



RESEARCH PAPER

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Study of reproductive characteristics of *Capoeta* in Alvand River, Kermanshah Province, Iran

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Abstract

The reproductive characteristics of *Capoeta trutta* were monthly in the Alvand River Kermanshah province for one year from August of 2008 till July of 2009. Totally, 225 fishes were caught, of which 126 were male and 99 were female. The sex ratio in this study was obtained as 1.27 ♂: 1 ♀. The maximum total length of the male and female fishes in Alvand River was measured as 372.66 and 383 mm respectively. Four reproductive characteristics including absolute fecundity, relative fecundity, Gonado-somatic Index (GSI) and ova diameter were measured and recorded from the fishes of Alvand River. The mean absolute fecundity of fishes in this river was 15233±11058, whose minimum and maximum was obtained as 2980 and 26756 respectively. The mean relative fecundity of fishes in this river was calculated as 37.25±2.38. The average of Gonad somatic Index (GSI) of male and female fishes was achieved as 1.41 ±0.45 and 2.02 ±0.39 respectively, which showed a significant difference in the level of 1 percent (P<0.01). The mean ova diameter of fishes in Alvand River was measured as 0.8±0.06 mm, for which the range of 0.11-2.02 was obtained. Considering the fact that the Gonado-somatic Index of this fishes is maximized in May, the time for spawning was determined to be in May and for reproduction period to be from March till July. Epithelial nodules appeared in March, maximize in May and disappear in July. The average water temperature and Dissolved oxygen in the water were recorded to be 19.52c° and 8.37 mg respectively.

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Introduction

Capoeta trutta is belonging to *Cyprinidae* family fishes, which is living in the west and south-west waters of Iran. This fish has a fusiform body, very small scales, sub-terminal mouth, 3-rows pharyngeal teeth with the formula of 2.3.4 - 4.3.2, and the most recognizable characteristic of this kind of fish is black spots scattered on its body (Abdoli, 2000). *Capoeta trutta* is of dominant fishes in the rivers of Kermanshah Province, especially in Alvand River. On one hand because of its abundance and on the other hand because of its economical and sport importance, and also the lack of studies about this species due to its specific regional distribution, this subject was chosen for the present research. This kind of fish has a vast distribution in the south of China, north of India, Turkmenistan, Aral Sea, the Middle East and Anatolia (Alp, 2005) and has 7 species and 3 subspecies in Iran (Abdoli, 2000). Studies of teleosti reproduction often favor commercial or valuable native species (Matsuyama *et al.* 1998; Appleford *et al.* 1998; Fowler *et al.* 1999; Smith and Walker 2004).

Few researches have been carried out on the biology of this fish in Iran. According to the searches that have been done, the summary of researches which were carried out about this fish will be presented in the following. Patimar and Farzi (2011) studied the factors of population dynamics of *Capoeta trutta* fishes in Meimeh River in Ilam province. Duman (2004) investigated about the reproductive biology of *Capoeta trutta* in Karakaya Dam Lake in Turkey. In 1991, Unlu studied the biological characteristic of *Capoeta trutta* in the Tigris River in Turkey. In 1996, Gul *et al.* investigated about characteristics associated with *Capoeta trutta* fish growth in the Firat River of Turkey. Also, Polat (1987) studied the age of the *Capoeta trutta* fish in Keban Dam Lake in Turkey. Additionally, Javaheri *et al.* (2012) examined the length-weight relationship and the condition factor of *Capoeta trutta* fish in the Shour River.

Capoeta trutta is living in the west and south-west waters of Iran; *Capoeta trutta* is of dominant fishes in the rivers of Kermanshah Province, especially in Alvand River, and it is very important study of reproductive characteristics of *Capoeta trutta* (Heckel; 1843) in Alvand River (Kermanshah Province, Iran).

The present research was carried out with aim to study and identify the reproductive characteristics of *Capoeta trutta* fish including absolute fecundity, ova diameter, Gonad somatic Index and relative fecundity of this species in Alvand River of Kermanshah province. It is hoped that the results of this study provide useful information for researchers, professionals and students in fisheries sciences.

Materials and methods

Study area

Kermanshah Province is located in the west of the Iran and Alvand River flows in it. Sampling locality was in 34° 31' 18" N and 45° 35' 56" E. The sampling was carrying out monthly from August of 2008 to July of 2009.

Method

Besides fishing, water physic- chemical factors including water temperature, Dissolved oxygen, pH, and Hardness and Electrical conductivity of water was measured and recorded by using a HACH Model SENTION 15 instrument. Samples were caught by gill net with the length of 20, 30 and 40 m and width of 2 m with various mesh sizes of 1, 2, 3, 4 and 5 cm, and Cast net with mesh sizes of 2 and 3 cm. After being caught, the fishes were fixed in 10% formalin and transferred to the laboratory for examination. Body weight measured with an accuracy of 0.1 g, total length, fish fork length and standard length of fishes measured with precision of 1 mm were recorded. For age determination scales were taken from above the lateral line below the anterior part of the dorsal fin. Each scale was cleaned with 5% KOH. After preparing the scale, age reading was then

carried out through microscopic examination using circular pattern and annulus numbers on the scales (Barber and Walker, 1988; Biswas 1993). The sex of fishes was determined by using macroscopic methods after ripping their belly. Fecundity was estimated by the gravimetric method (Zulfu and Sen, 2002). For this purpose, three 0.1 gr subsamples (front, middle and caudal sections) from each ovary were taken and the number of eggs was counted in each subsample and then the absolute fecundity (F) was estimated using the equation $F = (\text{Gonad weight} \times \text{Egg number in the subsample} / \text{Subsample weight})$ (Wootton, 1998). Fishes gonad weights were measured by using a 0.01 g scale. 20-30 ovules were sampled from each ovary (from the elementary, middle and end part) and their diameters were measured by using a micrometer-equipped loop. Gonado-somatic Index (GSI), the equation of $GSI = \text{GW} \div \text{BW} \times 100$ was used, where BW is body weight per gram and GW is Gonad weight per gram

(Bagenal 1978). To calculate the relative fecundity, absolute fecundity was divided by body weight of fishes (Bagenal 1978). In this study, parametric statistical methods were employed using spss16 and excel 2010 software.

Results

Frequency of fish in different months

In sampling from *Capoeta trutta* fishes in Alvand River, 225 fishes were caught, among which 126 fishes were male and 99 fishes were female. The sex ratio of male to female was obtained as 1.27 ♂:1 ♀. Table 1. shows the frequency of fish caught during different months in terms of genus.

Surveying the caught fish population in terms of age showed that fishes have 6 age classes (1-6). Table 2. is presenting the age, number, percentage and genus of fishes which have been caught.

Table 1. frequency of fish caught during different months of year in terms of genus from 2008 to 2009.

Sex	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Total
Male	10	9	15	8	8	11	8	5	9	10	19	14	126
Female	4	6	10	4	4	1	4	7	9	23	15	14	99

Table 2. Number, percentage and genus of fishes based on the age of fishes in the Alvand River from 2008 to 2009,

Age	Number of Samples	Total Percentage	male	female
1	9	4	4	5
2	43	19.11	31	12
3	71	31.56	48	23
4	77	34.22	40	37
5	23	10.22	3	20
6	2	0.9	0	2

Inspection of data reflected that there is a difference at the significance level of 5% ($p < 0.05$) between frequency of male and female genus in this river. Besides fishing, Alvand River's water physico-chemical factors such as temperature, pH, Electrical

conductivity, Hardness and Dissolved Oxygen measured during one year, whose changes are given in Table 3.

Physico-chemical characteristics of Alvand River's water

The overall range of total length for females and males was obtained as 197.4-383 and 195.75-372.66 mm, and the range of body weight changes as 93.6-613 and 88.5-562.66 g, respectively. Average ova diameter was 0.8 mm and the amplitude of these parameter changes was 0.11-2.02 mm. The maximum ova diameter for fishes of Alvand River was observed in May.

Table 3. Changes in physico-chemical characteristics of Alvand River’s water from 2008 to 2009.

Variables	Mean	Range	Maximum	Minimum	Standard Deviation	Standard Error
Water temperature (°C)	19.52	20	27	7	5.61	0.37
pH	8.19	0.9	8.5	7.6	0.25	0.20
EC(µs/cm)	1734	900	2300	1400	265	19.96
Hardness (mg/l)	262	138	310	172	45.82	3.44
O₂ (mg/l)	8.37	2.5	10.4	7.9	0.59	0.04

Table 4. Changes in mean ova diameter for fishes of Alvand River based upon spawning period in 2008-2009.

Month	Mean Ova diameter ±SD
Mar	0.86±0.15
Apr	0.94±0.05
May	1.15±0.13
Jun	0.93±0.16
Jul	0.51±0.11

Relationship between fish parameters

Mean absolute fecundity for *Capoeta trutta* fishes in Alvand River was calculated as 15233±11058, for which the minimum and maximum was obtained as 2980 and 26756 respectively. The relationship between total length-absolute fecundity, body weight-absolute fecundity, Age-absolute fecundity, ova diameter-absolute fecundity is plotted in Fig.1, 2, 3 and 4 respectively.

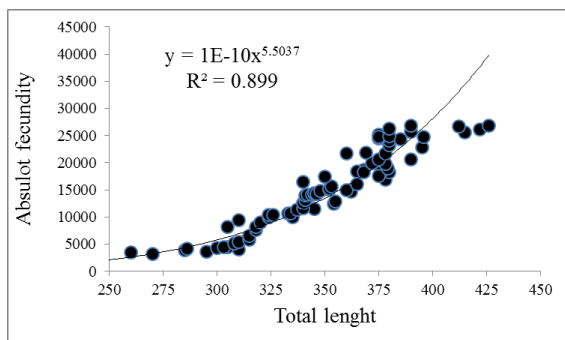


Fig. 1. the relationship between total length and absolute fecundity for fishes in Alvand River from 2008 – 2009.

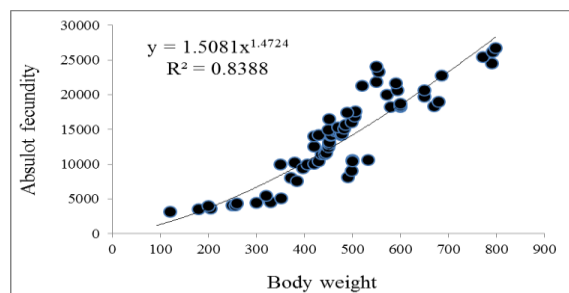


Fig. 2. the relationship between body weight and absolute fecundity for fishes in Alvand River from 2008 to 2009.

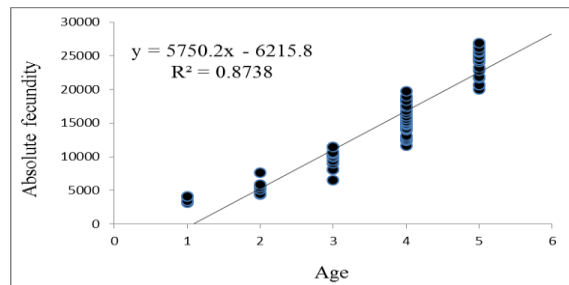


Fig. 3. The relationship between age and absolute fecundity for fishes in Alvand River from 2008 to 2009.

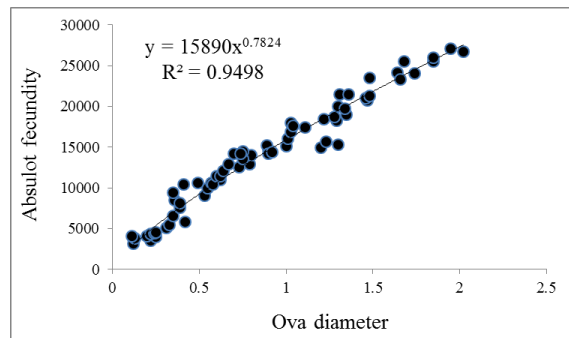


Fig. 4. The relationship between absolute fecundity and ova diameter for fishes in Alvand River from 2008 to 2009.

In this research, the scope of Gonado-somatic Index (GSI) for female fishes aged 1-6 years was varied between 0.28-4.14. The variations of Gonado-somatic index in different months of year have been presented in Table 5.

Table 5. Variations of Gonado-somatic Index for female fishes in Alvand River from 2008 to 2009 in different months of the Year.

Months of the Year	Variations of Gonado-somatic Index (\pm SD)
Aug	1.86 \pm 0.35
Sep	1.38 \pm 0.21
Oct	0.98 \pm 0.12
Nov	0.52 \pm 0.03
Dec	0.28 \pm 0.04
Jan	0.88 \pm 0.05
Feb	1.25 \pm 0.25
Mar	3.09 \pm 0.58
Apr	3.56 \pm 0.81
May	4.14 \pm 0.87
Jun	3.98 \pm 0.89
Jul	2.34 \pm 0.19

The maximized Gonado-somatic index of fishes in this river took place in May, which indicates the spawning time of this species. Similarly, ova diameter has also been at its maximum level in this month (May), which is completely converged. The changes of Gonado-somatic Index (GSI) for female fishes in different months of the year are plotted in Fig.5.

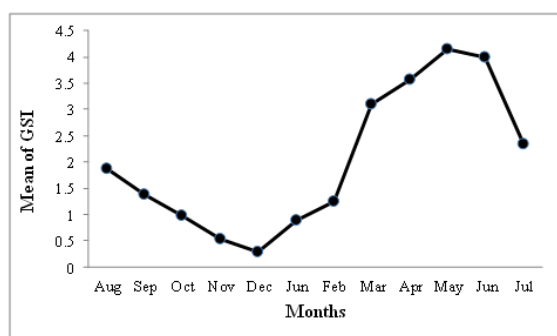


Fig. 5. The variation of Gonado-somatic index (GSI) for female fishes in different months of the year from 2008 to 2009.

The mean relative fecundity of Alvand River fishes was calculated as 37.25 \pm 2.38 ova per kilogram of body weight.

Discussion

Knowledge of the reproduction cycle and the factors affecting it are important issues in fish and fisheries biology (Tomkewicz *et al.*2003).During the one year survey of reproductive characteristics of *Capoeta trutta* fishes in Alvand River, 225 specimens were caught. Sex ratio (M : F) in this study was 1.27 : 1 , but sex ratio (M : F) In studies of Patimar and Farzi (2011), Kalkan (2008) and Duman(2004) were 1.35 : 1, 1 : 0.98 and 1 : 1.21. The sex ratio in most species is close to one, but it may vary from one population to another of some species and may vary year to year in the same population (Nikolosky, 1963). The observed age range was 1-6. The maximum age observed in Studies of Unlu (1991), Polat (1987), Patimar and Farzi (2011), Duman (2004) and Kalkan (2008) were reported to be as 10, 8, 6, 8 and 7 respectively. Comparing all of these data with present study data showed that the maximum age observed in this study is in accordance with the data of Ptimar and Farzi (2011). In this research, the mean total length of 6-year fishes was measured to be as 383 mm. In Studies of Patimar and Farzi (2011), Kalkan (2008) and Duman (2004), the mean total length of subjected 6-year fishes was recorded to be as 325, 342.2 and 407.2 mm respectively. According to the results, the total length of 6-year fishes in this research is lower only from Duman (2004) data and is higher than all of the other data. Variation in maximum age and size of fishes usually is resulted due to the differences in availability of food resources, individual growth rates and natural selection processes and /or exploitation patterns (patimar and Farzi, 2011). In this study, the maximum ova diameter was measured as 2.02 mm. In studies of Patimar and Farzi(2011), Duman (2004), Unlu (1991), Gul *et al.* (1996) Kalkan (2008), and Polat (1987), the maximum ova diameter were obtained respectively as 1.90, 1.85, 1.38, 1.20, 1.04 and 1.03 mm, in such a manner that the magnitude of this index obtained from Alvand River to be higher than the data achieved by other researchers. The diameter of the ovule depends on the size and species of fishes, and individuals which belong to one

species may have various ovule sizes in different regions (Zulfu *et al*; 2002). The mean absolute fecundity of 1-year and 6-year fishes was 2980 and 26756 respectively. In the research of Duman (2004), the absolute fecundity of 3-year and 6-year old fishes was reported respectively to be as 11995 and 28285, and in Patimar and Farzi (2011) for the same fish species, the absolute fecundity of 1-year and 6-year fishes was recorded as 1627 and 18329 respectively. According to the results, this is obvious that the absolute fecundity of this research's data is lower than of Duman (2004) research's data, but is more than of Patimar and Farzi (2011) research's data due to higher weight. Differences in fecundity estimates among studies might partly be artifacts due to differences in methods, or natural due to differences in fecundity with the geographic location or time, or intraspecific and inter-specific differences among species (Nikolosky 1963; Barbin&McCleave 1997; Jonsson and Jonsson, 1999). The variation range of Gonado-somatic Index (GSI) of fishes in Alvand River was 0.28 ± 4.14 , while this range in studies of Kalkan (2008) and Duman (2004) was reported (0.29-7.91) and (0.823-10.278) respectively, thus, the value of this index for fishes of Alvand River is lower than in the other data. In the viewpoint of Duman (2004), fish characteristics associated with spawning vary in respect of their species and ecological characteristics of their habitat water. Also, Nikolsky (1963) expressed that the spawning characteristics of fishes are determined by environmental factors. The maximum Gonado-somatic Index of fishes in Alvand River was observed in May, which coincided with the appearance of maximum ova diameter that was measured in the same month. Thus, the spawning time of this fish is in May. In studies of Kalkan (2008) and Duman (2004), the maximum value of Gonado-somatic index took place in May and June respectively, thus the data of Alvand River is convergent with the data of Kalkan (2008). Considering the appearance of Epithelial nodules in March and their disappearance in July and also due to the significant increase in Gonadosomatic Index since March (3.09) and a

sudden drop in July (2.34), the reproduction period of this fish is from March till July. In the studies of Patimar and Farzi (2011), Unlu (1991), Gul *et al.* (1996), Kalkan (2008) and Polat (1987), the reproduction period of this fish was respectively reported to be (March - May), (May-June), (May-July), (March-July), (April-June) and, hence, regarding the available data, the reproduction period for *Capoeta trutta* fish in Alvand River is consistent with the data of Kalkan (2008). The mean relative fecundity of fishes in Alvand River has been obtained as 37.25, and the relative fecundity for this species in the study of Patimar and Farzi (2011) was found to be as 70. The reason for this difference is the greater weight of fishes in Alvand than of fishes in Patimar and Farzi (2011) study.

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