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Certain Aspects of the Reproductive Biology of Berzem (*Barbus pectoralis*) in Karoon River

¹Sayede Maryam Ghafari and ²Shahla Jamili

¹Faculty of Marine Science and Technology, Islamic Azad University,
Tehran North Branch, P.O. Box 19585/936, Tehran, Iran

²Iranian Fisheries Research Organization, P.O. Box 14155-6116, Tehran, Iran

Abstract: This study was carried out from December 2007 to November 2008. From the total number of 352 specimens of caught fishes, 71 and 58 were males and females respectively and 223 specimens were immature. Length range was 94.5-200 mm. Morphological studies of the gonads revealed the existence seven maturity stages in *B. pectoralis* while gonadosomatic index (GSI) indicated that the breeding time extended from January to February. The species determined as a total spawner and eggs are release in shallow waters on gravel bottoms (Shoushtar Station). Results indicated that the age of maturation of male is less (3 years) than female (4 years). $LM_{50} = 35-40$ cm in males and 50-55 cm in females. Absolute fecundity ranged from 7144 to 332196 and relative fecundity varied between 3845 to 164753 per Kg. Highest ova diameter was 2 mm (February). Sex ratio was 1:2 (male/female). Correlation of body weight and total length was high and determined ($R = 0.95$), total length and age was ($R = 0.77$), total length and absolute fecundity was ($R = 0.64$).

Key words: Reproductive biology, sex ratio, spawning season, *Barbus pectoralis*

INTRODUCTION

Reproductive biology of Berzem was determined in this investigation. This species is a good sample for aquaculture in this region because of good taste and significant length and weight (about 30 cm and 1 kg). This project has been doing in South Iran Aquaculture Research Center (SIARC) now.

Berzem *Barbus pectoralis* (Cyprinidae) inhabiting Karoon river (of South-West Iran). The biology of *Barbus* have been widely investigated in world wide (Coad, 2008; Kerdgari, 2009).

There wasn't any available report on the maturing and spawning of *B. pectoralis*. Therefore an attempt has been made to study certain aspects of the reproductive biology of *B. pectoralis* and is the first to present complete of reproductive processes based on observations and information analysis.

Conclusively this fish is a good species for aquaculture. There is no basis for this statement.

MATERIALS AND METHODS

A total five sampling station (latitude $29^{\circ} 58' - 33^{\circ} 04' N$ and longitude $47^{\circ} 41' - 50^{\circ} 39' E$) were selected in the Karoon river for this study (Fig. 1, Table 1).

Corresponding Author: Sayede Maryam Ghafari, Faculty of Marine Science and Technology, Islamic Azad University, Tehran North Branch, P.O. Box 19585/936, Tehran, Iran



Fig. 1: The map of Iran and situation of Karoon river (stations) in Khozestan Province (South West of Iran)

Table 1: Five stations in Karoon river

Station	Longitude E	Latitude N
Gotvand	48°, 50'	32°, 12'
Shoshtar	48°, 46'	31°, 58'
Molasani	48°, 52'	31°, 29'
Ahvaz	48°, 51'	31°, 22'
Darkhovin	48°, 25'	30°, 45'

Samples were collected monthly by cast net and fixed gill net (2 and 14 cm mesh sizes) (Nikpey, 1996) from December 2007 to November 2008.

Total and standard length of fishes was measured in accuracy of (1 mm) and their weight was recorded in accuracy of (0.01 g) (Nikpey, 1996). The stages of maturity were determined according to Biswas (1993). The Gonadosomatic Index GSI calculated using the equation $GW \times 100 / TW$ (Bagenal, 1978). The highest values of GSI were used as indicators of the breeding season. The oocytes were measured using micrometer.

Length-maturity key as proposed by Everhart and Youngs (1981) was used to ascertain maturity stage of the entire population.

Length of sexual maturity, LM_{50} was calculated by using graphic method (Hodgkiss and Mann, 1978). Age determined by studying scales following (Par-Afkande-Haqiqi, 2000).

The sex ratio was established as the ratio of the number of males to the number of females for all mature individuals.

The absolute and relative fecundity were estimated following by Bagenal (1978). Environmental parameters (pH, temperature and transparency) were recorded monthly.

Data Analysis

The sex ratio was established. Significant differences from 1:1 were analyzed using the Chi-square. Correlation between length and weight were determined by Excel.

RESULTS

Pearl organs were observed in 88.9% of mature males (IV-VII stages of maturity) in spawning region (Fig. 2).

Gonadosomatic Index and Seasonal Cycle of Maturation

Results show GSI varied from 0.15 (September) to 1.7 (February). We also observed a peak with a range of 1.7 in the GSI of Berzem (Fig. 3).

It has been observed that seasonal peaks in the GSI values (Fig. 3) coincided with the peaks in the percentage of occurrence of matured individuals (Fig. 4).

The GSI result indicates males and females mature at the same time. The peak breeding period being January to February.

Spawning Season

It takes place at the end of January or at beginning of February when water temperature reaches 14.3°C.



Fig. 2: Pearl organ in Berzem

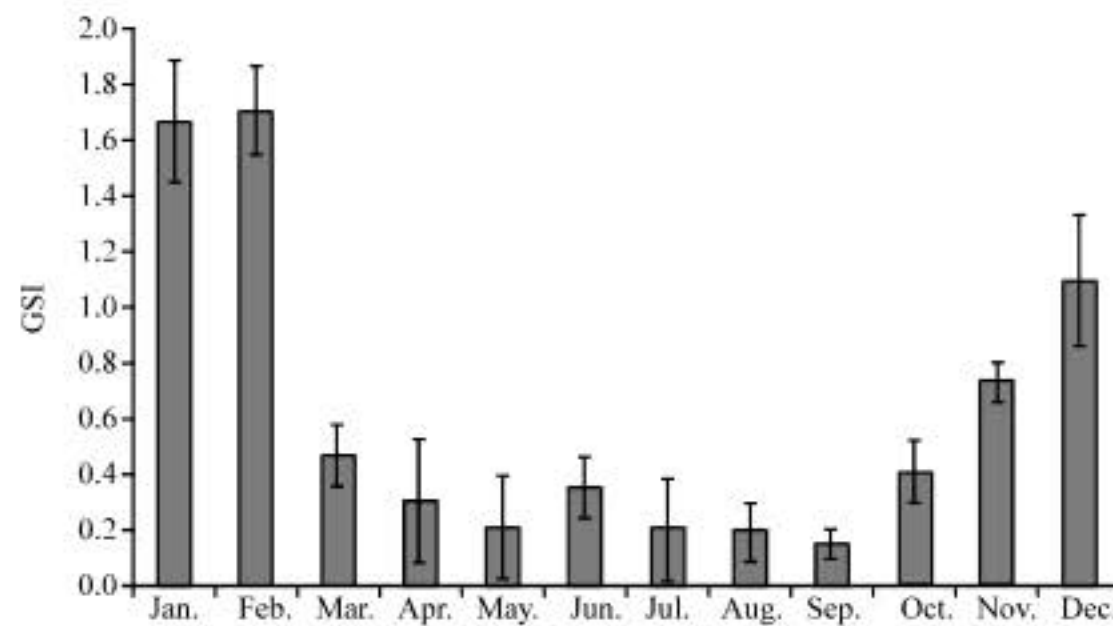


Fig. 3: Monthly variation of GSI of *B. pectoralis* in Karoon River, Khuzestan province, Iran, (Dec 2007-Nov 2008). Error bars indicate SD

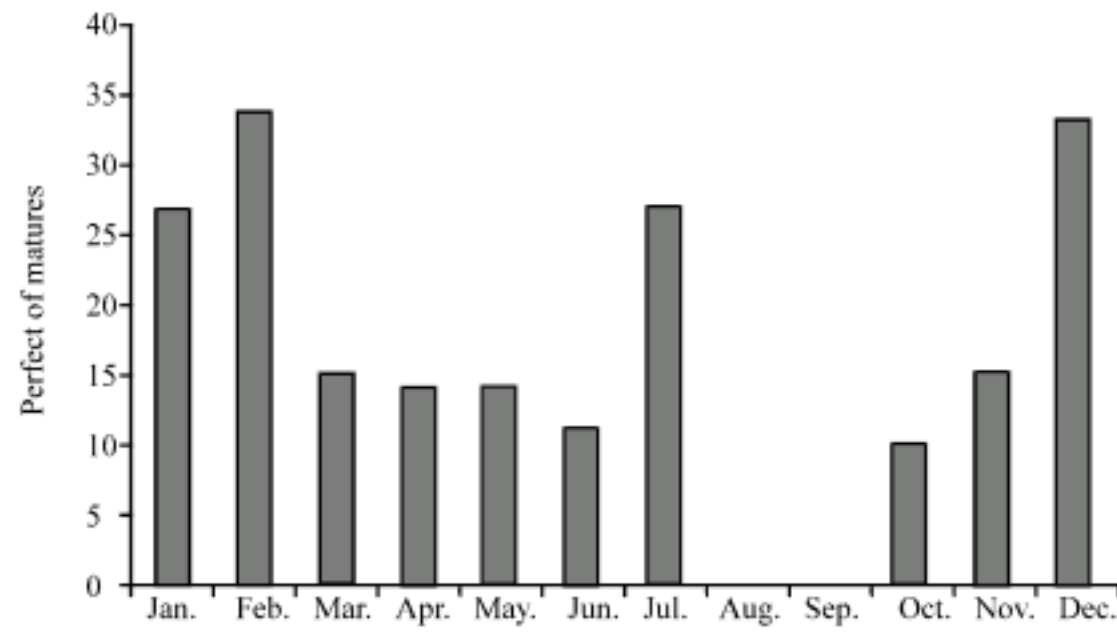


Fig. 4: Percentage of matures in karoon River, Khozestan province, Iran, (Dec 2007-Nov 2008)

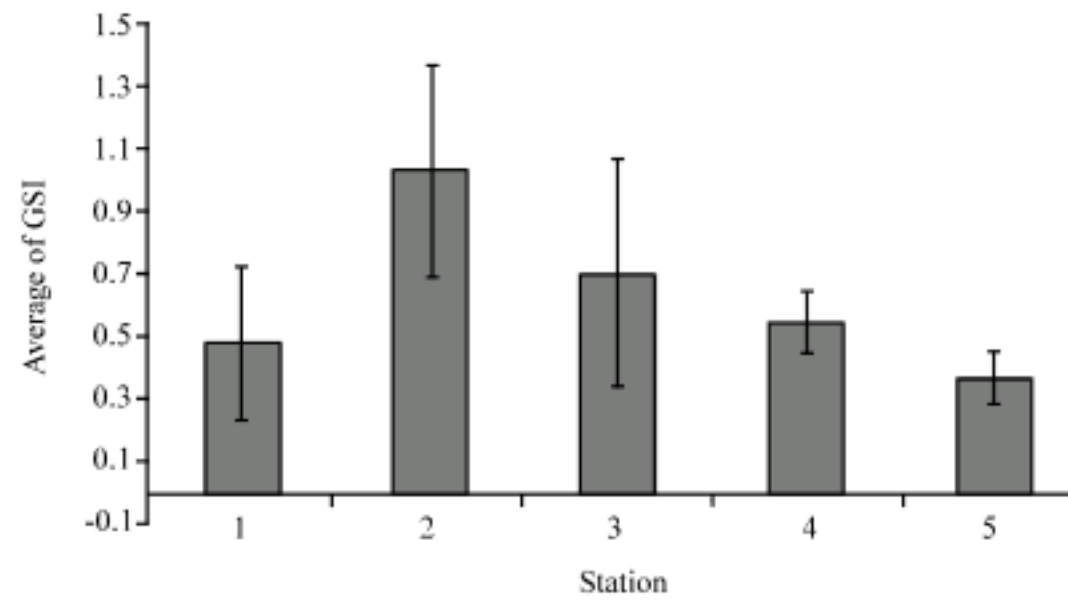


Fig. 5: Average of GSI in stations (1 = Gotvand, 2 = Shoushtar, 3 = Veise-Molasani, 4 =Ahwaz, 5 = Dar khovein). Error bars indicate SD

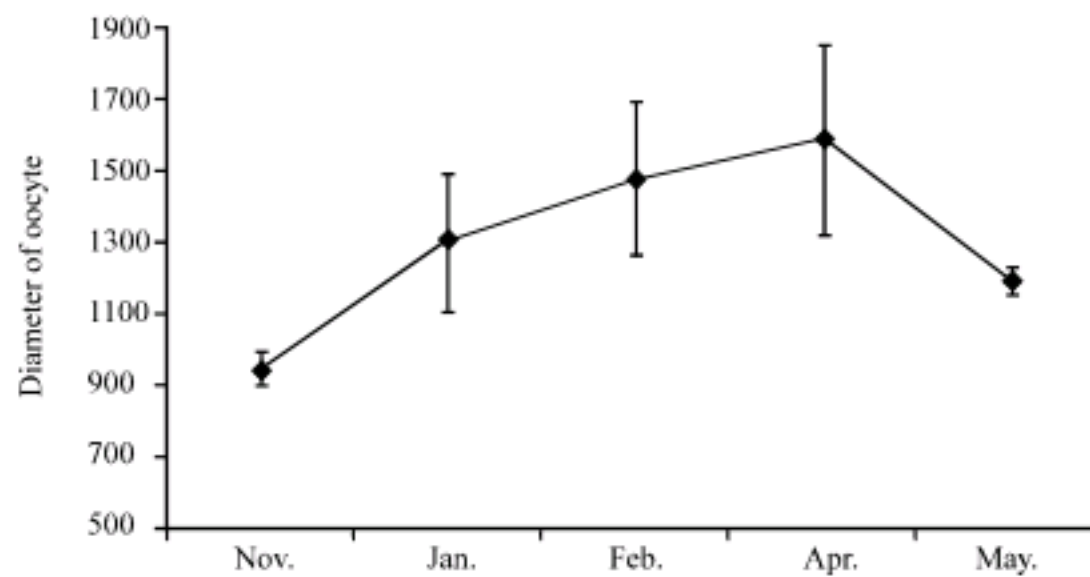


Fig. 6: Variation of ova-diameter. Error bars indicate SD

The gonad resting lasts until February. At that time, GSI in both sexes did not exceed 1.7.

A small amount of resorbing oocytes were observed in the ovaries after spawning.

Breeding Sites

GSI shows spawning occurs on sandy bottom in Shoushtar station (Fig. 5).

Ova-Diameter and Seasonal Cycle of Maturation

It was observed that the ova-diameter increased from 973 to 1893 μm , along with the progression of the maturity stages. Average of ova diameter is 1458 μm (Fig. 6).

Length at First Maturity and Determination of LM_{50}

Barbus pectoralis attains maturity from 35-40 cm (Fig. 7) and 3⁺ years old (male) and 40-45 cm (Fig. 8) and 4⁻ years old (female).

Indicating, maturation is at smaller size in male than female. Size associated sexual dimorphism was observed in Berzem since females dominated in the longer length classes and males in the shorter. Young individuals predominated during the entire study in Karoon. LM_{50} = 50-55 cm (female), 35-40 cm (male) (Table 2).

Sex Ratio

Males significantly predominated in February and females were in July. No significant differences in sex ratios were observed during another months (Table 3).

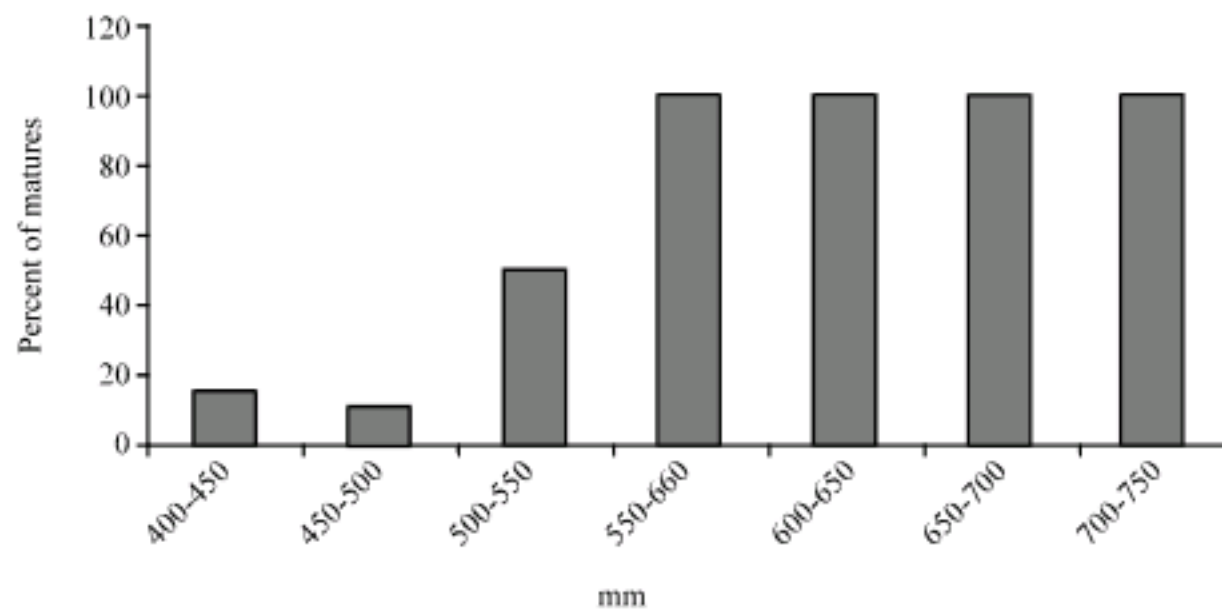


Fig. 7: Percentage of matures in females of *B. pectoralis* in Karoon River

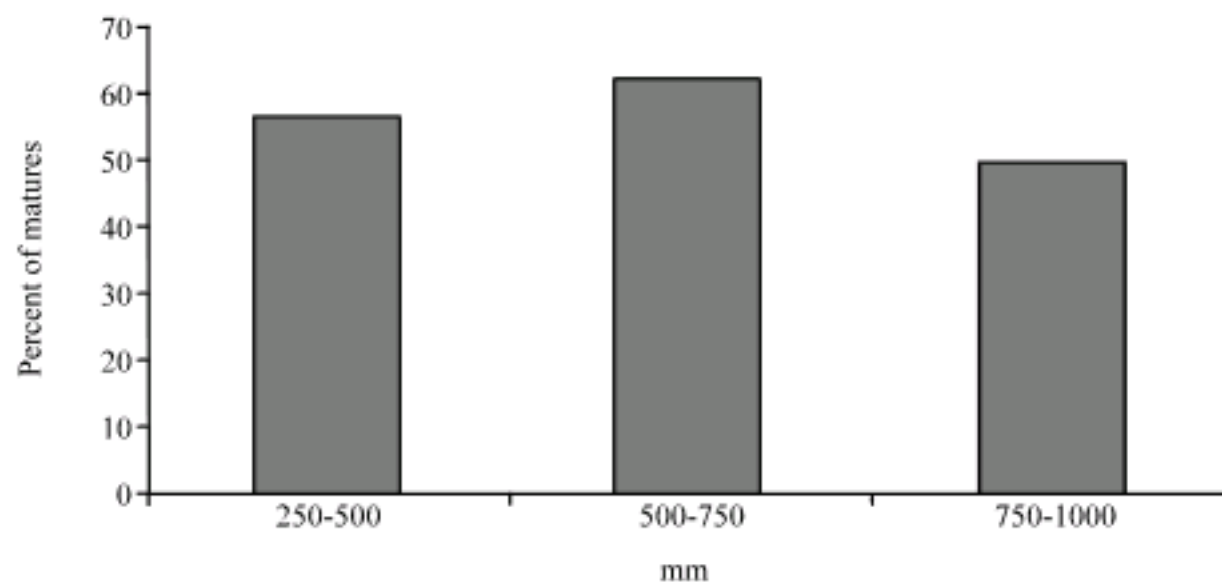


Fig. 8: Percentage of matures in males of *B. pectoralis* in Karoon

Table 2: LM₅₀ age and length at first maturity in *B. pectoralis* in Karoon River

Sex	Length at first maturity (mm)	Age at first maturity (year)	LM ₅₀ (mm)
Male	350-400	3 ⁺	350-400
Female	400-450	4 ⁻	500-550

Table 3: Sex ratio in Berzem in Karoon (2007-2008)

Month	Female	Male	Sex ratio	χ^2	p-value
Jan.	7	16	2.28:1	3.52	>0.05
Feb.	1	11	11:01	8.30	<0.05
Mar.	1	1	01:01	0.00	>0.05
Apr.	4	6	1.5:1	0.40	>0.05
May.	3	1	0.3:1	1.00	>0.05
Jun.	6	5	0.8:1	0.09	>0.05
Jul.	7	1	0.14:1	4.50	<0.05
Aug.	7	8	-	0.06	>0.05
Sep.	0	1	-	1.00	>0.05
Oct.	4	9	2.25:1	1.92	>0.05
Nov.	6	3	0.5:1	1.00	>0.05
Dec.	12	9	0.75:1	0.43	>0.05
Sum	58	71	1.2:1	1.30	>0.05

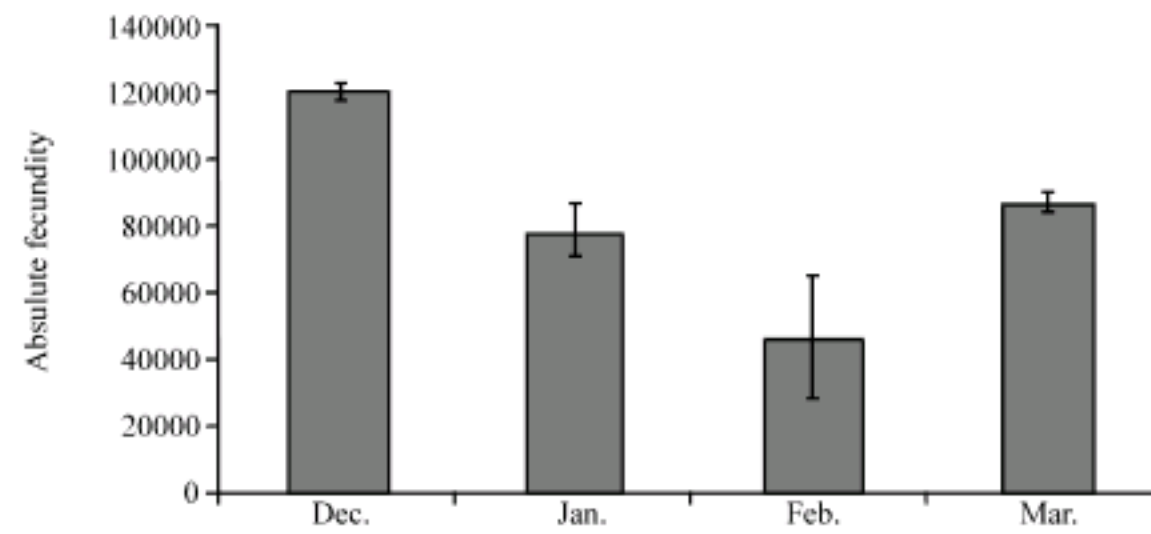


Fig. 9: Variation of absolute fecundity of *B. pectoralis* in Karoon. Error bars indicate SD

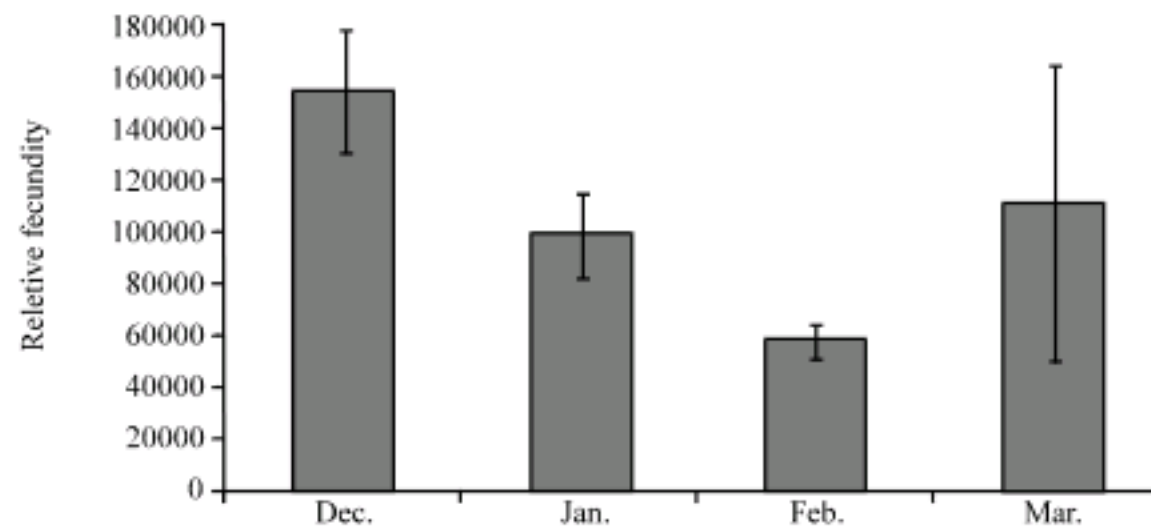


Fig. 10: Variation of relative fecundity of *B. pectoralis* in Karoon. Error bars indicate SD

Fecundity

The absolute fecundity of Berzem varied from 7144 eggs to 239716 eggs per female for fish with length that ranged from 565 to 830 mm and weight ranging from 1858 to 8250 g respectively (Fig. 9). The average relative fecundity ranged from 164753 to 3071 (Fig. 10).

The highest relative fecundity is reached by females when they produce almost 164753 eggs per kg of body weight. The correlation between total weight and total length was 95% (Fig. 11).

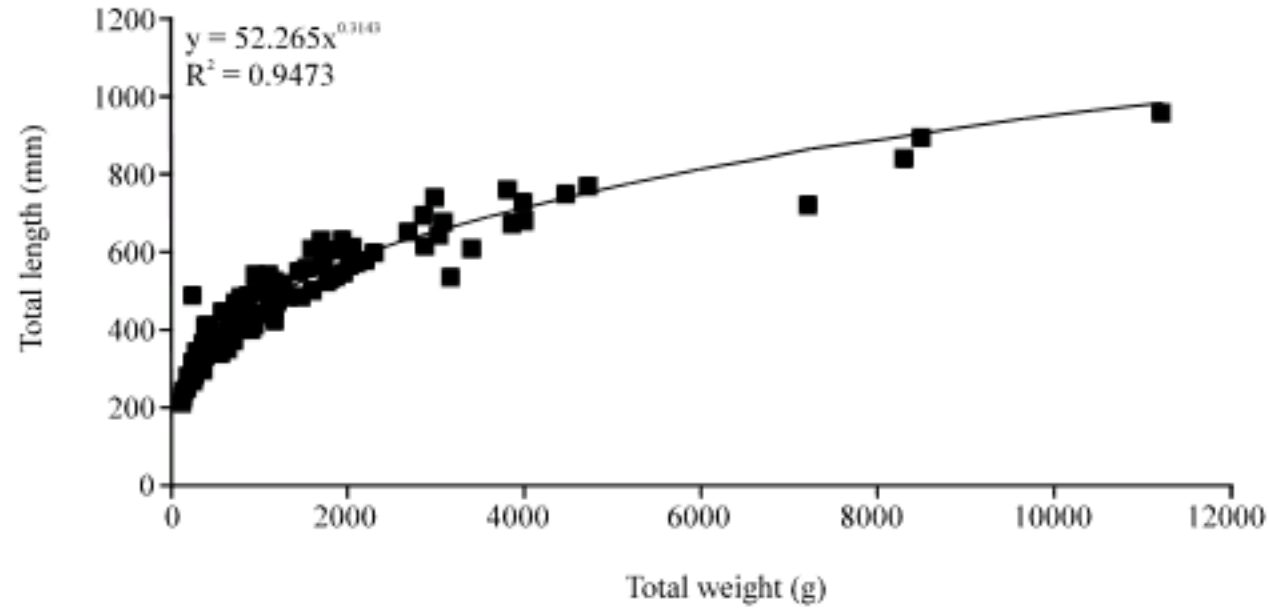


Fig. 11: Correlation between Total length and total weight

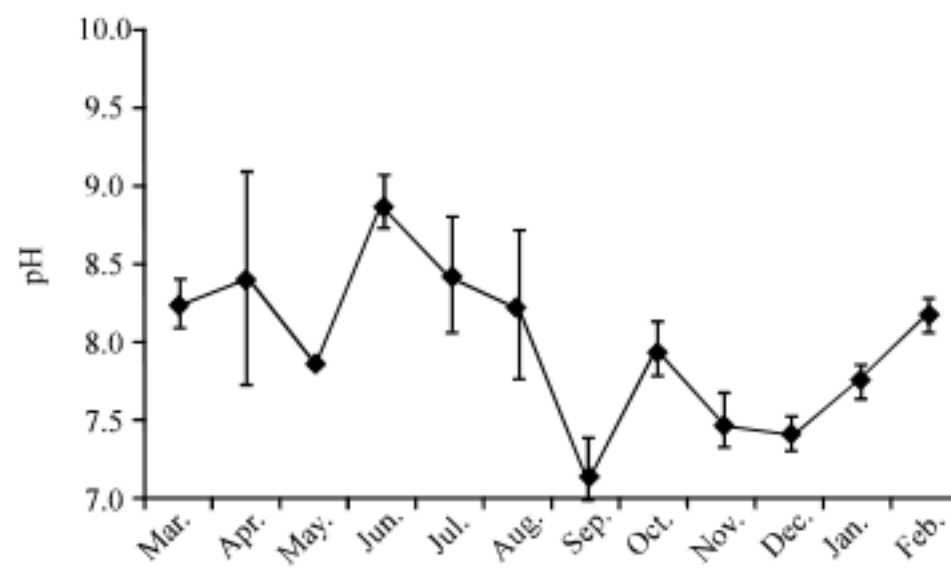


Fig. 12: Variation of pH in Karoon (Dec 2007-Nov 2008). Error bars indicate SD

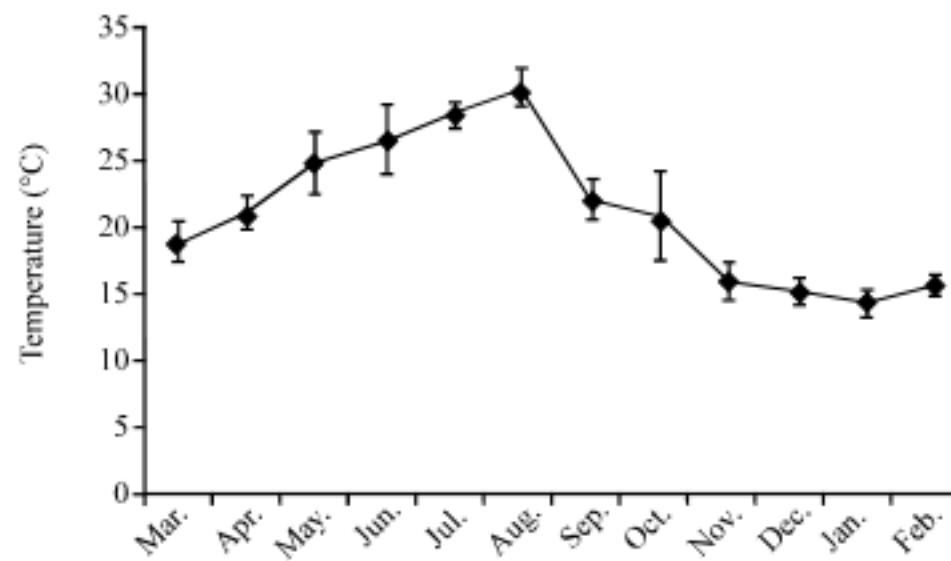


Fig. 13: Variation of temperature (°C) in Karoon (Dec 2007-Nov 2008). Error bars indicate SD

Environmental Factors

Temperature and pH were measured simultaneously. During this study the water temperature ranged from 12.5°C (Jan) to 33°C (Aug). The reproduction temperature for this species was 14.3°C (Fig. 13). pH range was 7.28-10.3. The average of pH was 7.75 in February (Fig. 12). Transparency range was 120 cm (Jun) to 13 cm (Jan) and average of transparency was 53.9 cm (Fig. 14).

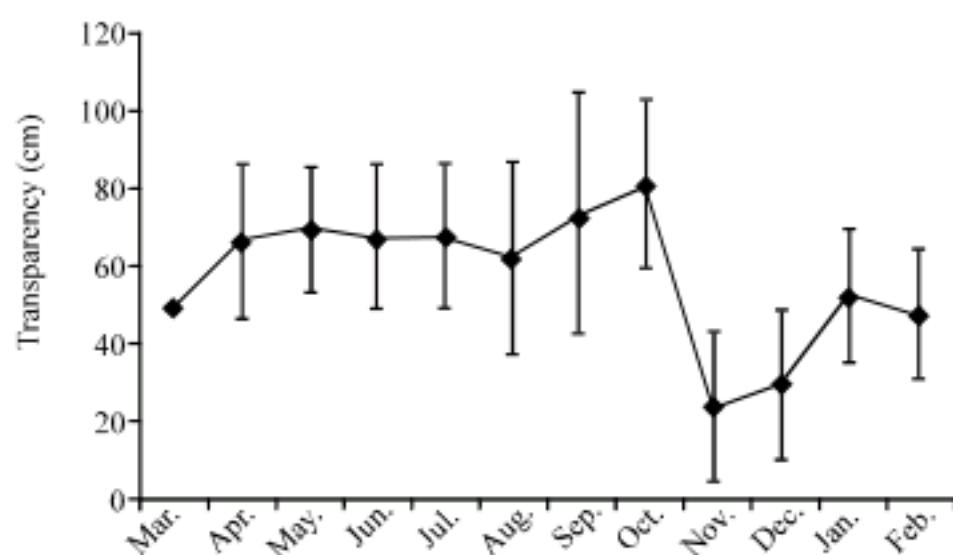


Fig. 14: Variation of transparency in Karoon (Dec 2007-Nov 2008). Error bars indicate SD

DISCUSSION

We observed 1 peak with a range of 1.7 in the GSI of Berzem. That is coinciding with the spawning period of species in south-west Iran (Eskandari, 1999; Nikpey, 1996). The spawning occurred from January to February. This pattern is similar to that reported by (Nikpey, 1996; Eskandari, 1999).

Breeding sites were identified as those with the largest concentration of individuals with mature and emptied gonads and the highest mean GSI. We observed that was on sandy bottoms.

The requirements for spawning necessarily limit the spawning grounds of fish (Santos *et al.*, 1996) which seek favorable conditions for development of their eggs, protection from predators and reduction of environmental stresses (turbulence and oxygen deficit among others) (Potts and Wotton, 1984).

The ripe eggs with a diameter of 1893 μm are similar to *B. esocinus* with diameter of 1593 μm (Eskandari, 1998).

Size associated sexual dimorphism was observed in Berzem since females dominated in the longer length classes and males in the shorter. Young individuals predominated during the entire study in Karoon. Females mature in 4⁺ and males in 3⁺ years old. *Barbus xanthopterus* matures in 1 (male) and 5 (female) (Eskandari, 1999). *Barbus hassi* matures in 2 (male) and 3 (female).

In this investigation the sex ratio shows differ from 1:1 in July (0.14:1), February (11:1). Sex ratio in *Barbus xanthopterus* was (1:1) (Eskandari, 1999) and in *Barbus bocagei sclateri* was (1.3:1) (Herrera and Fernandez-Delgado, 1992).

It was observed that fecundity ranged from 239716 to 7144 eggs, however 84625 in *B. grypus* (Nikpey, 1996).

The highest relative fecundity is reached by females when they produce almost 164753 eggs per kg of body weight.

It is well known that fecundity is affected by the age, size, species, feeding on fish, season and environmental conditions additionally, it differs between populations of some species and does not remain constant from year to year.

Fecundity increased when the fish length, weight and age increased and longer and older fish showed higher fecundity. These patterns were similar to those found: (Eskandari, 1999; Nikpey, 1996).

During the spawning season, temperature and transparency decrease but pH increase. It has been observed that cool water produce later maturity individuals of a species than warm waters (Blaxter, 1969; Ross, 1988).

At last time of reproduction of *Barbus pectoralis* determined in winter and the age of reproduction was 3, 4 for males and females respectively.

CONCLUSION

The breeding time extended from January to February. This species spawns in a short period in winter. The species determined as a total spawner and eggs are release in shallow waters on gravel bottoms (Shoushtar Station). Conclusively this fish is a good species for aquaculture.

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