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Fecundity of Gulsha *Mystus cavasius* (Hamilton) from Brahmaputra and Kongsa rivers

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Abstract

The fecundity of *Mystus cavasius* Hamilton collected from the Brahmaputra river and the Kongsa river was estimated by gravimetric method. The fecundity of the Brahmaputra river fish ranged from 1250 to 23819 with the mean of 10062±704 for the corresponding length of 13.93±0.24cm, body weight of 24.41±1.08g and ovary weight of 1.99 ±0.14g. Whereas the fecundity of fish collected from the river varied from 721 to 44837 with the mean of 11798±1207 for the corresponding length of 15.15±0.24cm, body weight of 24.88±1.09 g and ovary weight of 3.01 ±0.29g. The average number of eggs per gram of ovary was 5064 & 3979 and per gram body weight was 433 & 449 respectively for the fish of the Brahmaputra river and the Kongsa river. The gonadosomatic index (GSI) was calculated to be 8.29±0.47 and 15.63±4.51 respectively for the Brahmaputra and the Kongsa river. The amount of egg produced by a female was more for the fish of the Kongsa river than the fish of the Brahmaputra river. Higher 'n' value of the length-weight relationship $w=aL^n$ for the fish of the Kongsa river indicated better living conditions in the Kongsa than in the Brahmaputra river. The relationship between total length and body weight, total length and fecundity, body weight and fecundity, ovary weight and fecundity of the fish were found to be linear both arithmetically and logarithmically. Relationship were highly significant ($P<0.01$) and the parameters were positively correlated with each other. Ovary weight-fecundity relationship was found to be best fitted (r= 0.95 & 0.94) for the fish of both Brahmaputra river and Kongsa river.

Keywords: Gulsha, Fecundity, Brahmaputra, Kongsa

Introduction

Small indigenous fish species (SIS) are the essential sources of protein, micro-nutrients, vitamins and minerals and these micro-nutrients and minerals are not commonly available in many foods (INFS, 1977). These small fish are main source of animal protein and most of the fat soluble vitamins for the rural people and fishing communities (Hossain *et al.,* 1994). SIS is important as a good resource of our poor and low income groups both in nutrition and economics. Most of our poor people (67% at national level and 86% at international level, Sultana, 2004) are below absolute poverty level are catching these fishes from natural resources as a subsistence fishing and are also able to buy those from market in small quantities by spending small amount of money they earned. SIS production from natural waters in Bangladesh has been gradually declining over the years, some of the economic and delicious species are now being considered as endangered, which were once abundantly found all over Bangladesh. 'Gulsha' (*M. cavasius*) a popular catfish is one of them. It tastes good, consumers like it very much and it's price is very high because of great market demand.

For control production and/or conservation of the species knowledge of fecundity is important. The fecundity estimation is important for understanding of its biology, population dynamics as well as evaluating the commercial potentialities for scientific culture and management. Environmental factors might have also greatly determined the fecundity of *M. cavasius* in different habitat. Therefore an experiment was conducted to investigate the length weight relationship to estimate the fecundity and to establish the relationship between total length and fecundity, body weight and fecundity, ovary weight and fecundity of *M. cavasius* from Brahmaputra and Kongsa rivers.

Materials and Methods

The breeding season of *M. cavasius* in Bangladesh lasts from April to July and samples were collected during that period in 2005. Gravid females of *M. covasius* were collected randomly from the catch of the fisherman of Brahmaputra and Kongsa river and were then taken alive to the laboratory of the Department of Aquaculture, Bangladesh Agricultural University, Mymensingh as quickly as possible for fecundity study. Fifty (50) gravid females were selected from each stock of Brahmaputra river in Mymensingh and Kongsa river in Netrakona district.

Eye observation and common sense were applied in identifying full maturity of the fish. Gravid female was identified with enlarged abdomen and protruded genital aperture. Light pressure on the enlarged abdomen enabled them to be identified correctly with the release of some eggs. The total length of the specimens was measured from the tip of the snout to the end of the caudal fin to the nearest mm by a scale attached against a wooden board. The weights of the specimens were taken by an electric balance (METLER TOLEDO, Switzerland) with the capacity of three decimal points of a gram and were recorded. Excess water attached to fish was removed with the help of blotting paper before weighing.

Collection of ovaries

Fishes were dissected out by scissors starting from anus to lower jaw and the belly was opened. Stomach and intestine were removed carefully by means of fine forceps. Ovary was removed carefully and kept on a petridish. Ovary was washed and cleaned with distilled water. Length and weight of the ovary were taken and color of the ovary was observed and recorded. Ovary was then kept into boiled water for 5 minutes, cooled and preserved in 5% buffered formalin for further study.

Calculation of Gonadosomatic Index

Gonadosomatic index expressed as percentage of gonad weight to the total weight of the fish was calculated for each female separately.

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

Measurement of ova diameter

A random sample of 10 fresh ova was taken from each ovary after separating them from the tissue by a fine needle and brush. Those were arranged in several rows on a glass slide and the diameter of ova was then measured with the help of an ocular microscope. The measurement of ova diameter in nearest mm was recorded.

Estimation of Fecundity

There are several methods for the estimation of fecundity of fish of which the actual counting method was found to be the most accurate one. But this method is very tedious and time consuming as well as rather impossible in case of highly fecund fishes. Generally fecundity estimate have been based on counts from small eggs sample, adjusted to egg number of individual fish by the ratio of volume (volumetric method) or weight (Gravimetric method) of the samples to total volume or weight of the ovary (Lagler, 1956). The gravimetric method has been successfully used by Shafi *et al.,* (1978), Dewan and Doha (1979) and Das *et al.,* (1989) for high fecund fish bearing small eggs. Accordingly, for its greater efficacy over the other methods the gravimetric method was applied in the present study.

From the preserved ovary the external connective tissues and ovarian membrane were removed. The moisture of the ovary was removed with the help of a blotting paper. The weight of the preserved ovary of each fish was recorded in g with the help of an electric balance. At first each ovary was divided into three parts subsequently a part was taken from the anterior, central and posterior regions of both the left and right ovary as a sample and each part is subdivided into several parts again and the number of eggs in each part was counted. Fecundity was estimated by using the following formula.

$$F = \frac{N \times \text{Gonad weight}}{\text{Sample weight}}$$

Where, F = Fecundity of fish

N= Number of eggs in a sample

Data processing

The relationship of different parameters such as total length and body weight, total length and fecundity, body weight and fecundity, ovary weight and fecundity were determined as simple linear relationship both in arithmetic and logarithmic scale with the help of Micro Excel Programme. Regression equations of those relations were established. Coefficient of correlation (r) and regression co-efficient (b) were also determined.

Results and Discussion

Morphology of gulsha fish

The body of the fish is elongated, compressed and naked with small eyes and it possesses four barbels and adipose fin. Mouth usually somewhat subterminal, jaws with villiform teeth in bands. Fins with soft rays, anterior few rays of dorsal and pectoral fin are modified as spine, which is almost smooth. Gills covered by a pair of bony operculum. In case of matured specimens the gonadal enlargement was clearly visible externally.

Ovary

The ovary of *M. cavasius* is paired, situated along the body cavity and ventrally beneath the air bladder closely allied to the body wall. It is separated into two lobes. The ovary was spindle shaped, large at the middle than at the extremities and both were near equal in size and shape. The size and extent of the occupancy of the body cavity vary with the size and maturity of the females. The ovary weight vary also with the size and maturity of the females. The weight of the ovary ranged from 0.36 to 4.38 and 0.38 to 10.33 for the fish of Brahmaputra and Kongsa river respectively (Table 1). The colour 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 the immature one was found whitish in colour.

The diameter of *M. cavasius* ova was found to range from 0.70 to 1.25 mm for Brahmaputra river and from 0.8 to 1.30 mm for Kongsa river.

Fecundity

The fecundity of Brahmaputra river fish ranged from 1250 to 23819 with the mean of 10062±704 for the corresponding length 13.93±0.24cm, body weight 24.41±1.08g, ovary weight 1.99 ±0.14g. The average number of eggs per g of ovary and body weight was 5064 and 433 respectively.

The fecundity of fish collected from the Kongsa river ranged from 721 to 44837 with the mean of 11798±1207 for the corresponding length 15.15±0.24cm, body weight 24.88±1.09 g ovary weight 3.01 ±0.29g. The average number of eggs per g of ovary and body weight was 3979 and 449 respectively. The study indicated that *M. Cavasius* was highly fecund fish. Islam and Azadi, (1989) reported the fecundity of 'Gulsha' to vary from 13425 to 39405 in the size range of 23.2 cm to 29.2 cm. Whereas, Sultana, 2004 reported the fecundity of the Gulsha fish ranging from 15555 (17.5 cm in length) to 58321 egg (22.3 cm in length). In the present study the fecundity was found highly variable, which might be due to the continuous degradation of the aquatic environment together with other causes like feeding, availability of food organisms etc.

In the present study the value of GSI was found to be 8.29±0.47 for the fish of Brahmaputra river and 15.63±4.51 for the fish of Kongsa river (Table 1). The highest gonadosomatic index of 16.48 and 27.1 was recorded for *M. cavasius* and the lowest gonadosomatic index of 1.59 and 2.11 were calculated for the fish from the source in Brahmaputra river and Kongsa river respectively. This variation might be associated with the degree of maturity of ova. Those values are within the range of the findings of Khan *et al.* (1990), for *M cavasius,* Das and Das (1999), for *Notopterus notopterus* Pallas.

The ova diameter of *M. cavasius* was found to range from 0.70 to 1.25 mm for the fish live in Brahmaputra river and 0.80 to 1.30 mm for the fish live in Kongsa river. This variation might be associated with the degree of maturity of ova. This finding agrees with the findings of Das *et al.,* (1989), for *Heteropneustes fossilis.*

Table 1. Total length, body weight, ovary weight, gonadosomatic index (GSI) and fecundity of female *M. cavasius* from Bramaputra and Kongsa river

Source of fish	Mean total length (cm) ± standard error	Mean body weight (g) ± standard error	Mean ovary weight (g) ± standard error	Mean GSI ± standard error	Mean fecundity (no.) ± standard error
Brahmaputra river	13.93±0.24 (10.80-17.20)	24.41±1.08 (12.37-43.27)	1.99±0.14 (0.36-4.38)	8.29±0.47 (1.59-16.48)	10062±704 (1250-23819)
river	15.15±0.22 (11.00-18.60)	24.88±1.09 (4.44-46.35)	3.01±0.29 (0.38-10.33)	15.63±4.51 (2.11-27.21)	11798±1207 (721-44837)

*Figures in the parentheses indicate ranges of different parameters

Relationship between total length and body weight, total length and fecundity, body weight and fecundity, ovary weight and fecundity

In determining length-weight relationship length (L) was taken as independent variate and weight (w) was taken as dependent variate. In the determination of other relationships the total length (L), body weight (W), ovary weight (OW) were taken as independent variate (X), while fecundity (F) as it depends on them was taken as dependent variate (Y).

Relationship between total length and body weight

The scattered diagram obtained for the total length and body weight relationship shows a perfect correlation. The body weight (W) of the fish was plotted against their total length (L) both on arithmetic and logarithmic scales and shows the regression to be positive as the correlation. Calculating the values of regression co-efficient, intercept and co-efficient of correlation, the regression equation of weight (W) on total length was established for the fish (Table 2 & 3, Fig. 1 & 2).

Table 2. Showing b, r and regression equation of total length and body weight, total length and fecundity, body weight and fecundity, ovary weight and fecundity of *M. cavasius* from the Brahmaputra river

Relationship	Regression coefficient (b)	Coefficient of correlation (r)	Regression equation
Total length (L) body weight (W)	4.26 (2.46)	0.94** (0.95**)	W = 4.26L - 34.97 (LogW = 2.46 LogL - 1.44)
Total length (L) Fecundity (F)	1372.62 (1.79)	0.47** (0.39**)	F = 1372.6L - 8814.7 (LogF = 1.79 LogL + 1.91)
Body weight (W) Fecundity (F)	313.54 (0.75)	0.49** (0.43**)	F = 313.54W + 2648.1 (LogF = 0.75 LogW + 2.93)
Ovary weight (OW) Fecundity	4940.76 (1.02)	0.95** (0.96**)	F = 4940.76 OW + 229.18 LogF = 1.02 LogOW + (3.69)

*Figures in the parentheses indicate different parameters of logarithmic relationship

Table 3. Showing b, r and regression equation of total length and body weight, total length and fecundity, body weight and fecundity, ovary weight and fecundity of *M. cavasius* from the Kongsa river

Relationship	Regression coefficient (b)	Coefficient of correlation (r)	Regression equation
Total length (L) body weight (W)	4.38 (2.68)	0.91** (0.93**)	W = 4.38L - 40.62 (LogW = 2.68LogL - 1.76)
Total length (L) Fecundity (F)	2274.23 (2.73)	0.414** (0.37**)	F = 2274.23L - 22647 (LogF = 2.73LogL + 0.75)
Body weight (W) Fecundity (F)	696.46 (1.43)	0.61** (0.56**)	F = 696.46W - 6057.3 (LogF = 1.43 LogW + 1.98)
Ovary weight (OW) Fecundity	3904.61 (0.99)	0.94** (0.98**)	F = 3904.6 OW + 41.944 (LogF = 0.99 LogOW + 3.59)

*Figures in the parentheses indicate different parameters of logarithmic relationship

Length bears a strong positive relations with the weight. The value of 'r' was found 0.94 and the equation was log w = 2.46 log L-1.44 for the fish live in Brahmaputra river and r=0.91 and the equation was found to be logW= 2.68 logL-1.76 for the fish live in Kongsa river. The value of coefficient of correlation showed that the relationship between length and weight of the fish was highly significant ($P<0.01$). The fish obeyed Le Cren's law; the value of n in the length-weight equation ($w = aL^n$) was found to be 2.46 and 2.68 which were within the range 2.0-4.0 (Le Cren, 1951). The higher "n" value of the equation for the fish of indicate more robustness than the Brahmaputra fish, which subsequently indicated better living conditions of the fish in river.

The correlation coefficient of the total length and body weight was found 0.94 for the fish live of Brahmaputra river and 0.91 for the fish live of Kongsa river. Again coefficient of correlation between log total length and log body weight was found 0.95 for the fish live of Brahmaputa river and 0.93 for the fish live of Kongsa river (Table 2 & 3). In both the cases 'r' values were highly significant ($P<0.01$).

Relationship between total length and fecundity

The arithmetic and logarithmic relationships between total length and fecundity are shown in Fig. 3 and 4 respectively. The regression line in both the arithmetic and logarithmic relationship showed that the total length and fecundity were linearly related (shown in Table 2 & 3). The established relationships were highly significant ($p<0.01$).

From the regression equation obtained for total length and fecundity relationship, it was evident that the fecundity of *M. cavasius* bears a linear relationship with the total length. This findings agrees with the findings of Islam & Azadi (1989) for *M. cavasius,* Dewan and Doha (1979), for certain pond fishes, Mustafa *et al.,* (1980) for *Nandus nandus,* Das *et al.,* (1989) for *H. fossilis,* Kabir *et al.,* (1998) for *Gudusia chapra* as all the authors found straightline relationship.

Relationship between body weight and fecundity

The relationship of fecundity (F) and body weight (W) was calculated and expressed by the arithmetic and logarithmic formula (shown in Table 2 & 3). The correlation coefficient (r) between fecundity and log body weight relationship for the fish live in Brahmaputra and Kongsa river are highly significant ($P<0.01$). The regression equation and scattered diagram showed a positive and linear relationship between body-weight and fecundity (Fig. 5 & 6). Increase in fecundity with the increase in body weight is reported by various scientists, notably Dewan and Doha (1979) for certain ponds fishes (*Chela phula, Esomus danrica, Anblypharyngodon mola, Aplocheilus panchax, Ambassis nama, Glossogobius giuris* and *Colisa lalius*), Rishi and Kaul (1982) for *Mystus tengara,* Azadi *et al.* (1987) for Mystus vittatus, Das *et al.* (1989) for *H. fossilis,* Hossain *et al.* (1991) for *N. notopterus;* Misra (1994) for *Anabus testudineus* and Kabir *et al.* (1998) for *Gudusia chapra*, Das and Das (1999) for *N. notopterus.*

Relationship between ovary weight and fecundity

The data for the relationship between ovary weight and fecundity are given in the Table 2 & 3 for the fish from different sources (Brahmaputra and Kongsa river). A scattered diagram for the fecundity and ovary weight of the fish showed nearly a perfect correlation (Fig. 7 and 8). Here it is clearly observed that the number of eggs of *M. cavasius* from both the source in Brahmaputra and Kongsa rivers increased progressively with the ovarian weight. The relationship between ovary weight and fecundity was found to be the most significant ($p<0.01$) $r = 0.96$ and 0.98 for both Brahmaputra and Kongsa river than the relationship of fecundity with other parameters. Similar strong relationship was establish for *M. vittatus* by Azadi *et al.,* (1987), Das *et al.,* (1989) also recorded highly significant relationship between fecundity and gonad-weight in their study on *H. fossilis.*

Higher fecundity and 'b' value of the length weight relationship indicates the better habitable space for the species in Kongsa river than Brahmaputra river. Although in the present study a very highly significant relationship between total length and fecundity, body weight and fecundity, ovary weight and fecundity were found the relationship between ovary weight and fecundity was found to be the most prominent ($P<0.01$; $r= 0.95$& 0.94). The findings of the present study will provide base line information about the number of eggs produced by a female and its dependent factors will help in artificial breeding, fry rearing and rearing up to marketable size. 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.

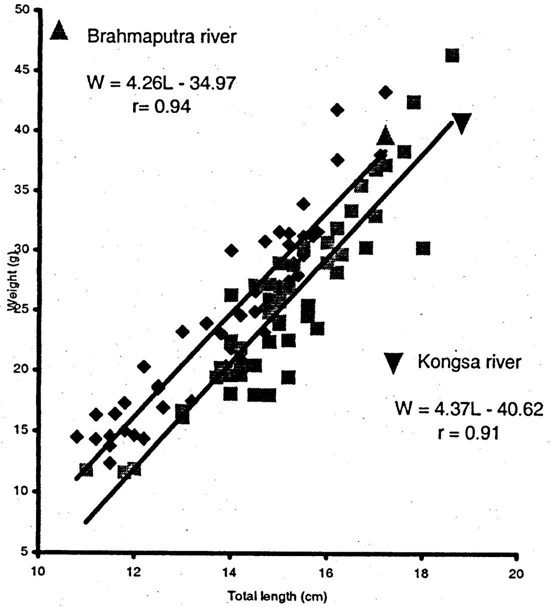

Fig. 1. Arithmetic relationship between total length and body weight of *M. cavasius* from Brahmaputra and Kongsa river

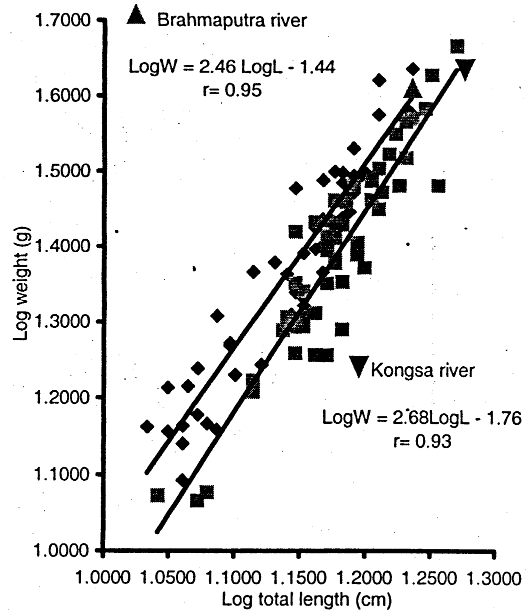

Fig. 2. Logarithmic relationship between total length and body weight of *M. cavasius* from Brahmaputra and Kongsa river

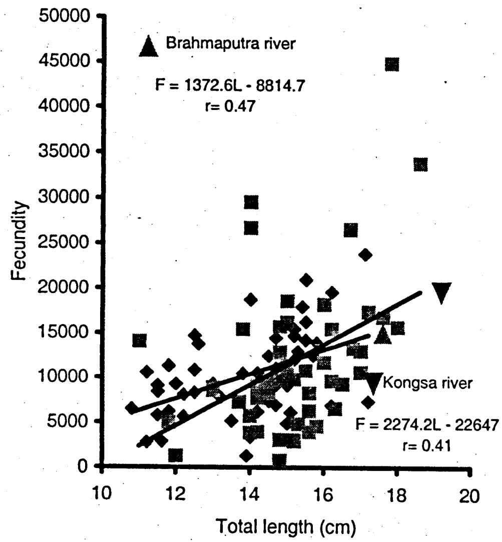

Fig. 3. Arithmetic relationship between total length and fecundity of *M. cavasius* from Brahmaputra and Kongsa river

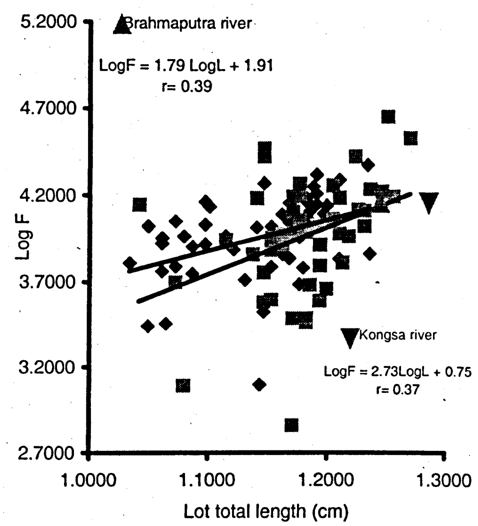

Fig. 4. Logarithmic relationship between total length and fecundity of *M. cavasius* from Brahmaputra and Kongsa river

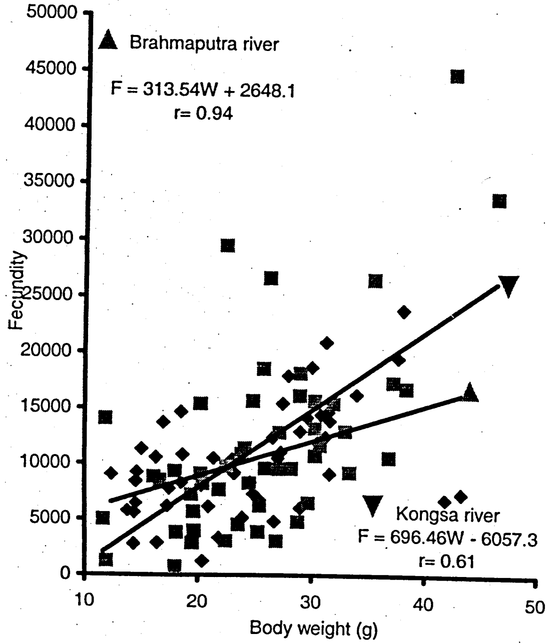

Fig. 5. Arithmetic relationship between body weight and fecundity of *M. cavasius* from Brahmaputra and Kongsa river

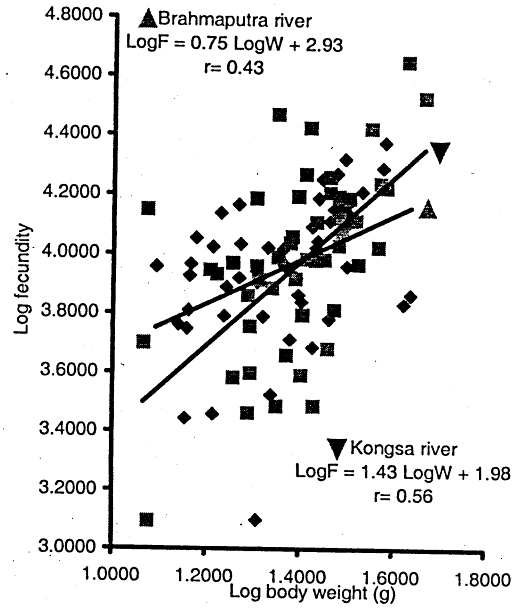

Fig. 6. Logaritmic relationship between body weight and fecundity of *M. cavasius* from Brahmaputra and Kongsa river

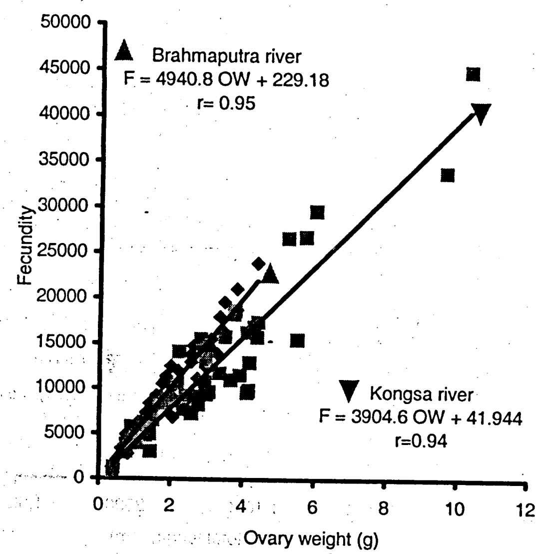

Fig. 7. Arithmetic relationship between ovary weight and fecundity of *M. cavasius* from Brahmaputra and Kongsa river

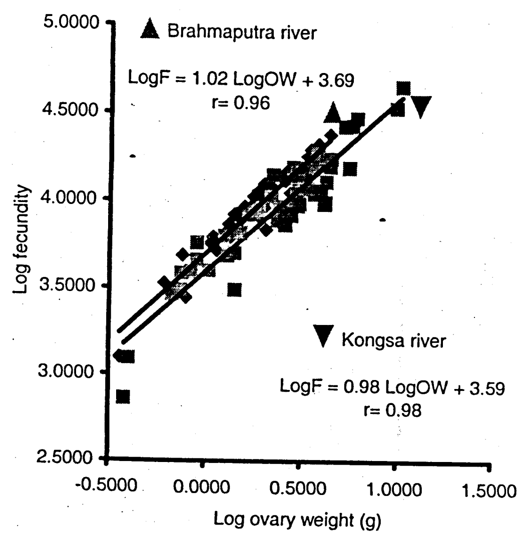

Fig. 8. Logarithmic relationship between ovary weight and fecundity of *M. cavasius* from Brahmaputra and Kongsa river

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