



FECUNDITY ANALYSIS OF A FRESHWATER FISH *MASTACEMBELUS ARMATUS* (LACEPEDE) FROM RIVER NAYAR, UTTARAKHAND

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Abstract: *Mastacembelus armatus* (Lacepede) is one of the most important eel like hillstream fish belonging to order Mastacembeliformes and family Mastacembelidae. During last few decades, the population of this species is considerably declining due to overfishing and other anthropogenic activities. Present investigation is an attempt towards conservation of this species in which reproductive power of the fish is estimated and preferred habitat and breeding grounds of fish were studied. The fish is monsoon breeder with maximum fecundity 11810.667 ± 1716.994 , observed in a fish size of 42.233 ± 1.365 cm and body weight 153.333 ± 7.638 g. The size of mature egg ranges from 1.2-1.6 mm. With the help of regression analysis, the relationship of fecundity with different body parameters was also traced out. It is suggested that avoiding fish catch during breeding season will be very helpful in conservation of species.

Keywords: Fecundity, *Mastacembelus armatus* (Lacepede), Nayar, Uttarakhand

Introduction

Reproduction is a biological process of a living organism through which it maintains its race and inherits its characters to new generation. Fish is the only group which has a diverse breeding quality. Some of the fishes are annual breeders, some are seasonal breeders, some are multiple spawner, which breed twice or thrice in a year, some breed once in a decade and some others breed only once in life time (Singh et.al. 1985). It is also quite variable that a species may spawn lacs of eggs while others may spawn only few hundreds or thousands in totality. Fecundity is basically defined as the reproductive capacity of a fish or number of eggs that are like to be spawned by a fish in a given attempt. The knowledge of Fecundity is very significant in fish biology because a proper management has to be done under control condition for fertilization, hatching

and further development of fish seed. Fecundity of fishes is variable from species to species and even within different populations of the same species in different ecological conditions. In the present study fecundity of *Mastacembelus armatus* (Lacepede) was estimated and mathematical relationship of fecundity with different body parameters was calculated using standard statistical techniques.

Review of literature indicated that a lot of work has been conducted on fecundity of fishes. Some of the significant contributors are Pathani (1982), Singh et al (1982, 1985), Sharma (1984), Nautiyal and Lal (1985), Agrawal et al (1988), Dobriyal (1988, 2012), Dobriyal and Singh (1987,1989), Dobriyal et al (1990, 2000, 2004, 2009, 2011), Kumar et al (2006), Rautela, et.al. (2006), Bahuguna et.al. (2007), Ram Kishan et.al. (2011),



Singh, et.al. (2012), Bahuguna and Dobriyal (2013), and Thapliyal et.al. (2018).

Material and Methods

The samples were procured from local fishermen during January 2014 to December 2015 from river Western Nayar. The habitat and behaviour of fish was observed on the spot and discussed with the experienced local fishermen. For fecundity study only mature specimens in limited number were taken into consideration and were preserved in 4 % formalin for further study after taking morphometric measurements. Size of mature egg was measured with the help of ocular micrometer and breeding season was estimated by Dobriyal Index (Dobriyal et.al 1999) and field observations on the spot. Only 20 mature females ranging from 28 to 43 cm in length were examined. The absolute fecundity was estimated by taking three random samples of 100 mg each from different regions of ovary. The total number of eggs in each ovary was estimated by following formula:

$$F = S \times OW / 100$$

In which: F = Fecundity, S = Average number of eggs obtained from three different samples of 100 mg each, OW = total weight of ovary in mg.

The relative fecundity was also calculated for each fish in terms of per g body weight, i.e.,

$$RF = AF / FW \text{ (g)}$$

In which: RF = Relative Fecundity, AF= Absolute Fecundity FW (g)= Fish Weight in g

The relationships between body length and fecundity, body weight and fecundity, ovary length and fecundity and ovary weight and fecundity were calculated by plotting the respective values as a scattered diagram and fitting the straight line equation $Y = a + b X$

In which: Y = Dependent variable, fecundity and relative fecundity X = Independent variable, Fish length, Fish weight, Ovary length, Ovary weight, 'a' and 'b' are the constants (intercept and slope)

The correlation coefficient (r) and correlation o determination (r^2) were calculated for each relationship which was tested by the analysis of variance (F test)

Results

Summarised data on the body parameters of *Mastacembelus armatus* and its fecundity and relative fecundity are presented in Table 1.

Table 1: Summarized data on the fecundity of *M armatus*

Size group	Fish length (cm)	Fish weight (gm)	OvaryLength (cm)	Ovary weight (g)	Absolute fecundity	Relative fecundity/ gram body weight
25.1-30.0	28.0 ± 0.0	48.0 ±0.0	6.0 ± 0.0	4.35 ± 0.0	9900 ±0.0	206.25 ±0.0
30.1-35.0	33.464 ±1.444	87.342 ±24.276	6.809 ±0.746	7.789 ±3.216	11618.364 ±316.804	133.08 ±13.04
35.1-40.0	37.060 ±0.754	130.000 ±7.906	8.500 ±0.975	15.172 ±0.539	11577.00 ±921.761	89.05 ±116.62
40.1-45.0	42.233 ±1.365	153.333 ±7.638	9.233 ±0.252	15.733 ±0.764	11810.667 ±1716.994	77.03 ±225.9

The relationship between fecundity and different body parameters are presented in Fig 1 (FL x F), Fig 2 (FW x F), Fig 3(OL x F) and Fig 4 (OWx F).

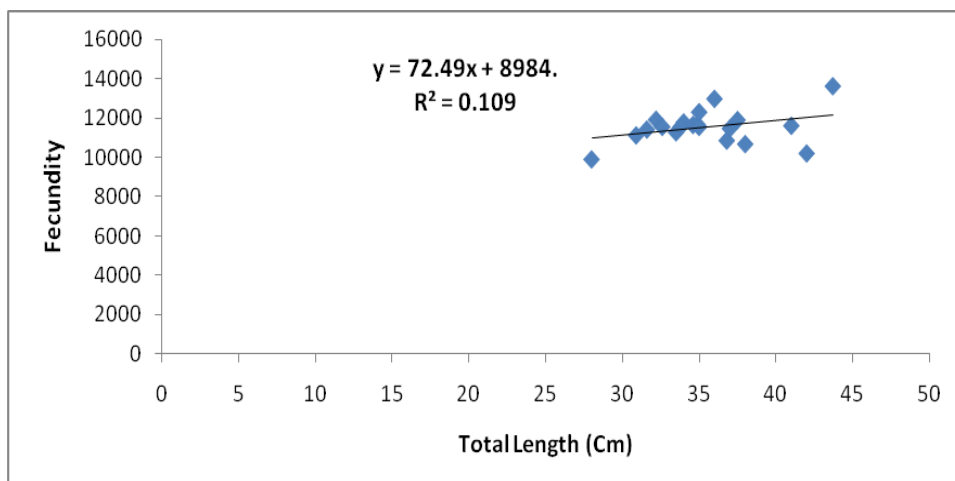


Fig 1: Regression analysis between Total length and Fecundity in *M. Armatus*

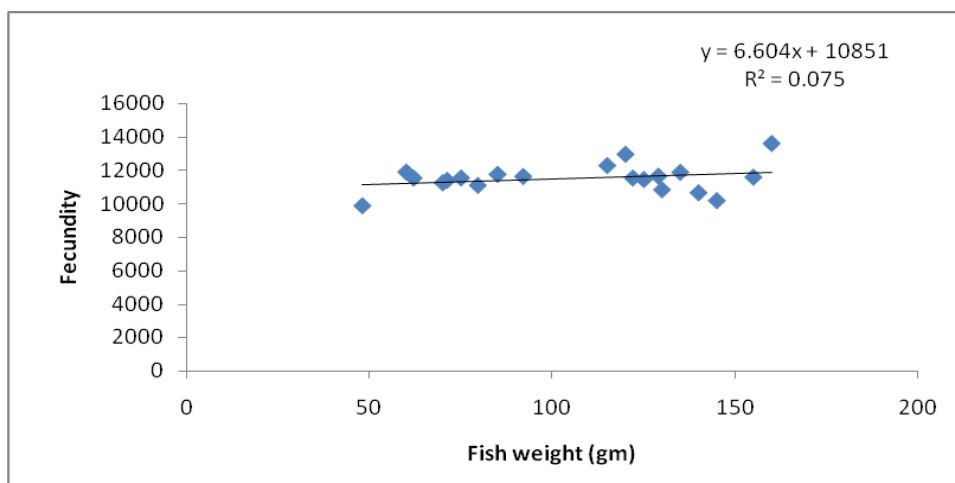


Figure 2: Regression analysis between Total weight and Fecundity in *M. Armatus*

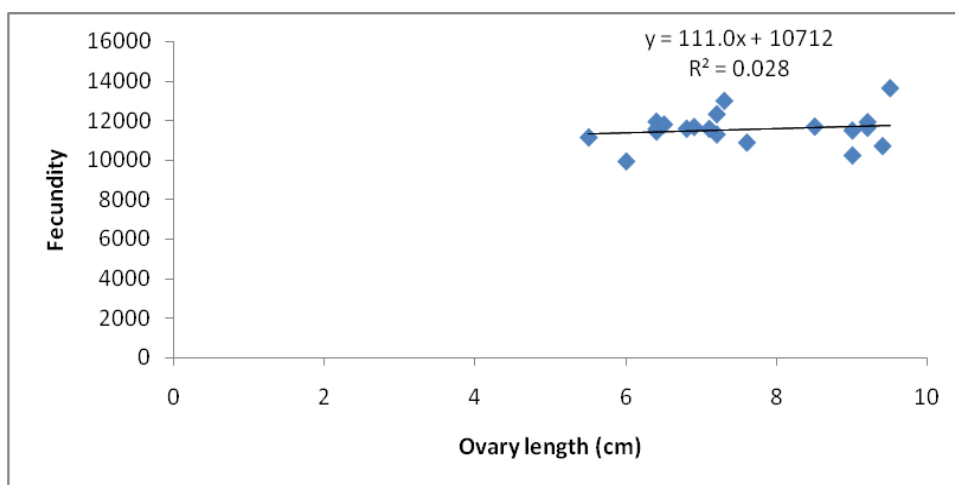


Figure 3: Regression analysis between Ovary length and Fecundity in *M. Armatus*

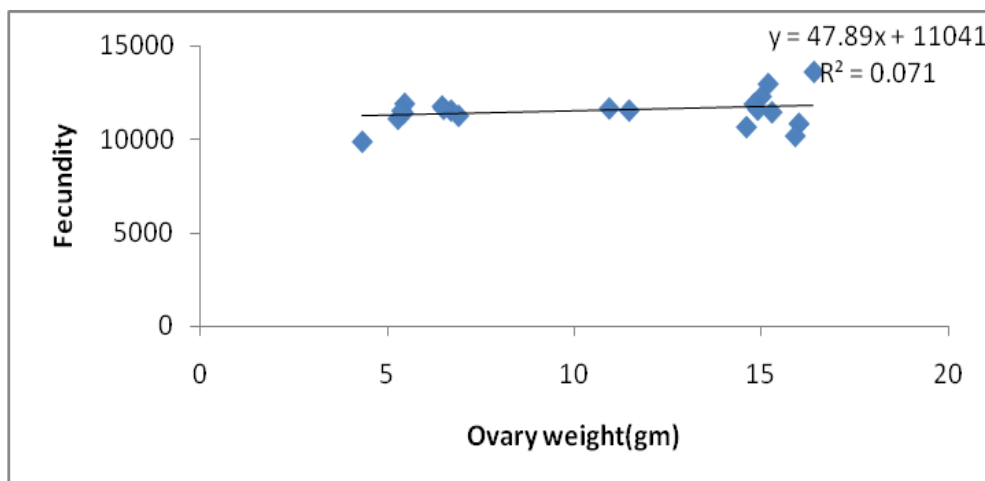


Figure 4: Regression analysis between Ovary weight and Fecundity in *M. Armatus*

The statistical modelling for each data related to fecundity and body parameters are presented in Table 2.

Table 2: Statistical data on the relationship of fecundity with independent body parameters

Relationship Between:	“a”	“b”	“r”	“r ² ”	“F” (ANOVA)	F _{0.05} critical value
TL x Fecundity	8984	72.49	0.3301	0.109	3794.495	Significant
BW X Fecundity	10851	6.604	0.273	0.075	3741.736	Significant
OL x Fecundity	10712	111.0	0.167	0.028	3812.941	Significant
OW x Fecundity	11041	47.89	0.266	0.071	3810.783	Significant

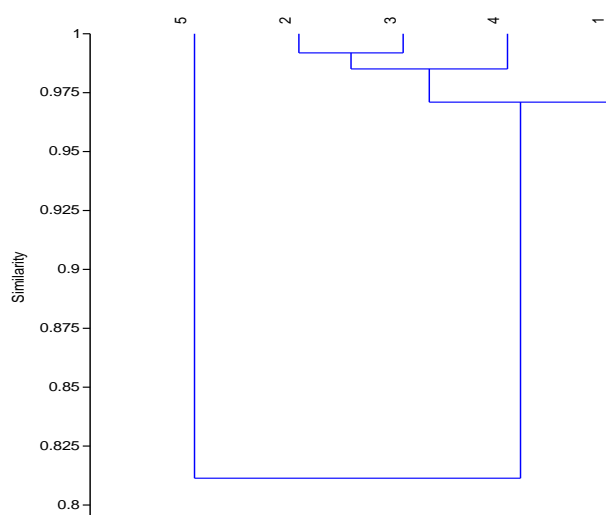


Figure 5: Clusture analysis between Fecundity (5) and Fish length (1), Fish weight (2). Ovary length (3) and Ovary weight (5) in *M armatus* based on correlation similarity

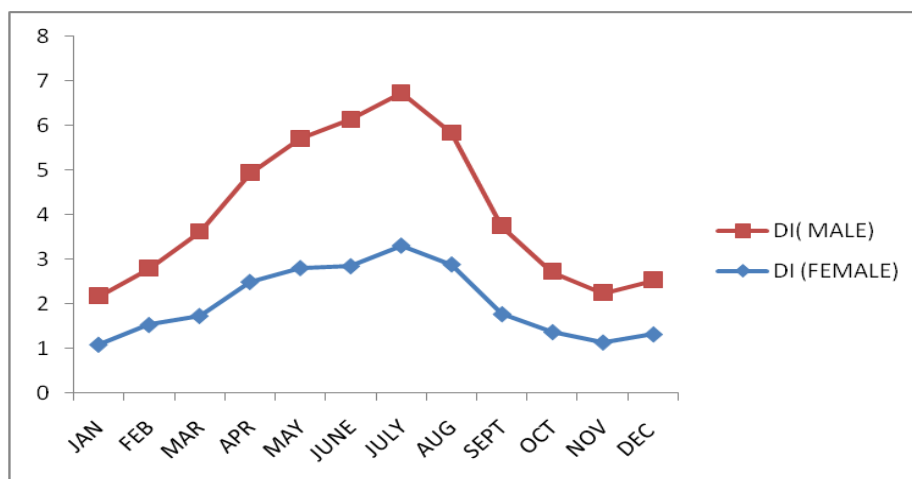


Figure 6: Dobriyal index for *Mastacembelus armatus* (Male and Female)

The multivariate analysis is done for the relationships between Fecundity and body parameters (Fig 5) by using cluster analysis based on correlation similarity by the software PAST. The spawning season of the fish was estimated by using Dobriyal Index (Fig. 6), which showed its peak in July and sharp fall in August indicating the period of high maturity in July and spawning in August

Discussion

Fecundity of a fish is directly related to its population dynamics and conservation issue. *Mastcembelus armatus* is a freshwater fish which has limited population and narrow range of habitat preference. The present study on fecundity of *M armatus* was studied in Nayar. The fecundity of fish ranges from 9900 in a fish of 28 cm to the maximum 11,810 in a fish measuring 42 cm. In general the fecundity increases with an increase in all the body parameters in *M armatus*. Fecundity estimation also depends on the size of eggs. In small size fish the relative fecundity is more, i.e., 206 per g body weight which decreases continuously with an increase in fish size. In average size of 33.4 cm the relative fecundity went down to 133 per g body weight, in fish size of 37.06 the RF was 89, whereas in the fish measuring largest average size 42.3, the RF was lowest 77. There may be two reasons for it. Firstly

the size of egg was low (up to 75 omd, 1 omd = 0.016 mm) in case of small size fishes and more in large sized fishes, secondly at the time of capture the fish might of already spawned some mature eggs, because it was observed that size of egg was very large (1.8 mm) in some fishes.

In freshwater fishes there are several reports of low fecundity. Jyoti and Malhotra (1972) reported the fecundity of *Schizothorax niger* from Kashmir valley as 8100 to 13940 in the fish ranging 12.3 to 36.5 cm. Raina (1977) reported the fecundity of *Schizothorax esocinus* to be 3,910 to 53,108 in the fish length group of 14.9 cm to 39.7 cm. Mishra (1982) while working on the biology of *Schizothorax richardsonii* (Gray) reported its fecundity as 3832 to 10,251 in the fish range of 35-53 cm in river Alaknanda. Agrawal et.al (1988) opined that the fecundity of *S.plagiostomus* had a range from 3474 to 13016 in the fish ranging from 30.1 to 55 cm and ovary weight from 13.2 to 19.7 g.

Rautela et.al. (2006) reported fecundity of *Garra lamta* from 4,930 to 55,553 and of *Glyptothorax telchitta* from 1208 to 7472 in the Khoh river of Garhwal Himalaya. Thapliyal et. al (2018) observed the fecundity of *Pseudecheneis sulcatus* in a range of 1299 to 6435 in the fish measuring 12.2 to 20 cm. Kumar et al (2004) reported fecundity as 1679 to 4000 in *Wallago attu*. Bahuguna et.al. (2007) reported fecundity in *Puntius conchoniis* as low as 523 in a fish of 5.4 cm to 1366 in the fish of 7.7 cm from river Mandal of Garhwal Himalaya. Dobriyal (2012)



reported fecundity of *Lepidocephalus guntea* in a range of 340 in a fish of 5.9 cm to 3260 in the fish of 8.4 cm.

In some cases high fecundity has also been reported. Joshi and Khanna (1980) reported the fecundity range of 47,168 to 3, 80,714 in *Labeo gonius*. According to Dobriyal et. al (2003), the fecundity of *Crossocheilus latius latius* was in a range of 20,660 to 70,630 in the fish measuring 16.0 to 26.3 cm from river Mandakini of Garhwal, Uttaranchal. Singh et.al. (2012) also reported high fecundity of *Labeo calbasu* from Ganga at Allahabad.

In the present study a straight-line relationship was observed between the fish length and fecundity, fish weight and fecundity, ovary length and fecundity, ovary weight and fecundity. In case of relationship between body length and fecundity the equation obtained was $\text{Fecundity} = 8984 + 0.3301 \text{ body length}$ ($r = 0.3301$, $r^2 = 0.109$, $F_{0.05} = 3794.495$). Relationship between body weight and fecundity was $\text{Fecundity} = 10851 + 6.604 \text{ body weight}$ ($r = 0.273$, $r^2 = 0.075$, $F_{0.05} = 3741.736$). For ovary length and fecundity the equation calculated was $\text{Fecundity} = 10712 + 111 \text{ ovary length}$ ($r = 0.167$, $r^2 = 0.028$, $F_{0.05} = 3812.941$). Similarly the relationship between ovary length and fecundity was traced as $\text{Fecundity} = 11041 + 47.89 \text{ ovary length}$ ($r = 0.266$, $r^2 = 0.071$, $F_{0.05} = 3810.783$). Thus the strongest relation was between body length and fecundity followed in decreasing order by body weight- fecundity, ovary weight – fecundity and least in ovary length- fecundity. Singh et al (1982) reported that the fecundity increases with an increase in fish length in *P. chilinooides*. According to Agrawal et al (1988), total fecundity consistently increases with an increase in the body parameters in *Nemacheilus montanus*.

It is evident that the ecological conditions of stream play a vital role in the development, maturation and fecundity of fish (Bahuguna et.al., 2007). The fecundity of cold water fishes is generally low due to the lower temperature range and less availability of food in nature. Nikolsky (1961) stated that the food consumed by fish determines not only the fecundity but also the quality of sexual products. Nautiyal and Lal

(1985) also suggested that the poor fecundity of Garhwal Himalayan mahseer, *Tor putitora* might be due to food paucity.

Multivariate analysis was also performed in present study on *M. armatus* based on correlative cluster analysis. The primary cluster was made by body weight and ovary length and secondary by the ovary weight and primary cluster. Fish length joined it as tertiary cluster. Top cluster was made by the fecundity. It shows a haphazard pattern in cluster formation.

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