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Trends in Relative Fecundity Estimation and its Relationship with Body Length and Weight in Himalayan Prawn *Macrobrachium dayanum*

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Abstract: Fecundity is the total no. of eggs produced by a female with reference to body weight during the average life span. The eggs were found attached to the body of the female inside the brood chamber. During the estimation of fecundity it was found that *Macrobrachium dayanum* spawned twice in a year (i) from May to July and (ii) Nov to Dec. It was observed that the no. of eggs spawned varied considerably with total length and body weight. The length of berried females, considered for the present study, ranged from 4.2 cm to 5.7 cm. The generalized trend as recorded during the present investigation revealed that the number of eggs showed an increasing trend (98-104) with the length increment (4.2-4.5 cm). Increasing trend of the egg number in relation to body length was in the order: 4.2 cm: 90; 4.3 cm: 99.5; 4.5 cm: 102. Following this, however, a decline is evident as the number of eggs was found to be 78 when the mean body length was 4.6 cm. The mean fecundity calculated was 50.75 ± 9.02 for the mean total body weight of 1.95 ± 0.47 g with average no. of eggs recorded as 95.6 ± 9.14. In *Macrobrachium dayanum* the breeding capacity ranges from 78 to 104 and increases with an increase in all the body parameters. The straight-line relationship has been observed between the fecundity and prawn length/weight. The fecundity was more dependent on body weight than the body length.

Keywords: *Macrobrachium dayanum*, Eggs, Length, Body weight

I. INTRODUCTION

It is important for a species to maintain and increase population density. Fecundity is important and well-studied in the field of population ecology. The increase or decrease in fecundity depends upon the times of hardship such as lack of food faced by the population as a whole and individual in particular. It is also very important in estimating the reproductive potential of a prawn species which in turn helps management strategies of prawn hatcheries, estimating the number of berried females required for producing desired quantity of seeds. According to Abowei et al. fecundity is a measure of the reproductive capacity of brood of prawns and also a function of population of the prawn especially the population of the females [1]. The evaluation of fecundity becomes necessary because it is considered a measure of the reproductive fitness of Crustacean [2] and is directly influenced by natural selection [3]. Crustaceans, especially members of the order Decapoda (shrimp, crabs, lobsters, etc.) are ecologically and economically important. This interest has prompted scientific studies in many areas, including reproduction. Studies in this area were initially conducted to generate data that could be used in aquaculture, including studies on larval development and gonadal maturation [4]. Intraspecific variation is the most important morphological, reproductive, and behavioural features of the majority of the species of *Macrobrachium* that has been studied only superficially. In particular, fecundity and egg size are two highly variable characteristics in most species of *Macrobrachium*. These two features can vary with female size and geographical location, as well as in the course of the incubation period [5], according to the time of the year [6], the quality of the diet [7] among other factors. The plasticity of these features may be a way of rapidly adapting to the changing conditions of freshwater habitats. In commercially exploited species, such studies are important to support governmental regulation of fishing, thus preventing the excessive reduction of stocks or adverse impacts on the

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environment. Hence the present study is aimed to study the fecundity of fresh water prawn *Macrobrachium dayanum* and its relationship with body parameters.

Fecundity Estimation

Fecundity in prawn was estimated by using Gravimetric method. The mature eggs were removed from pleopod and were counted with the help of pointed needles. The mean number of eggs were calculated and then divided by total weight to determine Relative fecundity. Relative fecundity was calculated by using formula:

Relative fecundity = Total number of ova/ Total weight of the prawn

The trend of relationship of fecundity with body length and weight was established by using formula:

$$F= a + b X$$

Where,
F= fecundity
L= body length
W= body weight
a and b are constants

II. RESULTS AND DISCUSSION

Fecundity is the total number of eggs found in a brood (Fig. 1) and in the present study it was observed that the no. of eggs spawned varied considerably with total length and body weight. The length of berried females, considered for the present study, ranged from 4.2 cm to 5.7 cm. The generalized trend as recorded during the present investigation revealed that the number of eggs showed an increasing trend (98-104) with the length increment (4.2-4.5 cm) as shown in Table 1 as has also been held by Dautov et al. who found that in larger females the absolute fecundity increased, reached the maximum value, and then decreased again in the largest females [8]. In the large sized individuals however, decline in mean number of eggs (78) was recorded. Increasing trend of the egg number in relation to body length was in the order: 4.2 cm: 90; 4.3 cm: 99.5; 4.5 cm: 102. Following this, however, a decline is evident as the number of eggs was found to be 78 when the mean body length was 4.6 cm. The apparent reasons for such variation could be (i) young and maturing organisms are obviously more fecund as compared to spent/old prawns. (ii) Mean egg size increases with the progressing age of the organism leading ultimately to reduce fecundity as the egg holding capacity /space remains more or less the same. (iii) With the age, resource/nutrition utilization of prawns decrease which ultimately effects general metabolism, reproductive activity and reproductive potential (Fig. 2).

Fig. 1. *Macrobrachium dayanum* having eggs in the brood chamber.

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The mean fecundity calculated was 50.75 ± 9.02 for the mean total body weight of 1.95 ± 0.47 g with average no. of eggs recorded as 95.6 ± 9.14. In *Macrobrachium dayanum* the breeding capacity ranges from 78 to 104 and increases with an increase in all the body parameters. A revealing factor was observed by the estimation of fecundity that the numbers of eggs present in the brood exhibit difference with total body weight and total body length. The straight-line relationship has been observed between the fecundity and prawn length/weight. The mean relative fecundity of *Macrobrachium dayanum* as studied presently was found to be significantly correlated with total body weight. The fecundity was more dependent on body weight than the body length (Fig. 3).

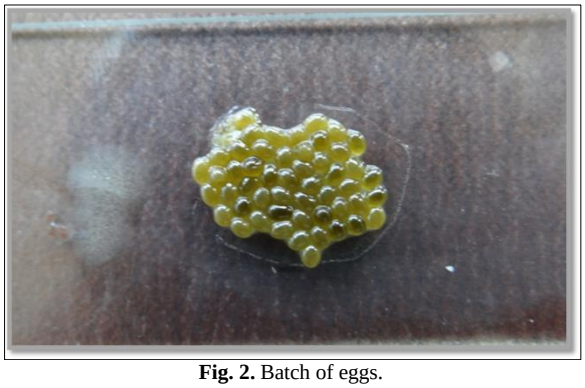

Fig. 2. Batch of eggs.

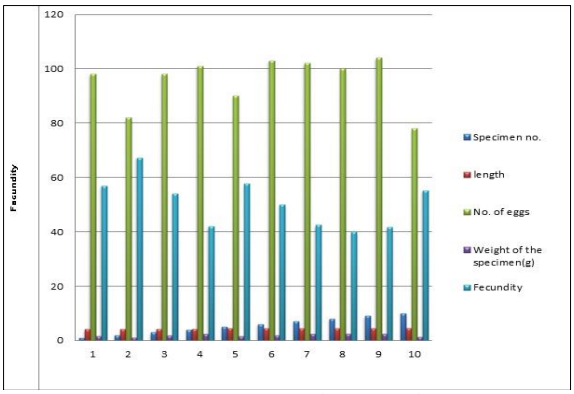

Fig. 3. Bar graph showing fecundity of prawn.

Table 1. Fecundity of female prawn.

Specimen no.	Length(cm)	Number of Eggs	Weight of the specimen(g)	Fecundity
1	4.2	98	1.72	56.97
2	4.2	82	1.22	67.21
3	4.3	98	1.81	54.14
4	4.3	101	2.4	42.08
5	4.4	90	1.56	57.69
6	4.5	103	2.06	50
7	4.5	102	2.4	42.5
8	4.5	100	2.5	40
9	4.5	104	2.5	41.6
10	4.6	78	1.41	55.31
Mean ± SD	4.4 ± 0.14	95.6 ± 9.14	1.958 ± 0.47	50.75 ± 9.02

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To establish the mathematical relationship of fecundity with other parameters, the values of regression coefficient (b), intercepts (a) correlation coefficient (r) were established by using the statistical formula y=a+bx. Linear correlationships were obtained in all the cases and the coefficient of correlations were highly significant.

The relationship between fecundity and body length was found to be highly significant at $p < 0.05$ at 5% as shown in Tables 2 and 3. The regression equation arrived was $Y = 4.96 + 0.19X$ with mean fecundity being 50.75 ± 9.02 and mean weight being 1.95 ± 0.47 g. Similarly coefficient of correlation and relationship between fecundity and total body weight were also highly significant as shown in Tables 2 and 3. The equation obtained was $Y = 3.54 \pm 0.31X$ and was found to be linear as shown in Figs. 4 and 5.

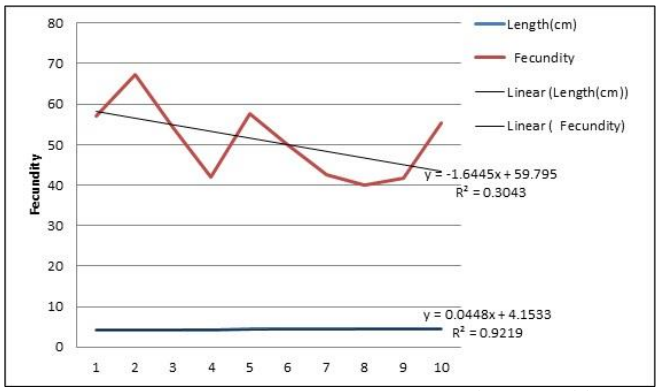

Fig. 4. Graph showing relationship between length (cm) and fecundity of female prawn.

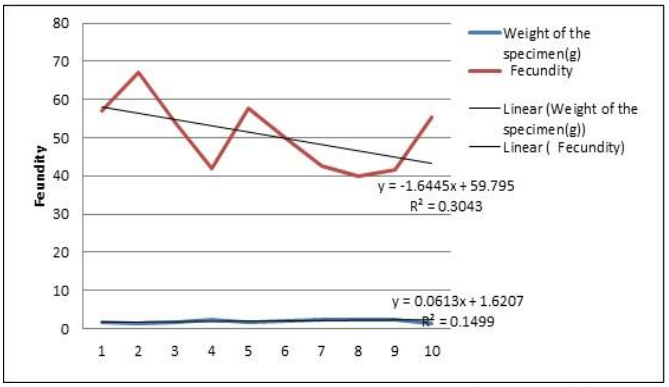

Fig. 5. Graph showing relationship between weight (g) and fecundity of female prawn.

An actual increase in total number of eggs appears to be related to both the body length and the body weight of the animal. There is a direct relationship noticed between total length and total number of eggs. However there was a slight variation observed in total number of eggs of the same size group. The prawn is a continuous breeder and subsequent brood may possibly liberalize within the spawning period. The number of eggs may be more in the first time and may show a tendency to decline in the subsequent brood.

Table 2. ANOVA of fecundity with length and weight of female prawn.

S.No.	Sex	Relation	Sum of square (SS)	df	Mean square (MS)	F	Sig.
1	Female	Fecundity/Length (cm)	2.752	11	0.196	4.026	0.073[b]
2	Female	Fecundity/Weight(g)	2.415	11	0.028	76.01	0.000[b]

In the present investigation two linear relationships were traced out between fecundity and body parameters (prawn length, prawn weight) for *Macrobrachium dayanum*. It was noticed that the fecundity was highly correlated with body

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length. Da Silva et al. observed that the highest fecundity in species of genus *Macrobrachium* was observed in *Macrobrachium rosenbergii* and *Macrobrachium carcinus* both being large sized species again strengthening the view point that fecundity is a direct function of body size [9].

Table 3. Regression analysis of fecundity with length and weight of female prawn.

S.No.	Relations	Groups	Y = a+ bX	R	R^2	Adjusted R^2	Allometry
1	Length/Fecundity	Female	Y= 4.960+0.019X	0.536[a]	0.287	0.216	_
2	Weight/Fecundity	Female	Y= 3.548+0.031X	0.940[a]	0.884	0.872	_

Rashid et al. studied the fecundity and embryonic development in three *Macrobrachium* species and found that fecundity of *M. rosenbergii* was higher in comparison with *M. lamarrei* and *M. malcolmsonii* [10]. In all three species, length versus. fecundity relationship was found to be significant but weight versus fecundity was insignificant in case of *M. malcolmsonii* and *M. lamarrei*. Relative fecundity per cm versus total length relationship of *M. rosenbergii* was insignificant in winter but significant in summer, insignificant for *M. malcolmsonii* and significant for *M. lamarrei* whereas, relative fecundity (/gm) versus total weight relationship was insignificant in all the species. Sharma and Subba reported that the fecundity of *M. lamarrei* ranged from 82-308 for females of 5.7-7.4 cm, *M. rosenbergii* ranged from 24225 to 191092 for females of 14.3 to 23.5 cm and *M. malcolmsonii* ranged from about 3500 to 94000 for females of 5.4 to 16.5 cm that was higher than the present study in all three species [11]. Among all the above referred species, the fecundity as observed presently lies close with *M. lamarrei.* The reason here again that can be held responsible is the size of the species which in rest all the species (*M. rosenbergii and M. malcolmsonii*) is very large as compared to *M. dayanum* and *M. lamarrei.* Apart from the size, fecundity of a species is definetly under both genetic and environmental control and was a measure of fitness which was affected by specific features of different environments as has been held by Hines [3].

III. CONCLUSION

According to Bal and Rao [12], in crustaceans fecundity was reported to be a measure of the reproductive fitness in the clutch size which in turn was highly correlated with the size of individuals. However, according to Chockley and Mary [13], individuals of the same species may produce varying number of eggs depending on their age, length, weight and environmental conditions. Graziani et al. [14] explained that in *Macrobrachium* species the fecundity was extremely associated with the female age and that fecundity could increase while the female becomes mature. Jee and Kok [15] found decreasing fecundity in *M. rosenbergii* during egg incubation which might be due to unfertilized eggs dropping off and some eggs being eaten by the brooders during the incubation period. As per the reports of Brown [16], fecundity could be as high as 80,000 to 100,000 eggs in mature females while first brood stock might be around 5,000 to 20,000. Present observations showed that fecundity in freshwater prawn is directly related to the total length, standard length and total weight of the animal which also gets strengthened from the earlier observations made by Bilgin and Samsun [17]. In *Macrobrachium macrobrachion* a significant positive correlation between female weight and the number of eggs is already on record. On the similar lines, Sarda [18] in *M. semisulcatus* authenticated a positive and significant correlation of fecundity with ovarian weight apart from body length and weight. In line with the present observations, several other authors in different species *viz. M. vollenhovenii* and *Pellonula leonensis* by Kingdom and Eronadu [19], *M. surinamicum* by Lima et al. [20], *Macrobrachium scabraculum* by Athiyaman and Rajendran [21,22] have also reported slight variations in total no. of eggs in the same size group.

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