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Fecundity changes in *Macrobrachium rosenbergii* (de Man) during egg incubation

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Abstract. For a study of the fecundity of *Macrobrachium rosenbergii*, a total of 117 berried females were sampled from ponds. Fecundity was found to vary from 1216 to 89747 eggs for prawns measuring 9·0cm to 15·8cm total length and weighing 6·22 to 45·80g. The relationship between fecundity (EN) and total length (TL) was found to be $EN = 0{\cdot}001876\ TL^{6{\cdot}3617}$.

The average egg number/g total body weight for prawns having orange, yellow and grey eggs was 1132·7 ± 484·1, 766·4 ± 524·3 and 745·5 ± 487·2, respectively, a decrease of 32·3% when orange eggs became yellow and 34·3% when they turned grey. This decrease was probably due to unfertilized eggs dropping off and some eggs being eaten by the brooders during the incubation period.

Egg numbers/g egg weight were found to be 11360·1 ± 1642·1, 10715·7 ± 2725·3 and 8634·0 ± 1892·3 for orange, yellow and grey eggs, respectively. When compared to orange eggs, yellow eggs were slightly heavier (6%), but grey eggs were significantly heavier by 31·6%. The increase in the weight of the grey eggs can be explained by the elongation of fully formed organs and appendages by about 17 days post fertilization.

Introduction

The fecundity of *Macrobrachium rosenbergii* has been mentioned briefly by several authors (Ling 1969; Jinadasa 1985; New & Singholka 1985; Patra 1976). These authors reported that the fecundity of *M. rosenbergii* ranges from 60000 to 130000. These estimations were made based mainly on wild populations (Patra 1976). During the incubation period of 19 days (26–28°C) it is known that some of the eggs will be lost, and their colour will change progressively from orange to yellow and finally to grey before hatching.

If prawn fecundity were known, hatchery operators would be able to estimate the number of broodstock needed for producing the required number of larvae. No report on changes in the fecundity of prawns during the incubation period is available. Thus in this study we report on prawn fecundity and changes in it during incubation period.

Materials and methods

A total of 117 berried female prawns cultured in 1987 for a period of 6 months were caught from ponds. The prawns were weighed (g), and measured (cm) for total length and orbital length. The eggs were removed, weighed and fixed in formalin as in Scott (1962) after the colour of the eggs was noted. Fecundity was estimated by a gravimetric method (McGregor

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1922) whereby each preserved total egg mass was weighed individually and 0·10-, 0·15-, 0·20-, 0·25- and 0·30-g subsamples from each were taken. All the eggs in the subsamples were counted and the means taken. The total number of eggs per prawn was then estimated. Regression analysis was done to find the relationship of fecundity (EN) to the total length (TL), orbital length (OL), total body weight (Tot BW), somatic body weight (Som BW) and egg weight (EW) (Snedecor & Cochran 1967). Som BW was calculated by subtracting egg weight from Tot BW.

Results and discussion

General fecundity

Fecundity was found to vary considerably from individual to individual and ranged from 1216 to 89747 eggs (mean = 17355·1 ± 19752·2 eggs) for prawns measuring 9·0 cm to 15·8 cm (mean = 11·61 ± 1·34 cm) total length and weighing 6·22 to 45·80 g (mean = 16·87 ±8·26 g). The relationship of fecundity to total length and body weight (total and somatic) of the prawn is given in Table 1. Using the logarithms of the values for fecundity (*EN*) and total length (*TL*), the following equation was derived:-

$$\text{Log } EN = -6{\cdot}2785 + 6{\cdot}3617 \log TL \ (r = 0{\cdot}73)$$

The resulting power equation for this relationship was:

$$EN = 0{\cdot}001876\ TL^{6{\cdot}3617}$$

Egg numbers were found to be increasing with both total and somatic weight. Fecundity had been expressed per unit length and unit weight of prawn. Egg number/cm TL increased with prawn length and egg number/g BW also increased with prawn weight. It has been reported that fecundity tends to decrease when animals reach a certain size (Nikolsky 1963). However, within the size range of the prawns we were able to sample, we found that fecundity did not show a decrease after a certain size. Samples of prawns over 100 g may be needed in order to give a more accurate result.

Table 1. Functional equations relating egg number to length and weight of *Macrobrachium rosenbergii*

Dependent variable	Independent variable	Linear regression ($Y = a + bx$) or (Log $Y = a + b \log x$)	r
No. eggs	*TL* (cm)	log Y = −6·2785 + 6·3617 *log TL*	0.73
No. eggs	*Tot BW* (g)	Y = −18 913·5 + 2155·7 *Tot BW*	0·92
No. eggs	*Som BW* (g)	Y = −21 292·3 + 2557·1 *Som BW*	0·89
No. eggs	*EW* (g)	Y = −914·8 + 10 677·4 *EW*	0·94
No. eggs/cm	*TL* (cm)	Y = 7662·8 + 779·7 *TL*	0·80
No. eggs/g	*Tot BW* (g)	Y = 163·0 + 41·3 *Tot BW*	0·67

*n + 110; $P < 0{\cdot}001$; *TL* = total length; *Tot BW* = total body weight; *Som BW* = somatic body weight; *EW* = egg weight; r = correlation coefficient.

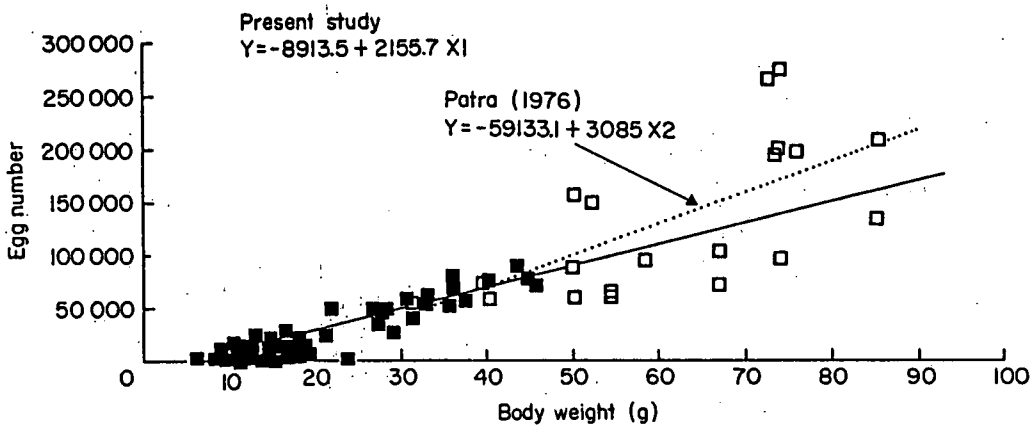

Figure 1. Egg number–total body weight relationship of *Macrobrachium rosenbergii*. Data from present study (■) and Patra (1976) (□) are plotted.

Since we did not have samples of prawns weighing more than 50 g, we have included data from Patra (1976) for comparison. The equation in the present study does not deviate much from that of Patra (Fig. 1). This indicates that there may not be much difference in fecundity between wild and cultured prawns. For the convenience of the aquaculturist egg numbers in relation to length and weight of the prawns are presented in Table 2.

Fecundity changes with egg colours

During egg incubation, egg colour changes from orange to yellow and then grey before hatching. Ling (1969) reported that starting from the 12th day of incubation (26–28°C), the bright orange colour of the eggs gradually becomes lighter (yellow), and in its place a light grey colour slowly develops. The colour gradually deepens to slate grey by the 16th to 17th day of incubation, when the larvae inside the eggs are fully developed.

The fecundity related to total length, total body weight and egg weight of prawns with orange, yellow and grey eggs is shown in Table 3. Orange egg prawns had the highest egg numbers followed by yellow and then grey egg prawns of the same weight. The average egg number/g Tot BW for orange, yellow and grey egg prawns were 1132·7 ± 484·1, 766·4 ± 524·3 and 745·5 ± 487·2, respectively (Table 4). Both yellow and grey prawns had significantly fewer eggs/g Tot BW when compared to orange egg prawns. The number of eggs/g Tot BW decreased by 32·3 and 34·3% when orange eggs becomes yellow and grey, respectively. Average number of eggs/g Som BW for orange, yellow and grey eggs prawns was 1280·1 ± 606·3, 850·7 ± 630·0 and 840·4 ± 594·0, respectively, showing similar decrease (33·6 and 34·4%) as the egg number/g Tot BW, when the orange colour became yellow and then grey. Average number of eggs/cm TL for orange, yellow and grey eggs prawns was 1691·5 ± 1337·2, 1233·7 ± 1452·2 and 1181·8 ± 1246·4, respectively, a decrease of 27·1 and 30·1%, when the orange colour became yellow and then grey. This decrease was not significant statistically because of the large standard deviation of the values. It is possible that the measurement of the total length is not precise, due to occasional broken rostrums and bending of the body. Overall results show that there is a decrease in egg numbers during

Table 2. Number of eggs in *Macrobrachium rosenbergii* predicted by length and weight

TL (cm)	*OL* (cm)	*BW* (g)	*EW* (g)	Egg no.
8·0	6·2	4·29	0·132	1044*
8·5	6·6	5·31	0·189	1535*
9·0	6·9	6·48	0·265	2209
9·5	7·2	7·82	0·364	3115
10·0	7·6	9·36	0·493	4317
10·5	7·9	11·10	0·657	5889
11·0	8·2	13·06	0·864	7917
11·5	8·6	15·25	1·122	10 505
12·0	8·9	17·69	1·442	13 771
12·5	9·3	20·40	1·834	17 855
13·0	9·6	23·40	2·310	22 915
13·5	9·9	26·70	2·885	29 134
14·0	10·3	30·31	3·574	36 719
14·5	10·6	34·26	4·394	45 903
15·0	10·9	38·57	5·364	56 952
15·5	11·3	43·25	6·508	70 163
16·0	11·6	48·32	7·846	85 867*
16·5	11·9	53·81	9·405	104 436*
17·0	12·3	59·72	11·212	126 279*
17·5	12·6	66·08	13·299	151 853*
18·0	12·9	72·91	15·699	181 660*
18·5	13·3	80·24	18·447	216 253*
19·0	13·6	88·07	21·584	256 239*
19·5	13·9	96·43	25·151	302 283*
20·0	14·3	105·35	29·195	355 112*

The above values are calculated from the following equations:

$OL = 0{\cdot}865512 + 0{\cdot}67094\ TL$ ($r = 0{\cdot}94$)
$\log BW = -5{\cdot}80593 + 3{\cdot}4927 \log TL$ ($r = 0{\cdot}96$)
$\log EW = -14{\cdot}2665 + 5{\cdot}8885 \log TL$ ($r = 0{\cdot}75$)
$\log EN = -6{\cdot}27854 + 6{\cdot}36169 \log TL$ ($r = 0{\cdot}73$)

Where BW = total body weight; EW = egg weight; EN = egg number; TL = total length; OL = orbital length.
Values marked with * are extrapolated.

incubation. This loss of eggs may be due to unfertilized eggs dropping off and to some of the eggs being eaten by the prawn. It is also likely that as the egg mass turns grey, the eggs become loosely attached, possibly due to a change in size. They are certainly more easily lost if the female does an escape flick from human net or predator.

Changes in egg weight during incubation

As presented in Table 5, the number of eggs/g EW were found to be 11360·1 ± 1642·09, 10715·7 ± 2725·33 and 8634·0 ± 1892·25 for orange, yellow and grey eggs, respectively. When percentage of increase in egg weight was calculated, yellow eggs showed no significant increase (6%), but grey eggs had significantly increased by 31·6% when compared to orange

Table 3. Functional equations relating egg numbers of various colours to egg and body weight

Dependent variable	Independent variable	Linear regression ($Y = a + bx$) or ($\text{Log } Y = a + b \log x$)	r	n
Orange	*BW* (g)	$Y = -18\,779{\cdot}8 + 2433{\cdot}13\ BW$	0.95	23
Yellow		$Y = -22\,534{\cdot}7 + 2416{\cdot}04\ BW$	0·96	25
Grey		$Y = -18\,694{\cdot}3 + 2054{\cdot}15\ BW$	0·94	54
Orange	*EW* (g)	$Y = -289{\cdot}3 + 11\,892{\cdot}4\ EW$	0·97	23
Yellow		$Y = -1280{\cdot}1 + 12\,238{\cdot}2\ EW$	0·98	25
Grey		$Y = -2023{\cdot}7 + 10\,792{\cdot}2\ EW$	0·95	54
Orange	*TL* (cm)	$\text{Log } Y = 4{\cdot}5076 + 5{\cdot}7863 \log TL$	0·85	23
Yellow		$\text{Log } Y = -7{\cdot}0681 + 6{\cdot}6566 \log TL$	0·72	25
Grey		$\text{Log } Y = -6{\cdot}1799 + 6{\cdot}2764 \log TL$	0·71	54

*$P < 0{\cdot}001$; *TL* = total length; *BW* = body weight; *EW* = egg weight; r = correlation coefficient; n = number of sample.

Table 4. Mean egg no./g total body weight (*Tot BW*), egg no./g somatic body weight (*Som BW*), and egg no./cm total length (TL) of various egg colours

	Colour		
Egg no.	Orange	Yellow	Grey
/g Tot BW	1132·7 ± 484·1	*766·4 ± 524·3	*745·5 ± 487·2
% decrease	–	32·3	34·3
/g Som BW	1280·1 ± 606·3	*850·7 ± 630·0	*840·4 ± 594·0
% decrease	–	33·6	34·4
/cm TL	1691·5 ± 1337·2	1233·7 ± 1452·2	1181·8 ± 1246·4
% decrease	–	27·1	30·1

*$P < 0{\cdot}05$ when compared with orange colour.

Table 5. Mean egg no./g egg weight of various egg colours

Colour	Egg no./g egg weight	Weight (g) 11 360 eggs	Egg weight increase (%)
Orange	11 360·1 ± 1642·09	1	–
Yellow	10 715·7 ± 2725·33	1·06	6
Grey	*8633·9 ± 1892·25	1·316	31·6

$P < 0{\cdot}05$ when compared with orange colour.

eggs. The latter increase can be explained by the fact that larvae have fully developed inside grey eggs about the 17th day of incubation.

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