REPRODUCTIVE FEATURESOF*MYSTUS CAVASIUS* (HAMILTON-BUCHANAN, 1822) FROM AYEYAWADY RIVER SEGMENT, MAGWAY TOWNSHIP

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Abstract

The study was conducted to elaborate the reproductive aspects, including sex ratio, condition factor, GSI, fecundity and correlation between fecundity and standard length, body weight and ovary weight in *Mystus cavasius* from Ayeyawady River Segment, Magway Township during December2018 to August 2019. A total of 78 males and 102 females contributing 1: 1.31 sexratios were presented. Mean standard length and mean body weight of collected fish samples were 10.39 to 11.86cm, 15.82 to 22.51 g and 10.06 to 12.68cm, 16.3 to 31.38g for male and female fish respectively. Condition factor (K) values ranged from 1.13 to 1.53 in male and 1.21 to 1.43 in female. The gonadosomatic index was calculated to be 0.059 to 0.22 and 0.57 to 12.33 respectively for male and female. The highest GSI 0.22 in May (male) and 12.33 in July (female) were observed. The absolute fecundity ranged from 4856 to 58889.5 eggs with the mean 27437.9±18193.4 for the corresponding length of 12.07±1.9cm, body weight of 27.57±11.28g and ovary weight of 3.86±2.5g. Relationships between standard length and body weight, were positively correlated in both sexes. Absolute fecundity was positively correlated with standard length and body weight whereas it was strong positively correlated with ovary weight.

Keywords: Sex ratio, Condition factor,GSI and fecundity, *Mystus cavasius*

Introduction

Cyclical or seasonal phenomenon of reproduction is commonly happened in most teleost species and is limited to a relatively brief time span (Misra, 1994 cited by Seetharaman, 2005).To manage appropriately for fishery conservation, a thorough knowledge of the cycles of gonad maturation is the most important (Seetharaman, 2005). The freshwater fishes are important and easily accessible source of protein. The amount and quality of protein is progressively degrading due to water pollution. In addition, the aquatic pollution has an effect upon fish reproduction. In recent past,many fish species population reduced drastically due to natural and anthropogenic stresses, so may lead to the extinction of some fish species.If any fish species is to be managed, conserved and exploited scientifically, various intricacies of reproduction should be deeply studied (Qasim, 1973 cited by Seetharaman, 2005). Small fish species are the biogenic sources of protein, micro-nutrients, vitamins and minerals which are not commonly available in many foods (INFS, 1977 cited by Islam and Das, 2006). In this area, small indigenous fish is important as a good resource of our poor and low income groups both in nutrition and economics. *Mystus cavasius*, a popular catfish is one of them. The length-weight relationship and condition factor of fish hadpositioned at the significant role in fishery management. The average weight of a given length group and the health status of the fish can estimate by the use of these senses (Bolger and Connoly, 1989 cited by Zargar *et al*., 2012). The sex-ratio of the population is analyzed to find out whether it deviates significantly from the hypothetical distribution of 1:1 or not (Siddique *et al*, 1976 cited by Seetharaman, 2005). In the absence of direct observation, gonadosomatic index canindicate the fluctuations in the breeding activity of a species all around the year (Kaul and Rishi, 1986 cited by Seetharaman, 2005).The fecundity of a fish is defined as the number of eggs that are likely to be laid during a spawning season (Bagenal, 1957 cited by Hossain *et al*., 2012). The fecundity estimation is important to understand its biology, population dynamics as well as evaluating the

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commercial potentialities for scientific culture and management. The study of fecundity and its relationships with various body parameters such as body weight, body length, ovary weight advantage for effective fish culture, stock management and assessment in any water body (Chandanshive, 2016).

The objectives of present study were:

- to observe length-weight relationship and condition factor of *Mystus cavasius* in the study area
- to investigate the reproductive performance of the studied species
- to analyze relationships between fecundity and the standard length, body weight and ovary weight

Materials and Methods

Ayeyawady River Segment, Magway Township situated between 20º 08′ to 20º 09′ N and 94º 54′ to 94º 55′ E was the study site (Fig1).

Figure 1 Map of the study site, Ayeyawady River Segment, Magway Township

Data collection was conducted from December 2018 to August 2019.Randomly 20 fishes were purchased from fishermen who fished in the study area. Collected fishes were identified according to Talwar and Jhingran 1991. After specimen collection, the standard length and total length were recorded to the nearest centimeter scale. The weight of the specimen was taken by an electric balance and recorded to the nearest gram. The gonad of each fish was taken out very carefully and preserved in 10% formalin with labeled vials for further study.

The condition factor (K), sex ratio, gonadosomatic index (GSI)of studied species were calculated by:

$$K = \frac{\text{Eviscerated body weight}}{\text{length}^3} \times 100 \text{ (Htun-Han, 1978)}$$

$$\text{Sex ratio} = \frac{\text{Number of female}}{\text{Number of male}}$$

To confirm the sex ratio of studied species, χ^2 test was done.

$$GSI = \frac{\text{Weight of gonad}}{\text{Weight of fish}} \times 100 \text{ (Nikolsky, 1963)}$$

Gravimetric method or weight method (Lagler, 1956) was used to estimate the fecundity of *Mystus cavasius*. In using this method, the external connective tissues were removed from the surface of the ovaries. Moisture of ovaries was removed with the help of blotting paper. Then the gonad weight was measured. Three subsamples, each from anterior, middle and posterior parts of the ovary, were taken and weighed (0.22 g), theneggs were counted carefully. Counting of eggs from each subsample was done under the sliding magnifier (10x). Then, calculated by:

$$\text{Absolute fecundity} = \frac{\text{the numbers of eggs in sample} \times \text{gonad weight}}{\text{sample weight}}$$

From the above data, the relationships of different parameters such as standard body length and body weight, fecundity and standard length, body weight and ovary weight were determined as simple linear relationship with the help of Excel programme.

Results

A total of 180 *M.cavasius* were examined, of which 78 (43.33%) were males(Plate 1)and 102(56.67%) were females (plate 1) giving an overall ratio (M:F) of 1:1.31 (Table 1). According to χ^2 test, there was no significant difference between male and female sex ratio ($P< 0.05$).The testes were paired, elongated structures located dorsally in the body cavity and the right testis was usually longer than the left one. The testes had short finger like projections forming a fringe along their length and whitish in color (Plate 2). The weight of testis in studied species ranged from 0.01 to 0.04 g (Table 2).The paired ovary situated along the body cavity and ventrally beneath the air bladder closely allied to the body wall was separated into two lobes. Spindle-shaped ovary was large at the middle than the extremities. The color of the ovary was deep yellow to yellow and sometimes whitish depending on the maturity of the ovary. The mature ovary was found yellow and immature one was found whitish in color (Plate 3). The ovary weight varied with the size and maturity of the females. The weight of the ovary ranged from 0.14 to 3.73 g (Table 2)

Mean standard body length and body weight in male ranged from10.39 ± 0.36 cm to 11.86 ± 1.49 cm and from 15.82 ± 1.64 g to 22.51 ± 4.09 g (Table 2). With respect to female, mean standard body length and body weight ranged from 10.06 ± 1.65 cm to 12.68 ± 2.25 cm and, from 16.3 ± 2.09 g to 31.38 ± 11.99 g (Table 3). The coefficient of determination (r^2) between standard length and body weight was 0.2805 for maleand 0.7582 for female*M.cavasius* were observed (Fig. 2).

The lowest and highest condition factor (K) of male studied fishes were 1.13 ± 0.32 at the eviscerated body weight 15.5 ± 4.37 g and the standard length 11.23 ± 1.25 cm and 1.53 ± 0.14 when the eviscerated body weight 20.91 ± 3.76 g and the standard length 11.08 ± 0.55 cm (Table 2). In the females, the lowest and highest K values were 1.21 ± 0.18 at the eviscerated weight of 24.5 ± 5.7g and the standard length 12.63 ± 1.12 cm and 1.43 ± 0.15 when the eviscerated weight 22.14 ± 6.22 g and the standard length 10.06±1.65cm respectively (Table 3).The values of GSI in males ranged between 0.059 ± 0.07 in January 2019 and 0.22 ± 0.07 in May 2019 (Table 2). In females, this value was between 0.57 ± 0.14 in January 2019 and 12.33 ± 4.73 in July 2019 (Table 3). Relation of GSI with body length was presented in Fig 3.The estimate of fecundity was based on 20 ripe females (Table 3). Their length and weight ranged from 10.2 to 17.5 cm and 13.76 to 54.67 g respectively. Estimation of total ova ranged from 4856 eggs for fish of standard length 10.2 cm, body weight 14.56 g and ovary weight 0.92g to 58889 eggs for fish of standard length 15.5 cm, body weight 54.67 g and ovary weight 8.89 g. The r^2 values were found as 0.6033between absolute fecundity and standard body length, 0.7258 between absolute fecundity and body weight, and 0.9406in relation absolute fecundity with ovary weight (Fig 4).

Table 1 The sample size and sex ratio of *Mystus cavasius* from studied area

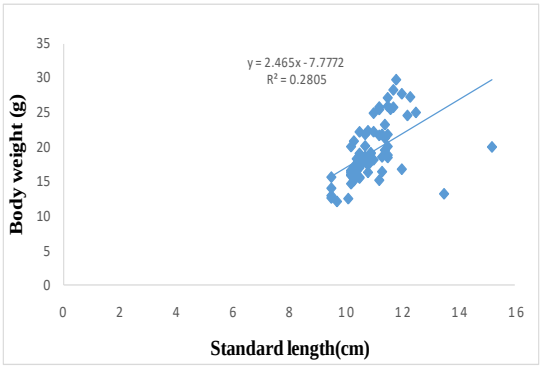
Month	Sample size	Male	Female	Sex ratio Male : Female
December, 2018	20	8	12	1:1.5
January, 2019	20	7	13	1:1.86
February, 2019	20	7	13	1:1.86
March, 2019	20	8	12	1:1.5
April, 2019	20	9	11	1.1.2
May, 2019	20	8	12	1:1.5
June, 2019	20	11	9	1:0.82
July, 2019	20	12	8	1:0.67
August, 2019	20	8	12	1:1.5
Total	180	78	102	1:1.31

Table 2 Monthly mean reproductive parameters of male *Mystus cavasius* in study area

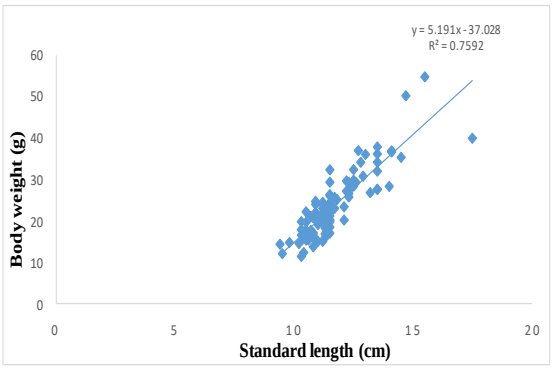
Parameters	Month																							
	Dec			Jan			Feb			Mar			Apr			May			Jun			Jul			Aug		
Standard length (cm)	11.23	±	1.25	11.1	±	0.64	11.06	±	0.73	11.86	±	1.49	10.39	±	0.49	10.39	±	0.36	10.54	±	0.55	11.08	±	0.55	10.51	±	0.59
Body weight (g)	17.37	±	5.27	19	±	3.35	21.46	±	3.89	22.14	±	3.59	16.05	±	1.77	15.82	±	1.64	17.55	±	1.99	22.51	±	4.09	19.1	±	3.99
Gonad weight (g)	0.013	±	0.01	0.01	±	0.00	0.02	±	0.00	0.02	±	0.01	0.02	±	0.00	0.04	±	0.01	0.03	±	0.01	0.03	±	0.01	0.02	±	0.01
Condition factor (K)	1.13	±	0.32	1.29	±	0.22	1.43	±	0.13	1.28	±	0.36	1.32	±	0.08	1.15	±	0.41	1.39	±	0.17	1.53	±	0.14	1.52	±	0.22
GSI	0.075	±	0.03	0.06	±	0.07	0.09	±	0.06	0.08	±	0.02	0.13	±	0.04	0.22	±	0.07	0.15	±	0.04	0.12	±	0.03	0.1	±	0.04

Table 3 Monthly mean reproductive parameters of female *Mystus cavasius* in study area

Parameters	Month																							
	Dec			Jan			Feb			Mar			Apr			May			Jun			Jul			Aug		
Standard length (cm)	12.23	±	1.26	12.6	±	1.12	11.79	±	0.55	11.47	±	0.71	10.7	±	0.58	10.48	±	0.77	10.82	±	0.64	10.06	±	1.65	12.68	±	2.25
Body weight (g)	26.27	±	9.01	27.2	±	6.23	24.26	±	3.68	21.33	±	3.12	16.30	±	2.09	18.09	±	4.42	20.28	±	3.55	25.65	±	7.21	31.38	±	12
Gonad weight (g)	0.15	±	0.06	0.16	±	0.06	0.15	±	0.03	0.14	±	0.04	0.14	±	0.04	1.12	±	0.59	2.34	±	0.54	3.73	±	1.71	3.24	±	3.9
Condition factor (K)	1.26	±	0.26	1.21	±	0.18	1.33	±	0.07	1.28	±	0.02	1.22	±	0.12	1.24	±	0.12	1.36	±	0.13	1.43	±	0.15	1.34	±	0.28
GSI	0.61	±	0.24	0.57	±	0.14	0.63	±	0.15	0.68	±	0.17	0.86	±	0.27	6.15	±	3.25	11.69	±	3.44	12.33	±	4.73	7.67	±	8.93
Absolute fecundity	0	±	0.0	0	±	0	0	±	0	0	±	0	0	±	0.0	9135	±	3278.0	13704	±	7156.8	31597	±	12002.3	52496.0	±	6191



A. Male



B. Female

Figure 2 Relationships between body weight and standard length of male and female *Mystus cavasius*

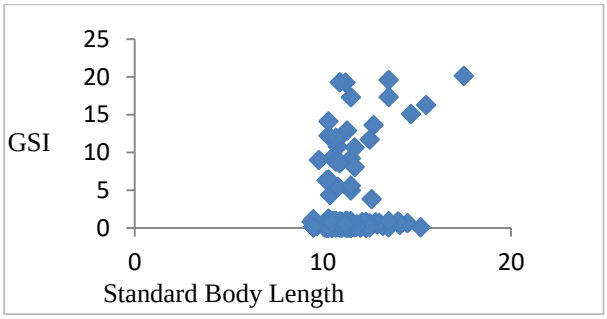
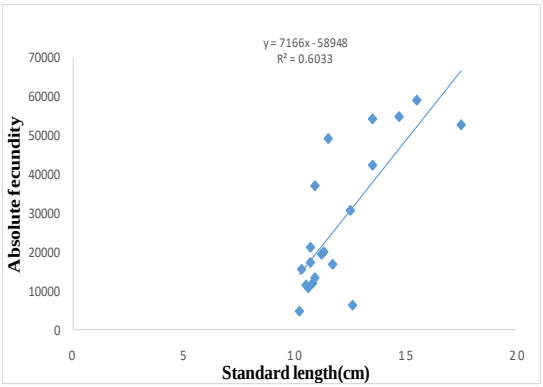
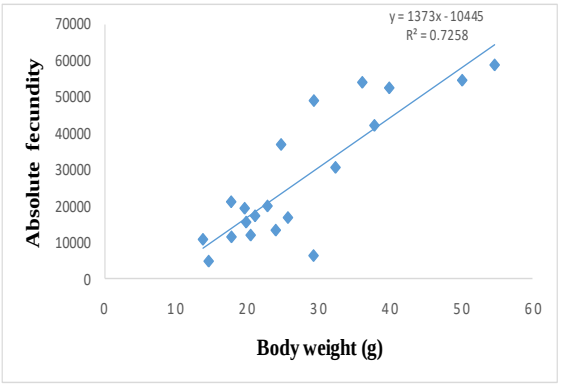


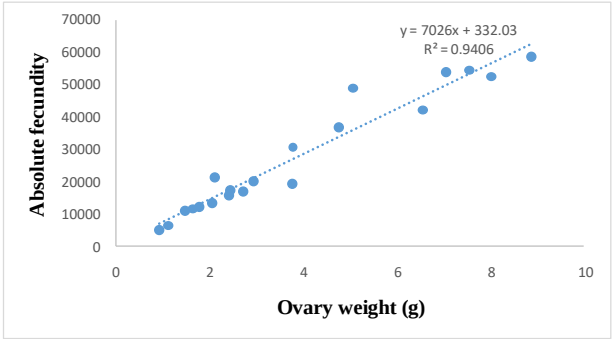
Figure 3 Relationship between GSI and standard body length of *Mystus cavasius*



A. Relationship between absolute fecundity and standard length



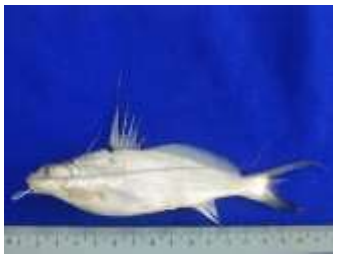
B. Relationship between absolute fecundity and body weight



C. Relationship between absolute fecundity and ovary weight

Figure 4 Relationships between absolute fecundity and standard body length, body weight and ovary weight of female *Mystus cavasius*

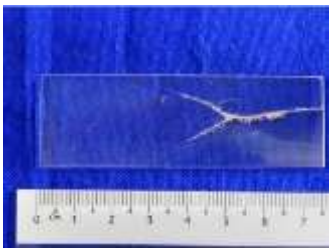
A. Male *Mystus cavasius*



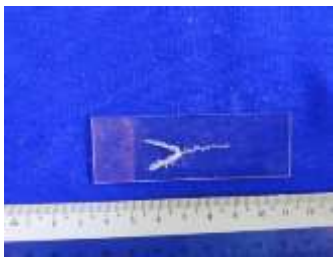
B. Female *Mystus cavasius*

C. Mature eggs (12X) of *Mystus cavasius*

Plate 1 *Mystus cavasius* and mature eggs



A. December, 2018



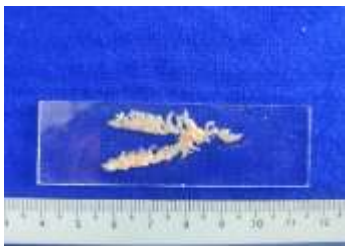
B. January, 2019

C. February, 2019

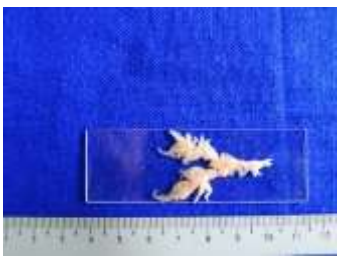
D. March, 2019

E. April, 2019

F. May, 2019



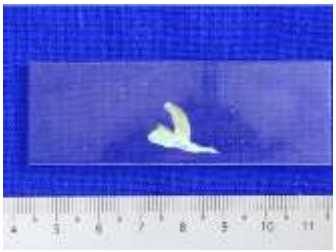
G. June, 2019



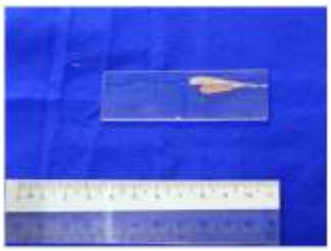
H. July, 2019

I. August, 2019

Plate 2 Monthly variations of testis



A. December, 2018



B. January, 2019

C. February, 2019

D. March, 2019 E. April, 2019 F. May, 2019

G. June, 2019 H. July, 2019 I. August, 2019

Plate 3 Monthly variations of ovary

Discussion and Conclusion

A total of 180 fish samples were analyzed during the study period. The sex ratio was 1:1.31 (male:female) not departing significantly from the expected sex ratio of 1:1 ($P < 0.05$). Most researchers have reported sex ratios in favor of female populations. Soomro *etal*., 2015 stated the dominance of female numbers in their studied fish *Mystus cavasius* from lower Indus River. They also revealed that previously female population dominating over male *M.cavasius* is reported by different authors (Rao and Sharma, 1984; Roy and Hossain, 2006; Musa and Bhuiyan, 2007;Gupta and Banerjee, 2013) cited by Soomro et al., 2015. According to monthly calculated mean values, testis weight ranged from 0.01 (January 2019) to 0.04 (May 2019), whereas the range of ovary weight was from 0.14 (March 2019) to 3.73 (July 2019). In most of teleostean species, gonad weight depends on the part of body weight (Mahboob and Sheri, 1997 cited by Mahboob and Sheri, 2002). However, in this study, gonad weight does not usually depend on the body weight. Monthly calculated mean values in standard length and body weight of male ranged from 10.39 cm to 11.86 cm and 15.82 g to 22.51 g in male. This data in female, 10.06 cm to 12.68 cm and from 16.3 g to 31.38 g were observed. According to mean values, present results also indicate that the females *M.cavasius* were larger than the males. Different finding was observed for *M. cavasius* from Indus river (Soomro *et al*., 2015). Male *M.cavasius* ranged in standard length from 9.5 cm to 13.5 cm with a mean of 10.88 ± 0.88 cm while female ranged from 9.4 cm to 17.5 cm with the mean value of 11.67 ± 1.3 cm. With respect to weight of studied fish showed the lowest 12.09 g and the highest 29.71 g with the mean value of 19.05 ± 4.10 in male, and the lowest 11.46 g and the highest 54.67 g with the average of 23.54 ± 7.75 in female. Length-weight relationship is considered to be one of the important biological information in order to describe mathematical relationship between the two variables, length and weight. If one is known, the othercan be determined easily. The coefficient determination r^2 is closed to (1), suggesting a good adjustment (Costa and Araujo, 2003 cited by Cho Cho Win, 2009). Regard with length-weight relationships, the correlation coefficient in studied species $r = 0.5296$ showed moderate correlation for male and $r = 0.871$ with high correlation for female *M.cavasius*. The length-weight relationship in fishes can be affected by several factors including habitat, area, seasonal effect, degree of stomach fullness, gonad maturity, sex, health preservation techniques and differences (Tesch 1971 cited by Hossain *et al*., 2009). The condition factor (K) gives information on the physiological condition of fish in

relation to its welfare (Getso *et al*., 2017). Perry *et al*. (1996) reported that fishes experienced with adverse physical environment or insufficient nutrition showed low condition index. Monthly mean K values of studied male species ranged from 1.13 to 1.53 and in female from 1.21 to 1.43. Ujjania *et al*. (2012) stated that condition factor greater or equal to one is good, indicating a good level of feeding and proper environmental condition. According to Maguire and Mace (1993) cited by Getso *et al*. (2017), increase in K values indicates the accumulation of fat and sometimes gonadal development. Angelescu (1958) cited by Getso *et al*. (2017) reported that the highest K values are reached in species if the fish is fully mature, and have higher reproductive potentiality. Generally the present results agreed with their findings. Gonadosomatic index (GSI) has been considered as reliable estimation method for gonad maturity and spawning of any species. GSI has increased according to the fish maturation and reaches to its maximum at the peak period of maturity (Nandikeswari and Anandan, 2013). The highest mean GSI calculated based on monthly for male was 0.22 in May 2019 and the lowest 0.059 in January 2019.The highest 12.33 in July 2019 and the lowest 0.57 in January, 2019 were calculated for females. The highest GSI value of testis in May and that of ovary in July indicates that male mature earlier than females. Maya *et al*. (2018) found that the GSI in *M.cavasius* for male was found highest in early July and lowest in late September, and for female it was highest in late July and the lowest in October. Farqu (1995) and Saha *et al*. (2014) described that four catfish species (*M.cavasius, M.vittatus, Heteropneustes fossilis and Clarias batrachus*) breeds from June to July. In this studied species, eggs were clearly visible in May and commenced egg count from this month. With scattered diagram that show relation between GSI and standard body length, this studied species mature and spawn at the size of 9-13 cm. So somewhat smaller or equal to this size should not catch to conserve this species. Fecundity is an index which measures the number of eggs carried by a gravid female fish. It is one of the various reproductive characteristics of fish species, thus fecundity estimate is of great importance for fisheries science (Hunter and Goldberg, 1980 cited by Eyo *et al*., 2013). Fecundity estimation was made based on the 20 gravid female *M.cavasius* with the range of standard length 10.2 cm to 17.5 cm and body weight from 13.76 g to 54.67 g. The largest fecund female with 58889.5 eggs measured 15.5 cm standard length, 54.67 g body weight and ovary weight 8.89 g. Least number of eggs 4856 was found in a female measuring 10.2 cm in length, 14.56 g body weight and 0.92 g ovary weight. The results showed that the largest number of egg was found in the largest female while the smallest number of egg count was not found in the smallest female. During the study, it was observed that the ovaries of the same size of fishes contained different numbers of eggs. Similar results were obtained in the works of Hossain (2014). He also stated that this variation may be due to the variations in environmental conditions and food intake by individuals. The fecundity and its relation to female size make it possible to estimate the potential egg output (Chondar 1977 cited by Hossain *et al.,* 2012) and the potential number of offspring in a season and reproductive capacity of fish stocks (Qusim and Quyyum 1963 cited by Hossain *et al.,* 2012). The relationships with absolute fecundity and standard length, body weight and ovary weight were highly correlated in studied species. Thus the present work would be useful for the future research with the fish *M.cavasius* and to develop an appropriate culture technology for the species and subsequently for the better management of the fishery resources and proper conservation of the species.

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