

Breeding ethos of fresh water prawn, *Macrobrachium Assamense Peninsularie* from Garhwal Central Himalaya, India

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Abstract

Breeding ethos of fresh water prawn is reported first time in Khoh River from Garhwal Himalaya. Total length of the fresh prawns ranged from 3.1 cm to 6.5 cm and total weight ranged from 1.698 g to 8.494gm. A total of 149 specimens were collected (66 females and 83 males) and studied. We calculated the data on GSI Index; which showed that the maximum values were recorded in the Month of July (8.518 ± 3.130 for female and 3.711 ± 0.952 for male). The minimum GSI values were recorded in the month of October (For male prawn 0.036 ± 0.012 and for female prawn as 0.098 ± 0.054). Dobriyal Index (DI) values ranged from 0.010 ± 0.004 to 1.573 ± 0.652 and 0.271 ± 0.038 to

4.926 ± 0.364 in *M. a. peninsularie* males and females, respectively. The highest DI values for male fish were recorded as 0.031 ± 0.009 and for female fish as 0.271 ± 0.038 in the month of October. Now onwards, it observed a trend of increase in DI value both sex and the lowest values were noticed in the month of June (1.573 ± 0.652 for male and 4.926 ± 0.364 for female). In this study, the percentages of actively spawning *M. a. peninsularie* were highest during monsoon and early autumn season. The mean length at first spawning or mean length at sexual maturity is generally defined as the length at which 50% of females in a stock are sexually mature (44 mm CL in the present study).

Keywords: *Macrobrachium assamense peninsularie* | Breeding ethos | G.S.I. | D.I. | Sexual maturity | spawning season

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Introduction

Studies on breeding ethos of prawn are important and a basic requirement for improvement and effective prawn fishery resources management and conservation, determination of basic life-history information

and for assessing the impacts of environmental variability on the dynamics of prawn populations. Knowledge of breeding ethos, seasons and areas are important to management and hence to the studies of breeding dynamics of commercially important species. A fresh water prawn, *Macrobrachium assamense peninsularie* is mostly consumed for obtaining essential nutrients like protein, mineral and vitamins and has great potential for aquaculture, with short larval duration and survivorship. In case of India, aquaculture is the best means of providing employment for farmers.

In general, the reproductive ethos of prawn is based on species of economic interest, such as *Macrobrachium felicinum* studied by Inyang (1981), *M. vollehoveni* and *M. macrobrachion* studied by Marioghae (1982), *M. australience* studied by Lee and Fielder (1982), *M. vollenhovenii* and *M. macrobrachion* studied by Marioghae and Ayinla (1995), *M. jelskii* and *M. amazonicum* studied by Gamba (1997), *M. formosense* studied by Otomi and Nakabayashi (1999), *M. acanthurus* studied by Albertoni et.al.,(2002), *M. olfersi* studied by Mossolin and Bueno (2002), *M. potiuna* studied by Boss and Althoff (2002), *M. lanchesteri* studied by Phone et.al.,(2005), *M. dux* studied by Arimoro and Jacob (2007), *M. carcinus* studied by Lara and Wehrtmann (2009), *M. gangeticum* studied by Singh et.al., (2012) and *M. vollenhovenii* studied by Kingdom and Erondy (2013).

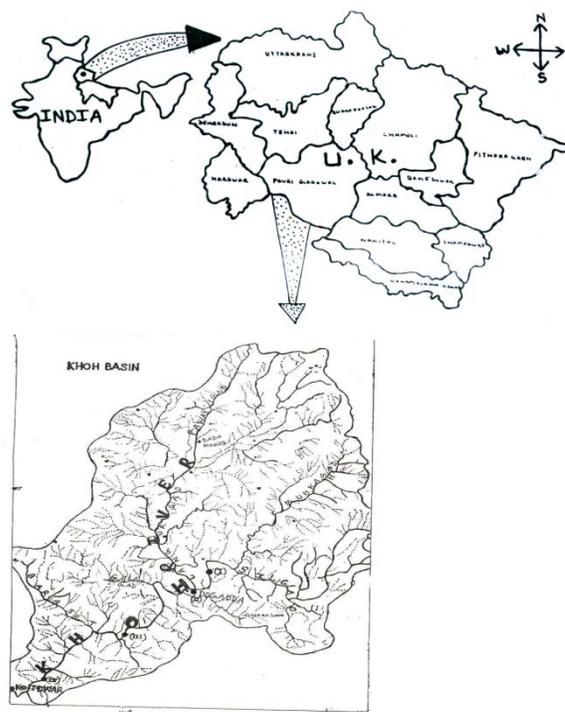
In recent years, few studies has done on the freshwater prawn, *Macrobrachium assamense peninsularie* (Bahuguna et. al., 2010;

Bahuguna and Kumar, 2011) therefore taking into consideration of local people, the present work has been carried out to promote aquaculture practices in the Garhwal region.

Methodology:

Field work

Samplings were collected during April 2010 to March 2011 from Khoh River using selective dip net (Map.1). The dip nets were set up for eleven hours (18.00 PM to 05.00 AM) and every sampling trip was for two days. After collection, the prawns were preserved and transferred to L. S. M. G. P. G. College Pithoragarh for further examination.



Map-1. Sampling Sites of Khoh River

Laboratory work

In the laboratory, prawns were sorted into species and identified according to Tiwari (1955) and Cai et.al, (2004). Carapace length and total length were measured to the nearest 1 mm, and body weight of each individual was

measured to the nearest 0.1 g after blot-drying the specimen. Carapace length was measured as the distance from the inside of the eye socket to the centre of the dorsal margin of the carapace, whereas total length was measured as the distance from the inside of the eye socket to the end of the telson.

Maturation Biology

(a) Sex determination:

The sex determination was based on the presence or absence of primary and secondary sexual characters of males/females and the examinations of gonad morphology after dissection.

(b) Calculation of Gonado-Somatic Index (G.S.I.):

Macroscopic and microscopic study

Macroscopic and microscopic studies were conducted for the determination of maturity and spawning in the prawn fish. For maturity stages, Ova samples were taken from ovaries and hardened in 5% formalin solution. Ova diameters were measured by means of an ocular micrometer. Sex was determined and a maturity classification was made (Farfante, 1969) where stages III and IV were considered to be mature for males and females respectively or otherwise modified as desired.

The Gonado-somatic index (GSI) was calculated according to the formula suggested by Lagler (1971) which is expressed as: $GSI = \frac{\text{Weight of Gonads}}{\text{Weight of Prawn}} \times 100$.

(c) Calculation of Dobriyal Index (D.I.)

The Dobriyal Index (DI) was calculated as: $D.I. = \sqrt[3]{GW}$ (Cube root of average gonad weight) (Dobriyal, *et.al.*, 1999).

(d) Measurement of ova diameter

To determine the oocyte diameter, the ovaries were preserved in 10% formalin solution. The diameters of 100 ova of each female prawn were measured using a Zeiss SV 6 dissecting microscope outfitted with an ocular micrometer. A total of 100 fresh ova were taken randomly from anterior, middle and posterior region of each ovary separated from the tissue by a fine needle and brush. The ova diameter was measured under microscope fitted with ocular micrometer according to recommended method given by LeCren (1951). Sex was determined, and the five-stage external characteristics system of ovarian development described by Wood (1930) was used to stage the female *M. a. peninsularie*.

Stage I-Immature-Found only in young shrimp, ovaries small and translucent (03–25 Omd).

Stage II- maturing-Ovaries larger, opaque, and yellowish (20-49 Omd)

Stage III mature-Ovaries larger and yellow to greenish (41-85 Omd).

Stage IV ripe-Ovaries green, filling virtually the whole space among other organs (45 -120 Omd);

Stage V spent-Spawned ovaries flabby and mud coloured (25–71 Omd).

The microscopic examination is generally required to determine the stage accurately.

(e) Estimation of spawning season

Season and frequency of spawning can be estimated by analyzing the GSI, DI, availability of spent prawns, the occurrence of eggs and larvae in their natural habitat.

(f) Determination of spawning grounds

It was observed that during spawning time *M. a. peninsularie* gathers in certain pockets on the lateral side of the streams.

Size at first maturity

For both males and females, the size at first maturity was determined by calculating the proportion of mature individuals in each size class (carapace length). The size at which 50% of individuals were mature was taken as the size at which prawns reach maturity for the first time (King, 1995).

Results

The breeding biology in crustacean was studied by many workers; but an annual reproductive pattern was not reported for species, *Macrobrachium assamense peninsularie*.

Size Range of Prawns

During the present study of breeding biology, the total length of the prawns ranged from 3.1 cm to 6.5 cm and total weight ranged from 1.698 gm to 8.494gm. A total of 149 specimens were collected (66 females and 83 males). Cold water prawns prefer hilly areas with gravel, cobbles and bedrock with a little amount of sand, as the substrate. In midland areas, gravel with pebble forms the main substrate. The determination of breeding season is an essential part of biological investigations of prawns.

Sexual dimorphism

The study of sexual dimorphism is very important in taxonomy, bionomics and breeding biology related research works. Mature males have proportionally small body size as well as head and claw. They exhibit a typical brood chamber formed by the first, second and third abdominal pleurae. Male prawns have a very dark blackish and brownish colour. Mature females can be easily recognized by their long and strong chelipeds with larger spines than in case of males. Female prawns are slight yellowish in colour with black spot mark all over the body parts.

Maturation Biology

The macroscopic study of gonads includes the physical measurements of length and weight of body and gonads. In the matured ovary, the eggs were fully ripe and yellowish in colour with a lot of yolk. Two prime indices, which were the basis of the present study, were calculated and presented in Table 1.1 for male and female prawn (GSI); and Fig.1.1 for male and Fig.1.2 female prawn (DI). We observed the data on GSI Index; which showed that the highest values were noticed in the Month of July (8.518 ± 3.130 for female and 3.711 ± 0.952 for male). The lowest GSI values were recorded in the month of October (For male prawn 0.036 ± 0.012 and for female prawn as 0.098 ± 0.054). From here onwards, there was a trend of increase in the GSI values in both sex and the maximum values were reported in the month of July and a minimum value was noticed in the month of October.

Changes in the gonado somatic index (GSI), calculated for the population in which females

spawn in batches, must not be used as the only credible indicator of the number of batches laid. Dobriyal Index (DI) values ranged from 0.010 ± 0.004 to 1.573 ± 0.652 and 0.271 ± 0.038 to 4.926 ± 0.364 in *M. a. peninsularie* males and females, respectively. The minimum DI values for male fish were recorded as 0.031 ± 0.009 and for female fish as 0.271 ± 0.038 in the month of October. From here onwards,

there was a trend of increase in both sex and the maximum values were reported in the month of June (1.573 ± 0.652 for male and 4.926 ± 0.364 for female). If we technically analyze the data, it is clear that the GSI values were at its peak in July and first fall in the value was observed in August which indicated that the fish starts spawning in August.

Month	G.S.I. of Male Prawns	G.S.I. of Female Prawns	Remark
April	01.253 ± 0.541	05.912 ± 1.154	Increasing
May	02.617 ± 0.679	06.612 ± 2.289	Increasing
June	03.121 ± 0.873	07.968 ± 3.930	Increasing
July	03.711 ± 0.952	08.518 ± 3.130	Highest Peak
August	01.514 ± 0.421	02.731 ± 0.325	Decrease
September	00.096 ± 0.039	00.121 ± 0.065	Decrease
October	00.036 ± 0.012	00.098 ± 0.054	Lowest Peak
November	00.072 ± 0.029	00.214 ± 0.074	Increasing
December	00.089 ± 0.037	00.397 ± 0.069	Increasing
January	00.219 ± 0.056	02.798 ± 0.562	Increasing
February	00.451 ± 0.084	03.023 ± 0.241	Increasing
March	00.731 ± 1.410	04.217 ± 0.346	Increasing

Table 1.1: Monthly values of Gonado-Somatic-Index (GSI) for male and female prawn, *Macrobrachium assamense peninsularie*

It indicates that first fall in the value was in July which is followed by sharp fall in August. Thus spawning started in July and became heavier in August. This observation was supported by our field observation that a few spent prawn fish were caught in the samples of July itself. The reason why GSI could not point out the slight fall is that when we calculate GSI we consider body weight also in calculation. Body weight not only depends on the gonad maturity but also on the physiological and ecological stress that fish faces, due to the fact than in flooded river, the food of fish becomes scarce and in mature condition also it cannot feed, thus losing slight weight. If weight of

body slows down, automatically GSI value shoots up as one of the value is in numerator and the other in denominator.

Measurement of ova diameter

Most of the ichthyologist followed the trend set in ICES scale proposed by Wood (1930). The workers in this field had classified the maturity stages of various fishes according to various features viz., general appearance, color, shape and size, position of the gonads, ova diameter, etc. In the present study, five stages of oocyte maturation were identified such as: (a) immature (b) maturing (c) mature (d) ripe and (e) spent phase and are presented in the Table 1.2.

S. No.	Maturity stages	Ova diameter (Omd) (1 Omd = 0.016mm)	Peaks
I	Immature	03-25	14
II	Maturing	20-49	31
III	Mature	41-85	69
IV	Spawning	45-120	90,98
V	Spent Phase	25-71	48

Table1.2: Classification of maturity stages in *M. assamense peninsularis*

Stage I: Immature-Found only in young shrimp, ovaries small and translucent (03–25 Omd).

Stage II: Maturing-Ovaries larger, opaque, and yellowish (20-49 Omd).

Stage III: Mature-Ovaries larger and yellow to greenish (41-85 Omd).

Stage IV: Ripe-Ovaries green, filling virtually the whole space among other organs (45 -120 Omd).

Stage V: Spent-Spawned ovaries flabby and mud coloured (25–71 Omd).

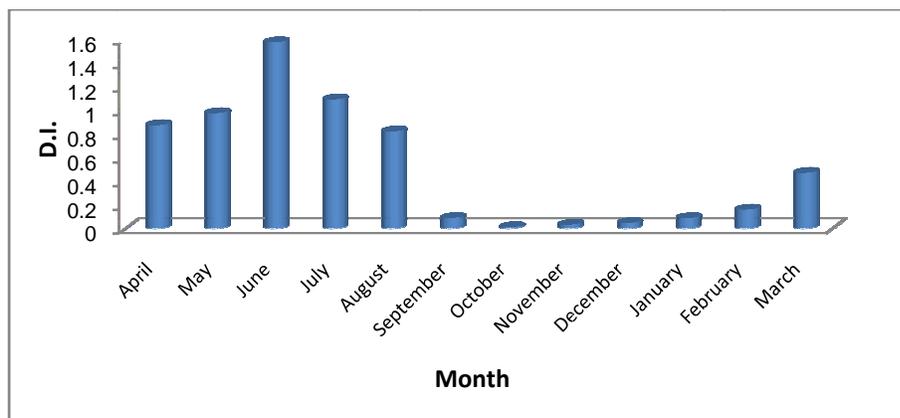


Fig.1.1: Monthly values of Dobriyal Index (DI) for male Prawn

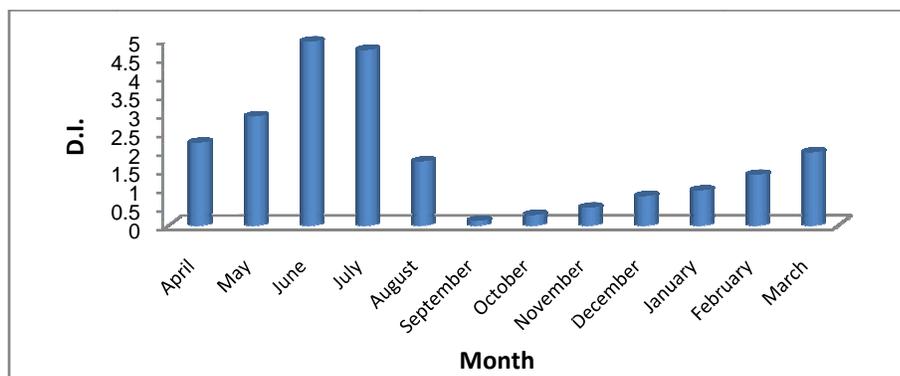


Fig.1.2: Monthly values of Dobriyal Index (DI) for female Prawn

Spawning season, spawning grounds and size at maturity

M. a. peninsularie spawning peaked in monsoon season (July) and in early autumn season (September), but with a lowest peak in middle autumn season (October; Figure 1.3). In contrast, some 78.50% of mature females were at stage III or IV during July, the balance of 5% then being recorded as stage V (Fig.1.3). Therefore, we conclude that the spawning activity of *M. a. peninsularie* in the Khoh river area peaks in July decreases slightly from August –September. It was observed that

during spawning time *M. a. peninsularie* gathers in certain pockets on the lateral side of the streams. From that vicinity some prawn eggs, larvae, adult male and female prawns were collected. Hence these spots were considered as probable spawning ground of the fresh water prawn (Plate 1). The length-at-50%-maturity (36 mm CL) is a useful indicator of spawning activity for management purposes, at least when assessed during the seasons of large-scale spawning. The maximum proportion of sexually mature females in the samples was 86% at 44 mm CL.

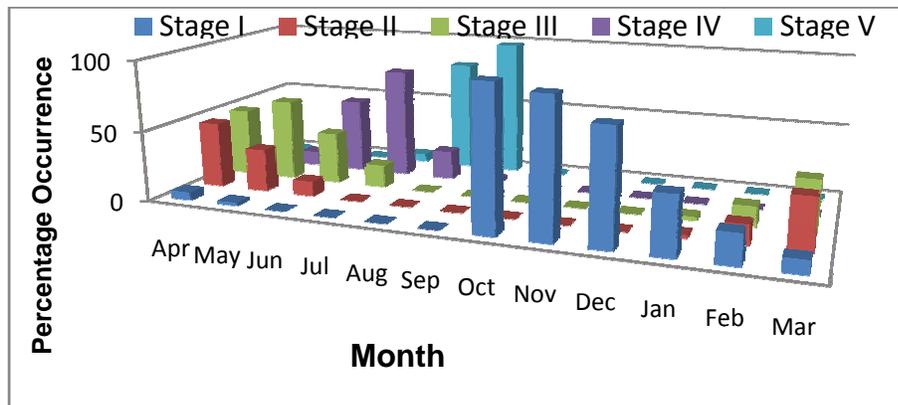


Fig.1.3: Percentage occurrence of different maturity stages on Prawn



Plate1: Breeding ground of fresh water prawn, *Macrobrachium assamense peninsularie*

Discussion

The time of spawning and recruitment (*i.e.* the time of the year) and the mean length, or age,

at which these events happen are important to fisheries studies, particularly the cycle of events leading to reproduction and the timing of gamete release. In this study, the percentage of actively spawning *M. a. peninsularie* was highest during monsoon and early autumn season. Although gonad development and subsequent spawning depend on various environmental conditions, prawns must reach a certain age or size before they are capable of reproducing. The mean length at first spawning or mean length at sexual maturity is generally defined as the length at which 50% of females in a stock are sexually mature (44 mm CL in the present study). Fishing pressure can reduce the size of target species and the size at maturity, but this anthropogenic influence apparently has a lesser effect on short-lived species such as crustaceans or cephalopods (Sparre and Venema, 1992).

The monthly fluctuation in the percentage of ovigerous females indicated that the prawn spawns during the summer and monsoon season (June to August). Total length of ovigerous females ranged from 07 to 14mm and egg size varied from 89 to 102 Omd. Compared to other species, the eggs of *M. a. peninsularie* were smaller than those of *M. lanchesteri* 0.8-1.0 mm and *M. olfersii* 0.4-0.6 mm reported by Hla *et al.* (2005) but similar to those of *M. lamarrei* (1.1-1.5 mm) reported by Arimoro and Jacob (2007). The maximum length attained by *M. a. peninsularie* in this study was 4.9 cm.

According to the Otomi and Nakabayashi (1999), the study of reproductive biology of the crane river prawn *Macrobrachium*

formosense Bate (Palaemonidae) was based on a large number of specimens which were sampled during a 12 month period in the Yabusa River in southern Kyushu, Japan. The carapace length at sexual maturity for females was estimated to be 10.20mm. Ovigerous females were found from May to September. The spawning and hatching periods were estimated to last from May to August and from June to September respectively, based on the occurrence of ovigerous females with first stage and last stage eggs. *M. formosense* in the river was considered to have multiple spawns during a single annual breeding season because ovigerous females which spawned early in the breeding season were found to have a high value of the gonadosomatic index. Egg size was 0.522-0.429mm at spawning and 0.651-0.523mm just before hatching.

Phone *et.al.* (2005), *Macrobrachium lanchesteri* is presumed to be one of the most common and widely distributed freshwater prawns inhabiting still or slow-moving waters in Myanmar. The study of reproductive biology of *M. lanchesteri* from the Zaw Gyi River and Taung Ta Man Lake in central Myanmar was based on the occurrence of ovigerous females and eggs in different developmental stages. The total numbers of specimens studied were 1307 from Zaw Gyi River and 757 from Taung Ta Man Lake. Ovigerous females were captured throughout the year. A higher percentage of ovigerous females were obtained from June to November. Carapace length of ovigerous females ranged from 6.3 to 12.5 mm and egg size (length) varied from 0.8 to 1.0 mm.

Singh *et.al.* (2012) reported that the Ganga river prawn, *M.gagaticium* starts breeding in May which continues till October. Percentage of males was found dominant in the month of May whereas females in months of July to October. Maximum males were recorded in the size range of 166-205 mm. Prawns starts breeding in May which continues till October.

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