



ISSN: 2347-5129

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.549

IJFAS 2016; 4(6): 208-211

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www.fisheriesjournal.com

Received: 15-09-2016

Accepted: 16-10-2016

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Reproductive aspects of freshwater prawn, *Macrobrachium lamarrei lamarrei* {H. M. Edwards 1837} in Upper Lake at Bhopal

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Abstract

Macrobrachium lamarrei lamarrei is an indigenous freshwater prawn found abundantly in freshwater bodies of Bhopal. The aim of the study was to investigate various reproductive aspects (reproductive period, fecundity and sex ratio) of *M. lamarrei lamarrei* from a freshwater body “Upper lake” in Bhopal region of India. During the course of research total 720 prawns were captured, 312 males and 408 females resulting in 0.70:1.30 (Male: Female) sex ratio. The reproductive peak period of *M. lamarrei lamarrei* occurred twice during the year, once during the month of June representing major Peak and once again during December representing minor Peak. Fecundity varies linear with the size (total length) of prawn and varied from 69-143 eggs per female. The knowledge about various reproductive parameters reported in the present study an important to define reproductive strategies of *M. lamarrei lamarrei* in Upper Lake of Bhopal.

Keywords: Reproductive aspects, freshwater prawn, Upper Lake, *Macrobrachium lamarrei lamarrei*

1. Introduction

Freshwater prawn comprise one of the most economically important aquaculture products because of its universal appeal, better taste, high unit value, and uprising demand in the international market as it has been given the first importance both national and worldwide. The tremendous demand for these aquaculture products in the world market resulted in the over exploitation of the natural freshwater prawn resources in many parts of the world including the freshwater bodies of India. Meanwhile, prawn fisheries have declined in the natural resources due to over exploitation; there has been a vital surge for the production of varieties of different prawn species. Most of the prawn species of commercial interest belong to the *Macrobrachium* ^[1] genus, distributed to the various tropical and subtropical regions of the world ^[2]. *Macrobrachium* genus is indigenous to all continents, except Europe ^[3]. At present, there are approximately 243 species of the *Macrobrachium* genus known in the world ^[4-6] of which 37 are registered from India ^[7, 8]. In Madhya Pradesh eight species of prawn are reported, out of which six belong to genus *Macrobrachium* and two belong to genus *Caridina* ^[9, 10].

The knowledge of the reproductive biology of freshwater prawns is an important tool to estimate the potential of a candidate for culture and to have knowledge about techniques of biological preservation. Fecundity is defined as the number of eggs laid per clutch that was found to adhere to the female pleopods ^[11]. Knowledge about the fecundity of species is very important for estimation of reproductive potential and stock size of different ecosystems, the aim of the research was to investigate reproductive aspects (reproductive period, fecundity and sex ratio) of *M. lamarrei lamarrei* from a freshwater body “Upper lake” in Bhopal region of India.

2. Material and Methods

Monthly samples of *M. lamarrei lamarrei* were collected from January 2014 to December 2014 from a local water body, Upper Lake, at Bhopal, of Madhya Pradesh. The Upper Lake is locally known as Bada Talab in the city of Lake, Bhopal. It is one of the oldest among the largest manmade lakes in the central part of the India and has been designated as a “Ramsar” site in November 2002.

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Due to the previous knowledge of the activity behavior already described for *Macrobrachium* species [12], the collections were carried out at dusk, with a hand-net. The obtained material was identified and segregated on the banks of the lake and the freshwater prawns were transported to the laboratory of Department Of Zoology and Applied Aquaculture, Barkatullah University Bhopal for the further studies. Specimen were properly labeled and preserved in plastic jars containing 4% formalin and 70% ethyl alcohol (1:1 volume). Sexes were distinguished on the presence and absence of *appendix masculina* on 2nd pleopod of the individual. *Macrobrachium* species were identified according to [8] and [13]. A total of 720 specimens were collected. Specimens were measured with a caliper (accurate to 0.05 mm) and the weight of the specimens was determined electronic precision balance (Biological Museum model LCB4-C Agra India) at 0.01 g precision.

2.1. Reproductive Parameters

The reproductive period was estimated by the presence of ovigerous females in the preserved samples during the different period of the year. Fecundity was obtained from ovigerous females by counting the total amount of eggs per female. Eggs were carefully removed from the brood pouch and were counted under the dissecting binocular microscope. Reproductive output (RO) is the ratio of total egg wet mass to total body mass, which was also determined with electronic precision balance (0.001g precision).



Buried female (*M. lamarrei lamarrei*).

2.2. Statistical Interpretation of the Data

Sex-ratio was calculated for the entire period of study and its significance was tested by Chi-square test [14]. Linear regression (Pearson's model) was used as a standard tool for the estimation of correlation between total weight and total length, body size and fecundity. Linear regression was used to find a relation between fecundity and female's size and to find a relation between RO and total female length (TL). Statistical interpretation was done using the Biostat 5.0 software at $\alpha = 0.005$.

3. Results

The present study was done from January-December 2014, for estimating the sex ratio of freshwater prawn, *M. lamarrei lamarrei*. During the course of study 60, prawns were randomly picked up every month from the obtained prawn population. Thus a total of 720 prawns were investigated for the sex ratio out of which 312 males and 408 females resulting in 0.70:1.30 (Male: Female) sex ratio. On the monthly basis sex ratio does not differ much from the expected ratio i.e. 1:1 and was found almost within the normal range. The sex ratio for *M. lamarrei lamarrei* shows a notable variation during the different months of the years and maximum difference in sex ratio was estimated during the months of May- June, which is peak breeding time for this species. During the entire study females were found to dominate males except the month of July- August, were expected ratio (1:1), and does not shows any difference. A total number of 38 females out of 60 were observed in months of May- June representing 0.57 males: 1.72 females (table 1).

Ovigerous females were found throughout the year with two peaks during different months of the year viz; one representing major peak during the June coinciding to the onset of monsoon and again during November representing minor peak coinciding to the onset of winter (table 2).

During the tenure of the research total 408 females were investigated during the different months of the year. Maximum of ovigerous females was recorded during the month of May (89.473%) and June (86.842%) and once again a maximum number of ovigerous females where recorded during the month of November (67.64%) and December (63.888%). As reproducing females are found throughout the year indicating there by *M. lamarrei lamarrei* is a continuous breeder i.e., breeding throughout the year but the highest number of matured females were recorded twice in a year, once in May-June period representing major peak and during November - December period representing a minor peak. From the research investigation it is clear that *M. lamarrei lamarrei* is a continuous breeder but attains maximum breeding intensity only twice in a year.

Eggs of *M. lamarrei lamarrei* are greenish, macroscopic, and oval to elliptical measuring about 0.98-1.27×1.21-1.47 mm. A minimum number of eggs observed during the present study were 69 while the maximum range was 143. The mean number of eggs per female was 105±2. Statistical analysis made among the different body measurements exhibited a positive correlation between fecundity and total length, cephalic length, the weight of the body while fecundity shows a negative correlation with rostrum length (table 3 & 4). During the embryogenesis, there is a gradual increase in length as well as the size of the females ($p \leq 0.001$) (table 4). The RO varies from 6.8% and 39.4%. The range of RO in other *Macrobrachium* species approximately occurs within the same range.

Table 1: Month wise sex population structure in *Macrobrachium lamarrei lamarrei* during the year 2014 in upper Lake of Bhopal.

Month	Total No. of Prawn	Male Prawn	Female prawn	%age of Male prawn	% age of female prawn	Sex ratio		X2	Remarks
						Male	Female		
January	60	24	36	40%	60%	1	1.5	1.20	NS
February	60	26	34	43.33%	56.66%	0.764	1.60	0.53	NS
March	60	26	34	43.33%	56.66%	0.764	1.60	0.53	NS
April	60	26	34	43.33%	56.66%	0.764	1.60	0.53	NS
May	60	22	38	36.6%	63.3%	0.578	1.72	2.13	NS
June	60	22	38	36.6%	63.3%	0.578	1.72	2.13	NS
July	60	30	30	50%	50%	1	1	0.00	NS

August	60	30	30	50%	50%	1	1	0.00	NS
September	60	28	32	46.6%	53.33%	0.875	0.39	0.13	NS
October	60	28	32	46.6%	53.33%	0.875	0.39	0.13	NS
November	60	26	34	43.33%	56.66%	0.764	1.60	0.53	NS
December	60	24	36	40%	60%	1	1.5	1.20	NS

χ^2 = Values are not significant at 1d.f. & $p \leq 0.05$); NS= Non-significant

Table 2: Month wise number and percentage of ovigerous (matured) females of *Macrobrachium lamarrei lamarrei* during the year 2014 in upper Lake of Bhopal.

Month	Total female present	Total No. of ovigerous females	Percentage of ovigerous females	Total number of maturing females	Un-matured Females
January	36	16	45%	12	8
February	34	11	32%	10	13
March	34	7	20.5%	19	8
April	34	12	35.29%	17	5
May	38	34	89.73%	2	2
June	38	31	81.57%	3	4
July	30	19	63.333%	6	5
August	30	11	36.66%	7	12
September	32	18	56.25%	7	7
October	32	19	59.37%	8	5
November	34	23	67.64%	9	2
December	36	24	66.667%	7	5

Table 3: Month wise number of eggs and measurement of different parts of females *Macrobrachium lamarrei lamarrei* during the year 2014 in upper Lake of Bhopal.

Month	Length			Total Weight (grams)	Weight after removal of eggs (grams)	Total no. of eggs
	T.L(cms)	C.L(cms)	R.L(cms)			
Jan-Feb	4.29	2.00	1.045	0.629	0.522	69
Mar-April	4.33	2.07	1.09	0.661	0.57	89
May-June	4.85	2.3	1.25	0.685	0.530	143
July- Aug	4.83	2.6	1.5	0.653	0.529	120
Sept-Oct	4.60	2.05	1.20	0.665	0.555	87
Nov- Dec	4.67	2.09	1.23	0.677	0.552	127

Table 4: showing correlation (value of r) between fecundity and various body parts of the body of female freshwater prawn *M. lamarrei lamarrei*.

Total length	Mean length	Standard deviation	Standard error	Value of 'r'	Remarks
		4.59	0.5377	0.2195	0.8792
Cephalic length	2.19	0.5100	0.208	0.6006	S
Rostum length	1.052	0.9481	0.3870	0.3800	NS
Weight	0.655	0.535	0.0218	0.6457	S

**Since values of r are significant if $P \geq 0.05$, NS; Not significant S; significant

Statistical analysis made among the different body measurements exhibited a positive correlation between fecundity and total length, cephalic length, the weight of the body while fecundity shows a negative correlation with rostrum length.

4. Discussion

The fecundity value obtained for *Macrobrachium lamarrei lamarrei* was highly variable. This situation had been reported by [15] while studying the fecundity of *Macrobrachium vollenhovenii*, who observed that many crustaceans have highly variable fecundity. Fecundity estimation in this study ranged from 69 to 143 and it was observed during the course of research fecundity increases with body size in *M. lamarrei lamarrei*, as reported before for the most of Caridean shrimps including various species of *Macrobrachium* genus, in which the fecundity has been studied [16, 17]. As a general rule, larger females of the same species have larger ovaries, capable of producing more offspring than smaller individuals. Fecundity of *M. lamarrei lamarrei* increases with increase in a cephalic weight similar to that of other crustaceans [18].

Knowledge of the sex population status estimation has its own significance in detecting differential prawn fishing, in different periods of the year and in the various size-groups. Thus we can get information about the abundance of the sex ratio at a breeding time, months, and seasons and throughout the year [19]. Stated theoretically, the expected composition of males to females is 1:1. In the present study, females mostly dominate the males throughout the year. The highest number of male population was observed in the month of July and August and lowest number of male population was estimated in the month of May. In the case of female prawns, maximum population calculated in the month May and a minimum number of female populations was estimated in the month of July and August. The results of the study of sex population status of *Macrobrachium lamarrei lamarrei* from the Upper lake of Bhopal shows a maximum sex composition in the month of May and June (0.57male:1.72female), which is non significant at $P=0.05$; and minimum sex composition in the month of July and August (1female:1male), which is non-significant at $P \leq 0.05$. Since value calculated for χ^2 is greater than χ^2 tabulated. The null hypothesis is accepted. From the

present research it is concluded that the sex ratio of the freshwater prawns does not show much significant difference within the different month of year in the Upper Lake of Bhopal.

5. Conclusion

From the present work and on the basis of earlier observation it is concluded that the sex population of the freshwater prawn, *Macrobrachium lamarrei lamarrei*, does not show significant difference although females dominated throughout the year. The overall finding on the *Macrobrachium lamarrei lamarrei*, the sex population was observed non-significant i.e. 0.754 male: 1.307 female. In *Macrobrachium carcinus*, a sex ratio of 1.3 females per male^[21]. Fecundity generally depends on the age, size and favorable climatic conditions. This study confirms that *M. lamarrei lamarrei* is a continuous breeder with maximum estimated fecundity during the months June - July. As an outcome of the research, fishing of *M. lamarrei lamarrei*, should be prohibited during June-July and November- December months as it represents peak breeding season to conserve this population.

6. Acknowledgement

Special thanks to Head of Department, Department of Zoology and Applied Aquaculture, Barkatullah University, Bhopal, Dr. Ashok Kumar Munjal, for logistic support and laboratory availability, at the Department, Ph. D research works in zoology.

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