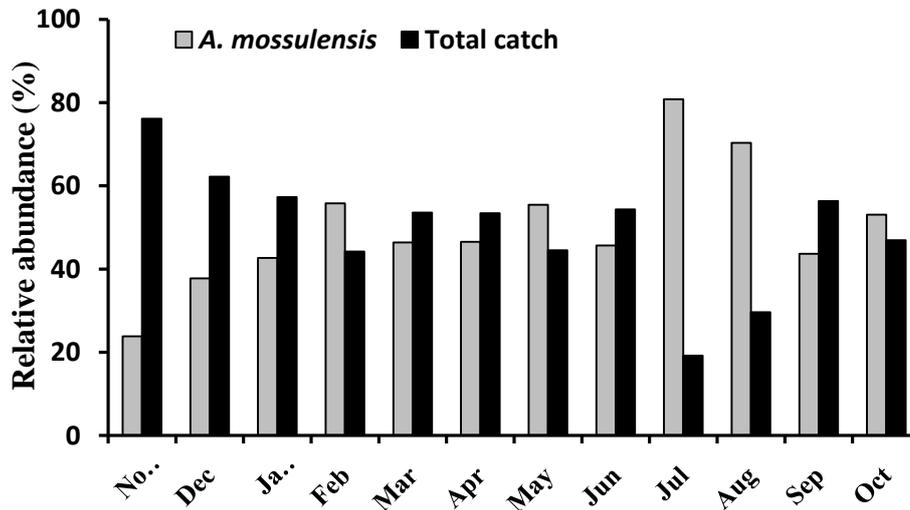


Figure (2): The relative abundance of *A. mossulensis* in Euphrates River

3.2 Length frequency distribution

The length-frequency distribution of 2307 individuals of *A. mossulensis* which ranged from 3.7 to 18.4 cm is presented in Figure 3. The smallest fish caught in May and the largest one in April. The length group of 9.0 cm was prevailing and formed 19.7%, followed by the length group of 10.0 cm, comprising 18.7% of the total catch. The fish at length groups 7.0 to 12.0 cm formed 85.6% of the total catch.

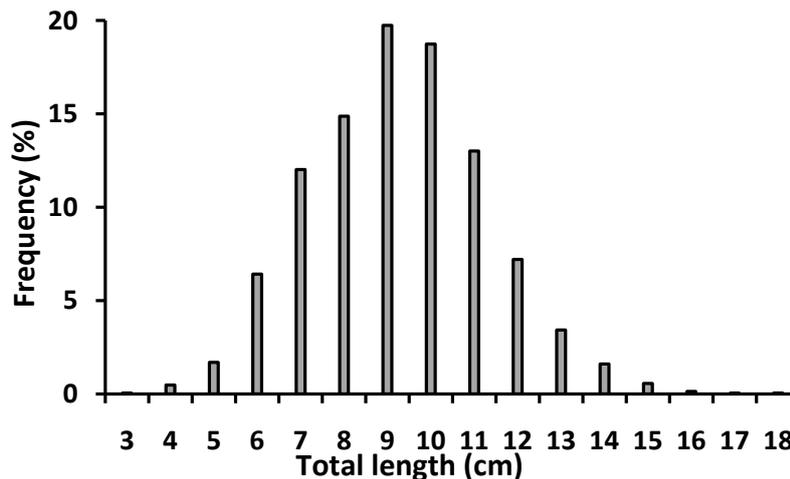


Figure (3): The overall length frequency of *A. mossulensis* in Euphrates River

3.3 Length-weight relationship and condition factor

Analysis of covariance showed that there was a significant difference in the regressions between immature fish and females of *A. mossulensis* ($t= 3.69, P<0.05$) and between the mature sexes ($t= 7.92, P<0.05$), but no significant difference was detected between immature fish and males ($t= 1.89, P<0.05$). Therefore, the length-weight relationships were calculated separately and represented with the following equations (Fig. 4): $W = 0.003 L^{3.087}$ ($r^2 = 0.776$) for immature, $W = 0.004 L^{3.027}$ ($r^2 = 0.778$) for males and $W = 0.002 L^{3.193}$ ($r^2 = 0.841$) for females. No statistical significant

differences were detected between the slopes of the regression equations for immature and males from the value 3.0 ($t=0.49$ and 0.20 respectively, $P> 0.05$), whereas for females was significantly different from 3.0 ($t= 2.23$, $P< 0.05$).

The relative condition factor (K_n) for immature fish was ranged from 0.71 in June to 1.44 in February, for males from 0.70 in August to 1.24 in January and for females from 0.78 in August to 1.44 in January (Fig. 5). The overall mean values of the relative condition factor for immature, males and females were 1.05, 0.99 and 1.06 respectively.

3.4 Age and Growth

The estimated age from scales ranged from 1 to 4 years, with most specimens in age two. The scatter diagram denotes the straight - line relationship between fish length and scale length. The relationship was expressed as: $L = 2.549 + 4.825S$. The linear agreement of the relationship was supported by high coefficient correlation ($r^2= 0.910$).

Table 1 represents the average length of *A. mossulensis* at each annulus as determined by back calculation of lengths from the fish of different ages. The mean lengths so estimated at ages 1 to 4 year were found to be 8.0, 11.2, 13.7 and 16.0cm respectively. Occurrence of rapid growth in length was found during the first year of life, followed by a period of slow growth rate in the rest of life. The percentage annual increment varied from 49.8% during the first year of life to 14.6% during the 4th year of life (Table 2).

The von Bertalanffy growth model was fitted to the age/length data of *A. mossulensis*, which can be expressed as: $L_t = 20.4(1 - e^{-0.35(t+0.277)})$. The growth performance index (Φ) of *A. mossulensis* was computed as 2.16.

3.5 Sex ratio, GSI and Fecundity

Results showed that the population of *A. mossulensis* was composed mostly of females (males= 147, females = 256). Females were more abundant than males throughout the year except in January (1:0.31) and February (1:0.4). The overall ratio (males to females) was 1:1.7, which deviated from 1:1 ($X^2 = 29.5$, $P<0.05$). The minimum length (L_{m50}) at which at least 50% of the fish samples were mature during spawning is considered as the minimum size at which the fish attains sexual maturity. The mean value of L_{m50} was 8.0cm for both the sexes, which corresponded to one year old.

Monthly changes in the mean gonado-somatic index (*GSI*) for both sexes of *A. mossulensis* are shown in Figure 6. There were peaks in the *GSI* in January, 14.0 for females and 5.8 for males. Thereafter, these values decline sharply. Following this period, the *GSI* values gradually decrease to minimum values of 0.8 for females and 0.6 for males in June as a sign of continuous release of eggs.

Fecundity estimates based on 20 mature females varied from individual to individual, ranging from 1119 eggs for a length (10.1 cm) and a weight (6.63 g) to 5022 eggs for a length (14.2 cm) and a weight (18.7 g). The relationship between total length (*L*) and the number of eggs (*F*) of *A. mossulensis* was $F = 0.148L^{3.939}$ ($r^2 = 0.605$).

4. DISCUSSION

The bleak, *A. mossulensis* was dominated in the study region and found throughout the year. It was one of the most abundant species in Iraqi waters. Epler *et al.* [5] found in the eighties of last century in Lakes Habbaniya, Tharthar and Razzazah (middle of Iraq) that *L. abu* was the most dominant species followed by *A. mossulensis* (*A. shetina*). In southern restored marshes, the species appeared during most of the year and came third in Chybayish marsh [7], fourth in East Hammar marsh [8] and fifth in Al-Hawizeh marsh [6]. *A. mossulensis* contributed 18.8 % of fish population in the Lesser Zab River, north Iraq [27].

Length distribution in the *A. mossulensis* population in the present study was 3.7-18.4 cm and the fish at length groups 9.0 - 10.0 cm were prevailing and constituted 38.7% of the total catch. Saud [16] found that the length size of this species in Garmat Ali River was 13.0cm, whereas in the southern marshlands, the total length of *A. mossulensis* ranged from 7.7 to 19.7 cm and the length group of 10.0 cm was prevailing [28]. In Turkey, the length distribution of *A. mossulensis* varied between 8.4 to 24.2cm in Ataturk Dam Lake [11], and 12.3 to 20.4 cm in Karakaya Dam Lake [12].

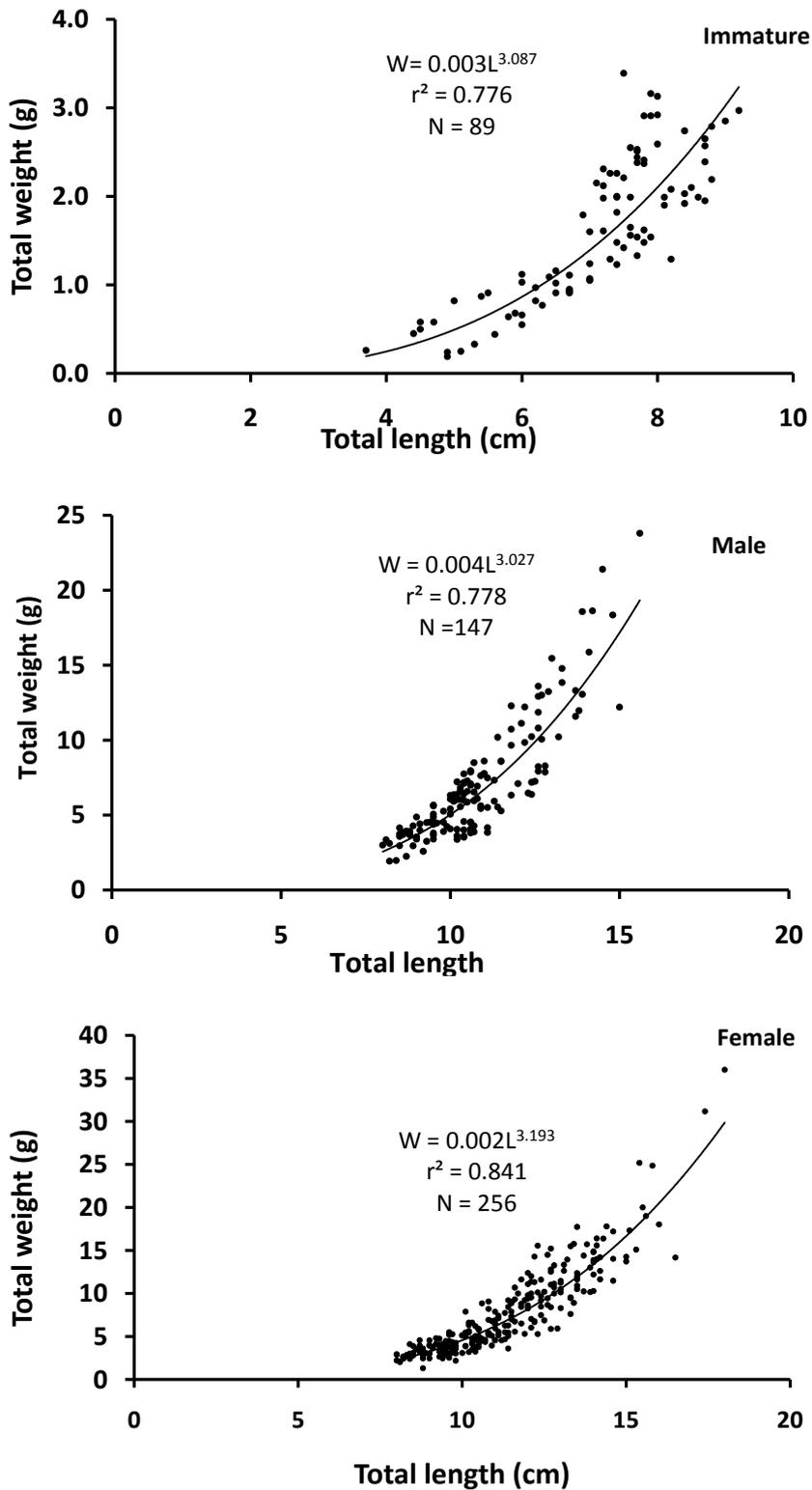


Figure (4): The length-weight relationships of *A. mossulensis* in Euphrates River

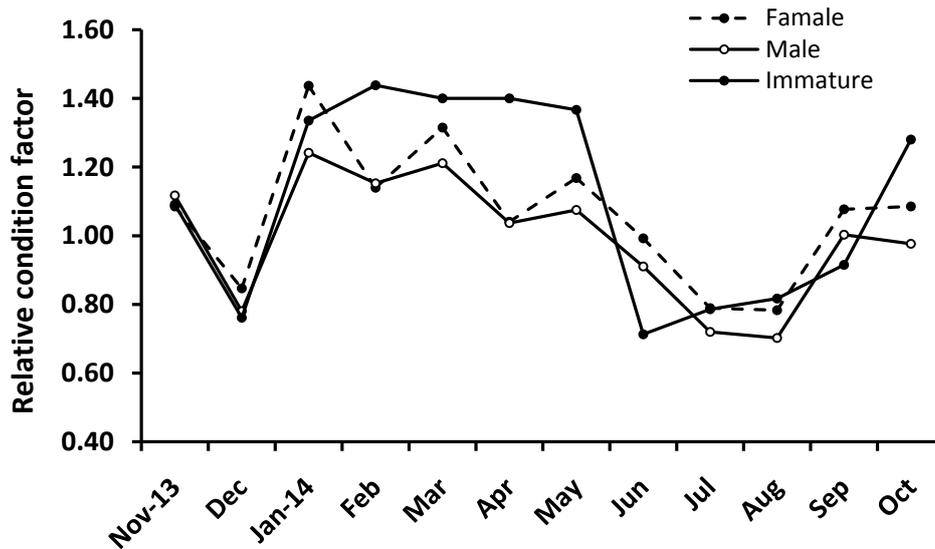


Figure (5): The relative condition factor (Kn) of *A. mossulensis* in Euphrates River

Table (1): Mean observed and back-calculated total lengths of *A. mossulensis*

Age	Number of fish	Length at age (cm)				Observed length (cm)
		1	2	3	4	
1	56	7.6				8.5
2	80	7.9	11.0			11.4
3	33	8.7	11.5	13.8		14.3
4	14	8.4	11.5	13.3	16.0	16.9
Mean length (cm)		8.0	11.2	13.7	16.0	
Annual increment (cm)		8.0	3.2	2.5	2.4	
% Growth increment		49.8	20.0	15.6	14.6	

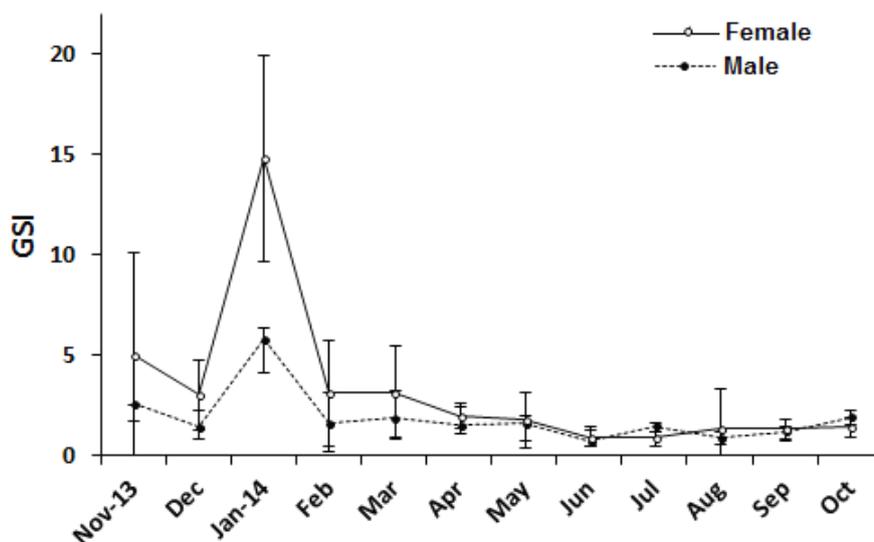


Figure (6): The gonado-somatic index (GSI) of *A. mossulensis* in Euphrates River

In the present study, the length-weight relationships of immature and male individuals of *A. mossulensis* showed isometric growth, indicating the proportional increments of weights to lengths. While female individuals exhibited

positive allometric growth, fish weight increased greater than its length. These results are comparable with the findings of other studies on the species in nearby waterways, the value of b was reported to be 3.12 in Garmat Ali River [16], 3.04 in East Hammar marsh [28]. Differences in length-weight relationship between sexes are known in the literature. For this species in Turkish waters, the b value was 2.91 for males and 3.13 for females in Karasu River [10], 3.31 in Ataturk Lake [11], 2.14 for males and 2.07 for females in Karakaya Lake, used fork length [12]. The b value for *A. mossulensis* in Gamasiab River, Iran was 3.17 [13]. These variations could be attributed to differences in size range of fish, degree of stomach fullness, sex, age, health, major change in environment factors and stage of maturity [23, 22, 29].

The monthly variation in the relative condition factor of *A. mossulensis* showed similar trends in both sexes, the maximum values were reported in January and the minimum values were observed in August for both sexes. This fluctuation may largely be attributed to filling gonads and to feeding opportunities. This same trend was observed with Gonado-somatic Index (GSI) values of the species, mean GSI values were highest in January. The relative condition factor of immature fish increased during spring months may be attributed directly to feeding activity. It seems that the overall relative condition factors of *A. mossulensis* population in the study region were higher than those of Tuz Chi River, north Iraq, $K_n= 1.00$ [18] and Karakaya Lake, Turkey, $K_n= 0.84$ for males and 0.90 for females [2]. Seasonal variation of relative condition factor is influenced by the gonad development, feeding activity and several other factors [22, 30, 31, 32].

The asymptotic length (L_∞) of *A. mossulensis* in the present study can be compared favorably with those from other Iraqi and Turkish waters. The values of L_∞ were 19.7cm [16] and 20.7cm [28] in Iraqi water, whereas 19.8cm in male and 21.9cm in female [10], and 20.1cm in male and 19.6cm in female [12] in Turkish water. The growth performance index (Φ) for *A. mossulensis* in the present study was between the values 2.75, 1.73 and 2.56 for males, females and both sexes, respectively in Karakaya Lake, Turkish [12]. It has been reported that there must be some differences between growth characteristics among localities as a result of diversity and availability of dietary items, hydrographical and climatic conditions [33, 34].

Analysis of the reproductive biology of the *A. mossulensis* population in the present work revealed that the overall sex ratio (males: females) was found to be 1:1.7, significant difference from the expected situation. In Garmat Ali River, the sex ratio (males: females) was 1:2.7 [16], in Tuz Chi River, 1:1 [18] and in Karakaya Lake, 1:3.12 [12]. The sex ratio of fish population changes based on spawning season, life stage of the fish, spawning ground, fishing area, and migration [33, 34]. The mean length at first maturity (L_{m50}) of *A. mossulensis* was 8.0cm for both the sexes, which corresponded to one year old. Saud [16] and Uçkun and Gökçe [12] have been reported that the species attained sexual maturity at the same age in Garmat Ali River, Iraq and in Karakaya Lake, Turkish, respectively.

The GSI indicates gonad development and maturity of fish, therefore monthly change in GSI was followed in order to determine the time of the spawning season and reproductive behavior. The GSI of males and females reached its peak in January in the population of *A. mossulensis*, and then sharply declined in February. According to these results, the spawning season of this species began in February and continued until May. The combination of GSI and condition factor has been suggested as appropriate indicator of spawning periods in teleosts [35]. According to [16] the peak of GSI for *A. mossulensis* in Garmat Ali River, south of Iraq occurred in February, whereas in April in Tuz Chi River, north of Iraq [18]. The peak of GSI for the species took place in May in Karakaya Lake, Turkish [12]. This could be related to the geographical and ecological differences between the populations of the species [33].

In this study, the absolute fecundity of *A. mossulensis* increased in proportion to the 3.939 power of fish length, which was within the range 2.3-5.3 calculated for a variety of species by [36]. The fecundity ranged from 1119 to 5022 eggs, this result was within the fecundity range of *A. mossulensis* reported in the literature. In Garmat Ali River [16] the absolute fecundity of *A. mossulensis* varied from 1926 to 11779 eggs, while in Karakaya Lake the absolute fecundity ranged from 1777 to 3814 [12]. The variation of fecundity is common in fish and the number of eggs produced by an individual is body length, age, condition dependent [37].

5. CONCLUSION

This study has provided basic information on the distribution, size, weight, condition, growth and reproduction for *A. mossulensis* that will be helpful in similar studies. As no information on these biological aspects currently exists in FishBase, the present results may contribute to this invaluable database.

6. REFERENCES

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