

**ORIGINAL ARTICLE**

# Age and growth of Abu Mullet, *Planiliza abu* (Heckel, 1843), in Karun River, Southwestern Iran

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## Abstract

A total of 460 specimens of *Planiliza abu* (Heckel, 1843) were collected from the Karun River of Khuzestan Province, Iran (November 2016-September 2017). Sex ratio was 1:1.06 male to female which was not significantly different ( $P>0.05$ ). The average condition factor for males and female was 1.34 and showed no significant difference among different months in both sexes ( $P>0.05$ ). The total length range was 9.3-17.3cm ( $13.18\pm 1.35$ ), and the total weight 10.3-71.28g ( $31.05\pm 9.22$ ). The maximum age based on scale readings was 7<sup>+</sup> years for females and males. The most frequent age groups were 4<sup>+</sup> in both sexes. The total length-weight relation for females was  $W=0.03TL^{2.63}$  ( $R^2=0.88$ ) and for males was  $W=0.02TL^{2.72}$  ( $R^2=0.91$ ), indicating a negative allometric pattern for females and males. The Von Bertalanffy growth model was estimated as  $L_t=11.90[1-e^{-0.21(t-2.26)}]$  and  $L_t=13.45[1-e^{-0.66(t-3.67)}]$  for males and females, respectively. The growth performance index ( $\Phi'$ ) value was 3.39 in males and 4.79 in females, indicating a faster growth rate in females.

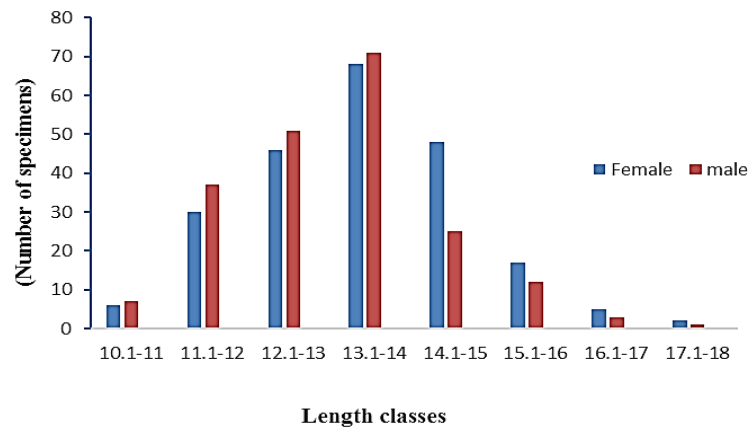
**Keywords:** Length-weight, Growth pattern, Mugilidae, Karun.

## INTRODUCTION

The study of age and growth in fish is a prerequisite to generate information on recruitment, longevity, mortality and fluctuations in fishery caused by various year classes, all of which can contribute towards planning for a rational exploitation of fish stocks. An accurate and reliable technique to age fish is an essential requirement for assessing the health of a fish population (Khan & Khan 2014). Age determination is an important step in studying age-length keys, survival rate, growth and mortality indices, age composition and stocks reproduction rate which are the key subjects in fisheries management (Keivany et al. 2018). Growth is one of the most important features of fish biology, especially in economically important species. Growth information could be used for multiple purposes, e.g., stock assessment, aquaculture and protection (Keivany et al. 2017). The usual starting point in fisheries' work is determination of growth quality, the basis of which is the weight-length relationship (WLR) of the target species (Demirel & Murat Dalkara 2012). The relationship between body weight and length is a simple but essential in fishery

management (Chien-Chung 1991). Length-weight relationships drastically help scientists to convert growth-in-length equations to growth in weight in stock assessment models (Bobori et al. 2010).

Based on the latest checklist of freshwater fishes, 292 species in 106 genera, 36 families, 24 orders and 3 classes have been reported from Iranian inland water basins (Eagderi et al. 2022). The most diverse order is Cypriniformes (182 species). The mullets or grey mullets are found world-wide in temperate to tropical coastal waters readily entering estuaries and even resident in freshwaters (Coad 2016). Six species of mugilids have been identified from the Iranian basins, including *Chelon auratus* (Risso, 1810), *C. saliens* (Risso, 1810) from Caspian Sea basin, *Ellochelon vaigiensis* (Quoy and Gaimard, 1825) from Tigris River drainage, *Mugil cephalus* Linnaeus, 1758, from Caspian Sea and Tigris River drainage, Bushehr and Hormuz basins, *Planiliza subviridis* (Valenciennes, 1836) from Tigris and Bushehr basins, and finally, *Planiliza abu* (Heckel, 1843), from Tigris River drainage and Bushehr basin (Shabaninejad et al. 2021). The mullet, *Planiliza abu*, known in the region



**Fig.1.** Length classes frequency of *Planiliza abu* in the Karun River (2016-2017).

as biah, is one of the important fishes in the Persian Gulf basin from both ecological and commercial points of views. As a migratory fish, rivers of Tigris-Euphrates (Karkheh, Karun, and Arvandrud), Hormuz (Hasanlangi and Mehran), and Bushehr basin (Hendijan, Genaveh, Helleh, Kaki, and Mond) play important roles in accommodating this species (Keivany et al. 2016). It appears in the market as a regular food fish in Ahvaz, Khuzestan, and is an important food fish in southern Iraq, but there is little information about the age and growth status of this species, so this study was carried out with the aim of investigating the growth aspects of this species in the Karun River.

## MATERIAL AND METHODS

A total of 460 specimens of *Planiliza abu* from Karun River were collected monthly during November 2016 to September 2017, using a trawl net. The specimens were anesthetized in 1% clove oil, fixed in 10% buffered formalin and transferred to the laboratory. Routine laboratory measurements, including total (TL), standard (SL) and fork (FL) lengths to the nearest 0.1cm and total body weight to the nearest 0.1g, were carried out. For each specimen, 10-15 scales were removed from above the lateral line, below the anterior extent of the dorsal fin on the left side of the fish, washed in water and dried between two slides for microscopic studies (Asadollah et al. 2017). The condition factor ( $K$ ) of the experimental fish was estimated from the relationship:

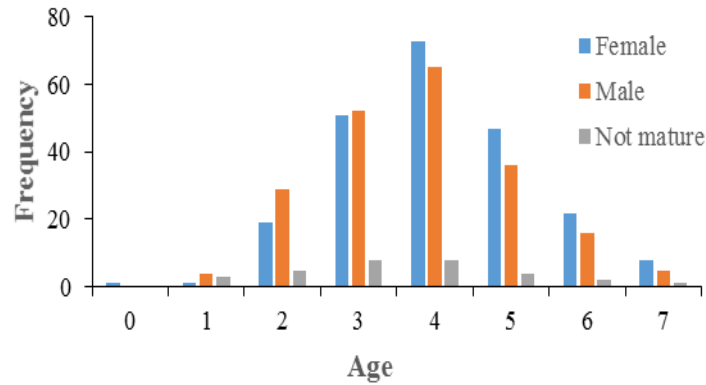
$K = (W/L^3) \times 100$  (Pauly 1983) Where;  $W$ = Weight of the fish in grams  $L$ = The total length of the fish (cm).

The relationship between the length ( $L$ ) and weight ( $W$ ) of a fish is usually expressed by the equation  $W = aL^b$ . Values of the exponent ' $b$ ' provide information on fish growth. When  $b=3$ , increase in weight is isometric. When the value of  $b$  is other than 3, weight increase is allometric (positive if  $b>3$ , negative if  $b<3$ ). This parameters ( $a$ ,  $b$ ) are important in stock assessment studies (Froese 1998).

The von Bertalanffy growth parameters were calculated using  $L_t = L_\infty [1 - e^{-K(t-t_0)}]$  for FL and where  $L_t$  is the length of fish in cm at age  $t$ ,  $L_\infty$  is asymptotic fish length in cm,  $e$  is the base of natural log (2.71828),  $t$  is the fish age (year),  $t_0$  is the hypothetical time at which the length of the fish was zero,  $K$  is the rate at which the growth curve approaches the asymptote, and  $b$  is the constant in the length-weight relationship (Sparre 1992). Growth performance index ( $\phi'$ ) was computed from the equation:  $\phi' = \ln k + 2 \times \ln L_\infty$  (Pauly & Munro 1984). Statistical analyses were carried out in SPSS 19 and Excel 2019 computer software.

## RESULTS

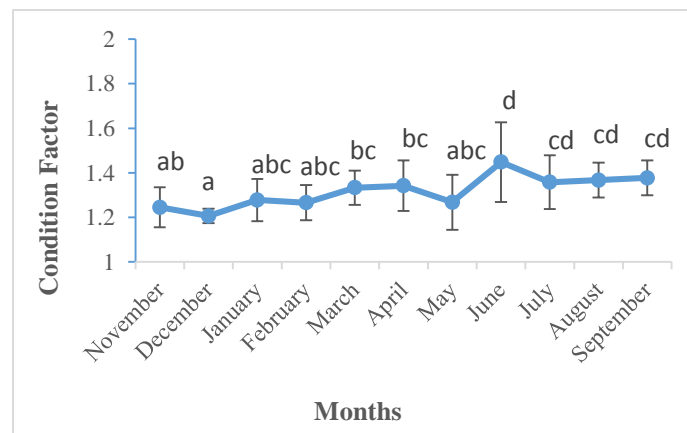
The total length of males ranged from 10 to 17.1cm ( $13.16 \pm 1.26$ ) and that of females 10.5-17.3cm ( $13.44 \pm 1.35$ ). The range of weight of male and female fish was 12.92-71.28g ( $30.51 \pm 8.64$ ) and 16.23-69.89g ( $33.00 \pm 9.41$ ), respectively. The dominant male and female length class was the 13.1-14cm (Fig. 1). The



**Fig.2.** Age classes frequency of *Planiliza abu* in the Karun River (2016-2017).

**Table 1.** Number and sex ratios of *Planiliza abu* specimens in different age groups.

Age group	Sex	Number	M:F ratio	<i>P</i>
0 <sup>+</sup>	M	0	0	-
	F	1		
1 <sup>+</sup>	M	4	4	<i>P</i> >0.05
	F	1		
2 <sup>+</sup>	M	29	1.52	<i>P</i> >0.05
	F	19		
3 <sup>+</sup>	M	52	1.01	<i>P</i> >0.05
	F	51		
4 <sup>+</sup>	M	65	0.89	<i>P</i> >0.05
	F	73		
5 <sup>+</sup>	M	36	0.76	<i>P</i> >0.05
	F	47		
6 <sup>+</sup>	M	16	0.72	<i>P</i> >0.05
	F	22		
7 <sup>+</sup>	M	5	0.62	<i>P</i> >0.05
	F	8		



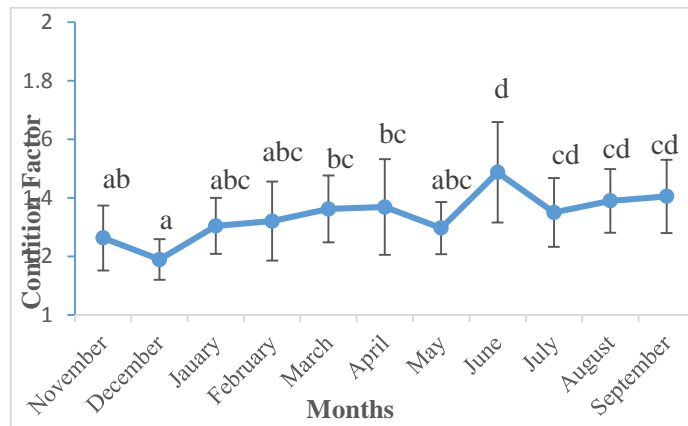
**Fig.3.** Average condition factor of male *Planiliza abu* in different months in the Karun River (2016-2017).

age range of fish in both males and females was between 0<sup>+</sup> to 7<sup>+</sup> years.

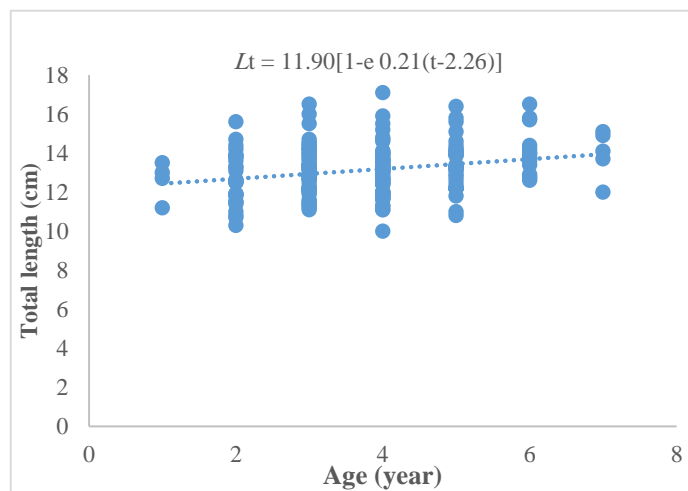
Both sexes were the most abundant in the 4<sup>+</sup> age group (Fig. 2). Also, the sex ratio in different age groups showed that there was no significant difference

between age groups (Table. 1). Sex ratio was 1M: 1.06F.

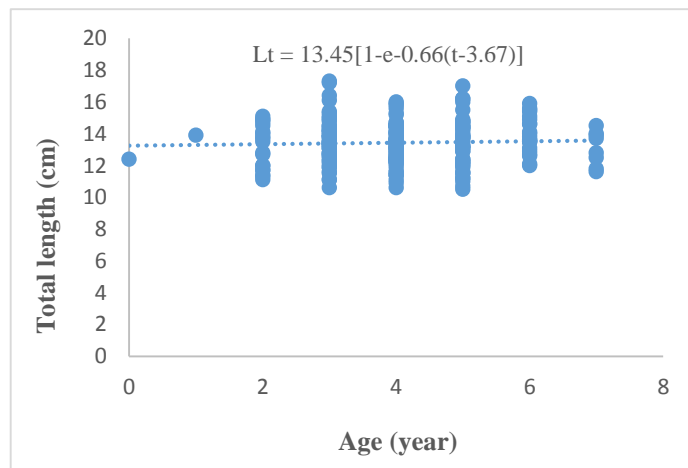
The total length–weight relation for females was  $W = 0.03TL^{2.63}$  ( $r^2 = 0.88$ ) and for males was  $W = 0.02TL^{2.72}$  ( $r^2 = 0.91$ ), indicating a negative allometric



**Fig.4.** Average condition factor of female *Planiliza abu* in different months in the Karun River (2016-2017).



**Fig.5.** Age-length relationship of male *Planiliza abu* in Karun River (2016-2017).



**Fig.6.** Age-length relationship of female *Planiliza abu* in Karun River (2016-2017).

pattern for females and males. The average condition factor of females and males during different months showed a significant difference ( $P < 0.05$ ) (Figs. 3 and 4). But there was no significant difference between males and females. The mean of condition factor in

males and females was 1.34.

The age-length and age-weight relationships in males and females were estimated as  $L_t = 11.90[1 - e^{-0.21(t-2.26)}]$ , and  $L_t = 13.45[1 - e^{-0.66(t-3.67)}]$  respectively (Figs. 5 and 6). The growth performance

index ( $\Phi'$ ) value was 3.39 in males and 4.79 in females, indicating a faster growth rate in females.

## DISCUSSION

The maximum observed total length and weight of *Planiliza abu* were 17.3cm and 69.89g for females and 17.1cm and 71.28g for males, respectively. (Ay & Özcan 2016). Fork length of all individuals ranged from 2.2 to 18.5cm and total weight from 1.85 to 66.40g. Growth variation could be due to the adaptation to environmental changes (Nikolsky 1963). The sex ratio of females in this study were abundant than males (1M: 1.06F). The differences between the number of females and males was not significant. Reproductive characteristics of *Liza abu* showed that sex ratio is 1: 2.7 male to female, respectively (Chelemal et al. 2009). However, the male: female ratio differed with season and length class and these differences are most probably related to sexual differences in growth rate, natural mortality rate and energetic cost of reproduction (Stergiou et al. 1996). The maximum age of the examined *P. abu* specimens was 7<sup>+</sup> years and the most common age class was 4<sup>+</sup>. As reported by Ay & Özcan (2016), the maximum age of abu mullet collected from the Orontes River was 4<sup>+</sup>, the females were grouped into 5 age groups, while in the males, 4 age groups were found, from the examination of otoliths, fish aged 4 years were found. Ages of males ranged between 0 and 3 years, of females between 0 and 4 years. Also that reported by Şahinöz et al. (2011) from the Atatürk Dam Lake, South eastern Turkey was 5<sup>+</sup> years. The length-weight relationship determined in this study implied that the growth was negatively allometric for females and males. Ay & Özcan (2016) reported an isometric growth was observed for males ( $b=2.938$ ) and all individuals ( $b=2.907$ ); positive allometric growth was observed for females ( $b=3.246$ ) of *L. abu* from the Orontes River in Turkey. The mean of condition factor changes in both males and females showed a significant difference in different months, but there was no significant difference between males and females. The mean of condition factor in males and

females was 1.34. The condition factor as an indicator of growth and nutrition intensity is used to compare fitness and fish health (Fagade 1979). Ay & Özcan (2016) found no significant differences between males and female of *Liza abu*, but found a significant difference among the months in both sexes. The mean of condition factor in female was  $0.83\pm 0.03$  and in male was  $0.79\pm 0.02$ . Regarding  $b$ -value and condition factor of *P. abu* from Tireh River, calculated as 2.82 and 1.21, respectively (Mouludi-Saleh & Eagderi 2019). Doğu et al. (2013) studied the growth characteristics of *Liza abu* in Atatürk dam Lake that the condition factor values was 1.18 for males and 1.15 for females. The differences in conditions may have resulted from the species differentiation, feeding activities and ecological conditions such as water temperature, feeding and food abundance (Ahmet et al. 2005). In this study the  $L_{\infty}$  values were 11.90 (males) and 13.45cm (females). Ay & Özcan (2016) reported the  $L_{\infty}$  values were 19.48 (males) and 20.31cm (females) and also Unlu et al. (2000) recorded similar results with them, while the  $L_{\infty}$  values were lower than the reported by Kaya (2010) for Devegeçidi Reservoir (males: 32.96 and females:(34.55cm). Fish populations inhabiting standing waters have better growth performance than that of the flowing waters because of homogeneity of ecological situations such as food abundance and water temperatures (Yölmaz et al. 1996). The growth performance index ( $\Phi'$ ) value was 3.39 in males and 4.79 in females. The growth performance index ( $\Phi'$ ) values were higher than the reported by Ay & Özcan (2016), Unlu et al. (2000) and Kaya, (2010). The differences in growth between regions can be attributed to differences in size of the largest individual sampled in each area and to the differences between populations. On the other hand, it is also possible that the variations in population parameters of the species represent epigenetic responses to different conditions (temperature and food) prevailing in different areas (Keivany & Kamaloo 2020).

## ACKNOWLEDGMENTS

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## مقاله کامل

# مطالعه سن و رشد ماهی بیاه *Planiliza abu* (Heckel, 1843) در رودخانه کارون، جنوب

## غرب ایران

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### چکیده

تعداد ۴۶۰ قطعه ماهی بیاه در رودخانه کارون در استان خوزستان از آبان ۱۳۹۶ تا آذر ۱۳۹۷ مورد بررسی قرار گرفت. نسبت جنسی ۱: ۱/۰۶ نر به ماده بود و اختلاف معنی دار وجود نداشت ( $P > 0/05$ ). میانگین فاکتور وضعیت برای جنس نر و ماده ۱/۳۴ بود و نشان داد اختلاف معنی داری بین ماه‌های مختلف سال وجود ندارد ( $P > 0/05$ ). دامنه طول کل ۱۷/۳ - ۹/۳ سانتی‌متر (۱۳/۱۸ ± ۱/۳۵) و وزن کل ۷۱/۲۸ - ۱۰/۳ گرم (۳۱/۰۵ ± ۹/۲۲) بود. حداکثر سن در هر دو جنس نر و ماده ۷ سال به دست آمد و گروه سنی ۴+ سال بیشترین فراوانی را در هر دو جنس داشت. معادله رابطه طول و وزن برای جنس ماده ( $t^2 = 0/88$ ) و برای جنس نر ( $t^2 = 0/91$ )  $W = 0/02L^{2/3}$  به دست آمد و الگوی رشد برای هر دو جنس آلومتریک منفی بود. پارامترهای رشد برتالانفی *P. abu به صورت  $K = 0/21$ ، سانتی‌متر  $L_{\infty} = 11/90$  و  $t_0 = 2/26$  برای جنس نر و  $K = 0/66$ ، سانتی‌متر  $L_{\infty} = 13/45$  و  $t_0 = 3/67$  برای جنس ماده برآورد شد. شاخص عملکرد رشد  $\phi'$  برای جنس نر ۳/۳۹ و برای جنس ماده ۴/۷۹ برآورد شد که نشان‌دهنده نرخ رشد سریع‌تر در جنس ماده است.*

**کلمات کلیدی:** رابطه طول-وزن، پارامترهای رشد، کفال ماهیان، کارون.