



## RESEARCH PAPER

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## Age structure and growth of the *Gurra rufa* (Cyprinidae), in southern Iran

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### Abstract

The age structure and growth of *Gurra rufa* (Heckel, 1843), in the Dalaki river (Boushehr province in southern Iran) were studied in samples caught from May 2007 to September 2007. The maximum total lengths were 171 mm in females (168) and 188 mm in males (156). Age determination based on the 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 were computed by the von Bertalanffy equation for females and males as:  $L_{\infty} = 164.14$ ,  $W_{\infty} = 117.11$ ,  $t_0 = -1.16$ ,  $K = 0.189$  and  $L_{\infty} = 168.16$ ,  $W_{\infty} = 116.28$ ,  $t_0 = -1.14$ ,  $K = 0.213$  respectively.

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## Introduction

The *Garra rufa* is a demersal fish species with little economic importance in Iran (Abdoli., 2000). It inhabits both lotic and lentic environments and occurs in western Asia. In Iran, it is found throughout the eastern part of the Tigris-Euphrates basins southwards close to the Persian Gulf basin (Coad., 1995). Although it is found in different habitats such as rivers, lakes, small ponds and small muddy streams (Abdoli., 2000), it is predominantly adapted to life in swift-flowing waters. A sucking-disc enables the fish to live in mountain streams even in strong currents.

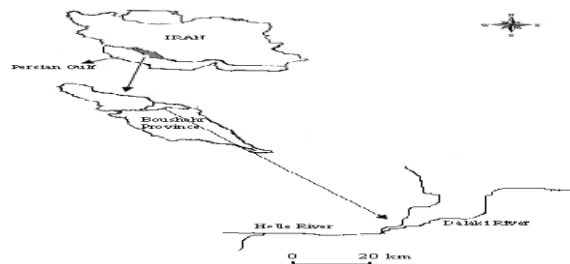
Few studies have been carried out on the ecology and biology of the inland freshwater fishes of Iran, particularly fishes that have no commercial value (Abdoli *et al.*, 2002). Compared with other species of *Gurra*, little attention has been paid to the biology of this species but there are some studies on its taxonomy and distribution (Coad., 1987; Coad., 1996, Abdoli., 2000). Abdoli (Abdoli., 2000) provided some information on the morphology and biology of this species based on a limited data set, and Esmaeili & Ebrahimi (Esmaeili & Ebrahimi., 2006) provided length-weight relationships. Yazdanpanahi (Yazdanpanahi., 2005) and Esmaeili *et al.* (Esmaeili *et al.*, 2005) studied some reproductive characteristics and Patimar *et al.* (Patimar *et al.*, 2010) some life history aspects in southern Iran.

Differences are known to occur in biological features between the populations of same species living in different regions. There was no data available on age structure and growth of this species in Iran or any country until now and consider economic importance of this species and distribution in Iran, investigations on biological characteristics of it for fisheries management and protection of wildlife species seems importance. Therefore, this study was carried out to describes the age structure and growth of the *Gurra rufa* in the Dalaky River in the south of Iran.

## Material and methods

### Study area

The study area is located in the Dalaki watershed basin in the south of Iran (28°42'–30°20'N, 50°35'–52°10'E). This basin includes the Dalaki and Shapour rivers and also the closed sub-basins of the Persian Gulf, Dasht Arjan and Kemarej plains. Near Borazjan city, the Dalaki and Shapour rivers join together and form the Helle river, which flows into the Persian Gulf between Boushehr and Genaveh cities. The climate of the study area is dry-warm. The habitat of *Garre rufa* consists of rocky-sandy bed. Other fish species in the Dalaki river were *Carassius auratus* (Linnaeus, 1758), *Barbus grypus* (Heckel, 1843), *Barbus luteus* (Heckel, 1843), *Mastacembelus mastacembelus* (Banks & Solander in Russell, 1974) and *Barilius mesopotamicus* (Berg, 1932).



**Fig. 1.** Location of the study within the Dalaki River (Boushehr, Iran).

### Methodology

Sampling was carried out from May 2007 to September 2007 on every month. Samples were caught by gillnet (15 m length and 2 m height) with 6, 10, 15 and 20 mm mesh size, cast net with 10 mm mesh size. Samples were preserved in 10% formalin and then were 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 formula was applied (Ricker., 1975):

$$W = aL^b \quad [1]$$

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 the formula (Bagenal & Tesch., 1978):  $\text{Ln } W = \text{Ln } a + b \text{ Ln } L$  [2]

For age determination, the scale and opercle were used. Growth rings were read by microscope (X 40) and binocular (X 10-20). The instantaneous growth rate was calculated by the formula (Bagenal & Tesch., 1978):  $G = \text{Log} (W_{(t+1)} / W_{(t)})$  [3]

Where  $W_{(t)}$  is the fish weight at age  $t$  and  $W_{(t+1)}$  is the fish weight at age  $t+1$ .

We used von Bertalanffy growth curves to quantify growth patterns of females and males (Bertalanffy., 1938):  $L_t = L_\infty (1 - \exp \{-K [t - t_0]\})$  [4]

Where  $L_\infty$  is the theoretical asymptotic length,  $K$  is the body growth rate coefficient, and  $t_0$  is the hypothetical length at age zero (Ricker., 1975). We calculated von Bertalanffy curves using the age and length at capturing specimens. We also used the same function to estimate growth in weight:

$$W_t = W_\infty (1 - \exp \{-K [t - t_0]\}) \quad [5]$$

#### Statistical analysis

For statistical examination of the data, first the normality of the data was examined using Kolmogorov-Smirnov test and the statistical

comparison of parameters were determined using one-way ANOVA and Bonferoni test in SPSS®16 software environment (Zar., 1999).

## Results

### Age classification

Five age classes, from 0 to 4, were determined by posterior body scale readings. The oldest fish in this study was 4 years old, although such individuals were poorly represented.

### Length-weight relationship

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 32 g. The length of females ranged between 35 and 170 mm, and their weight between 4 and 35 g. 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 3).

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

	a	b	S.E. (b)	R <sup>2</sup>	n	P=0.05
Males	0.0229	2.89	0.0113	0.97	156	P<0.05
Females	0.0221	2.93	0.0114	0.94	168	P<0.05
All fish	0.0223	2.91	0.01	0.93	324	P<0.05

### Von Bertalanffy growth parameters

The Von Bertalanffy growth parameters calculated using the mean total length and total weight at ages were;

$L_t = 164.14[1 - \exp(-0.189(t+1.16))]$ ,  $W_t = 117.11[1 - \exp(0.189(t+1.16))]^{2.93}$  in females and  $L_t = 170.11[1 - \exp(-.213(t+1.12))]$ ,  $W_t = 115.09 [1 - \exp (-.213 (t+1.12))]^{2.89}$  in males (Table 2.).

**Table 2.** Estimates of the von Bertalanffy growth parameters  $L_\infty$ ,  $W_\infty$ ,  $K$  and  $t_0$  for females, males and sexes combined of the *Gurra rufa*.

	$L_\infty$	$W_\infty$	$K(\text{yr}^{-1})$	$t_0(\text{years})$
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
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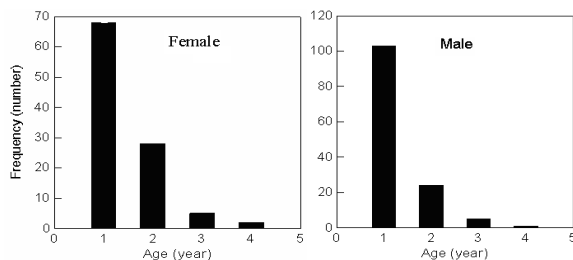
**Table 3.** Instantaneous growth of the *Garra rufa* in Dalaki river.

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

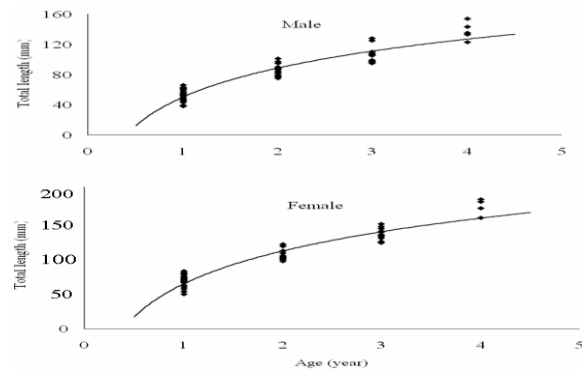
**Discussion**

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 the present study, the 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 (Kaya and Akyurt., 2008, Al-Hazza., 2005). The majority of the samples in the population were in the first age group. Few studies have been carried out on the ecology and biology of the *Garra rufa* to be compared with this research.

The oldest fish in this study was 4 years old, although such individuals were poorly represented (Fig. 2.). The Von Bertalanffy growth curve indicated the females grew more rapidly than males (Fig. 3.). This result is similar to other studies on other species (Kaya and Akyurt., 2008; Pazira *et al.*, 2009; Pazira *et al.*, 2005). Theoretical maximal length (170 mm) and weight (117 g) seem to be realistic, since the largest specimens sampled during the surveys were 164 mm and 90 g, respectively.



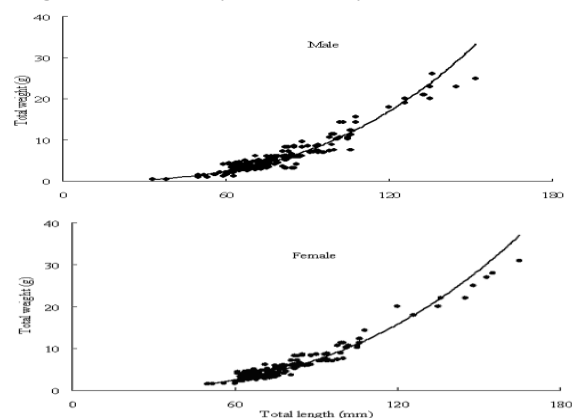
**Fig. 2.** The age distribution of the *Gurra rufa* from Dalaky River.



**Fig. 3.** Von Bertalanffy length-at-age growth curves for male and female *Garra rufa* from Dalaky River.

The 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 (Table 3.).

The growth of *Garra rufa* in Dalaky river is isometric ( $b=2.91$ ) and female fish increase in weight at a more rapid rate than males (Fig. 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.



**Fig. 4.** Relationship between total length (mm) and total weight (g) of *Garra rufa* from Dalaky River.

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