



Evaluation of gonadal indices to understand the reproductive rhythm of *Macrobrachium assamense peninsulare* from Rawasan stream, Uttarakhand, India

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Abstract

Macrobrachium assamense peninsulare is a minor freshwater prawn and found in the Foothill Rivers and streams of Uttarakhand. However, no such studies were found to understand the reproductive rhythm of this species by observing the gonad development throughout the year. The aim of present study was to govern the maturation of gonads by study the Gonado-Somatic index (GSI) and Dobriyal index (DI) to understand the gonadal rhythm and breeding seasons. The GSI value ranged from 0.281 ± 0.56 to 8.583 ± 0.86 and DI value ranged from 0.023 ± 0.981 to 5.456 ± 0.082 during the interval of two year (August 2013 to July 2015). It is clear from the value obtained from the study that the maximum value of indices was in the month of April and minimum in the October in both the sexes (male and female). The patterns of breeding suggest that the animal take single spawning within breeding season and breeding start in the month of May which continued till September.

Key Words: Gonado-Somatic index (GSI), Dobriyal index (DI), *Macrobrachium assamense peninsulare*, Rawasan stream

Introduction

The Rawasan stream is bounded by $29^{\circ}55'33.82''N$ and $78^{\circ}26'42.41''E$ having an elevation 2835 feet. This stream has its origin from the Kher-pokhri Danda (1130m asl). Its upper tributary is known as Sateri sot and the Jarpani sot is another important sub-tributary of the Rawasan stream meeting it below Padyana. Below the junction of the Sateri and the Jarpani the stream is called Rawasan and flows toward Southwest throughout its course. After traveling a long distance the stream reaches in the Bhabar track near Laldhang and flows towards South and Southwest, meeting the Holy River Ganga at an altitude of 240m asl at a distance of 4.22 km from the village Tantwala in Amsot block, Haridwar after crossing the national highway NH-74 from Haridwar to Najibabad. The entire stretch of Rawasan stream is well mixed and harboring, with the rich fish fauna. However, the primary productivity is apparently average, as compared to the other rivers in the region. The bottom topography

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is mostly flat dominant with gravels, boulders and some rocky substratum. Next to fish crustaceans (prawn and crab) were the most important natural resource in the Rawasan stream. The water of the stream is used for the irrigation and other household purposes by the local habitants. The *Macrobrachium assamense peninsulare* is a newly recorded prawn species in Rawasan stream. They are generally feed on zooplanktons and, in turn, represent as a food source to the higher fish form, thus acting as important link between the secondary producer and the upper trophic level. The biology of prawn attracts attention of biologists, due to their commercial importance although, but their detail scientific study is in infancy (Sharma and Subba 2004). The successful culturing of an animal requires a basic knowledge about its biology and the most important biological aspects is the reproductive biology including gonadal maturation, maturation stage and fecundity. Some important contribution were made to study the reproductive biology of freshwater prawn (Booolootian *et al.* 1959; Cummings 1961; Subramanayam 1963; Raman 1967; Lawrence *et al.* 1979; Kulkarni & Nagabhusanam 1982; Rao 1967; Gyananath & Sarojani 1986; Cavalli *et al.* 2001; Conides *et al.*



2008; Magalhaes *et al.* 2012; Kingdom & Erondu 2013; Sethi *et al.* 2014; Parvaiz *et al.* 2014, Koshal *et al.* 2015). The present study indicated the quantitative analysis of gonad i.e., Gonado-Somatic index and Dobriyal index to understand the gonadal rhythm, breeding pattern and reproductive biology of the *Macrobrachium assamense peninsulare* in Rawasan stream.

Materials and Method

To understand the maturation of gonad of *Macrobrachium assamense peninsulare*, monthly collection of male and female specimens were made from August 2013 to July 2015 in Rawasan stream. During collection a random screening of all the adult specimens encountered were made in order to count the berried female, sexually matured males and females, and to examine the monthly ratio of male and female in the population. The grading of sexually mature was done on the basis of color changes in gonads and visual appearance of gonads through carapace in live specimens. The change in color of ovary and testes were also observed. In order to examine the rhythm of gonadal maturation, the gonado-somatic (GSI) and Dobriyal (DI) indices were studied at least 10 male and 10 female prawns per month. Each individual was weighed after wiping off surface moisture and dissected out to remove its complete gonad which was weighed on a digital balance of 0.001 g. The gonadal maturation was examined by calculating the Gonado-Somatic index (GSI) (Giese, 1959)

$$\text{Gonado - Somatic index} = \frac{\text{Weight of gonad}}{\text{Weight of animal}} \times 100$$

Dobriyal Index (DI) was calculated by using the formula given (Dobriyal *et al.* 1999)

$$\text{DI} = \sqrt[3]{\text{GW}} \text{ (Cube root of average gonad weight)}$$

Results and Discussion

The breeding biology of *Macrobrachium assamense peninsulare* was studied by estimating the monthly changes in the maturity index from August 2013 to July 2015. Gonado-Somatic index (GSI) and Dobriyal index (DI) was used to study maturation of gonads. Monthly fluctuation was recorded in maturation of gonads in both the sex

and their mean±SE value was presented in the Table 1. As the animal grows the morphology of gonads changes associated with their degree of maturation was found in the different developmental stages changes in their size, shape and color and weight of gonads (testes in male) and (ovaries in female).

Gonado-Somatic index (GSI)

The monthly variation in the mean±SE value of GSI of *Macrobrachium assamense peninsulare* collected during the year 2013-2015 (Table 1 & Fig 1(a)). Fluctuations in the value of GSI were observed which may be due to the gonad development and maturation in both the sexes. The GSI value formed a peak from February to May and the highest value was recorded in the month of April (2.038±0.77) for male and (8.583±0.86) for female. The minimum GSI value was recorded (0.281±0.56) in male and (0.382±0.76) for female in the month of October.

Dobriyal Index (DI)

Dobriyal index of male and female *M. assamense peninsulare* was examined for an interval of two years from Rawasan stream. The monthly mean±SE value of gonads indices for male and female shown in Table 1 and Fig 1(b). Dobriyal index values ranged from 0.023±0.981 to 1.583±0.562 in male and 0.341±0.383 to 5.456±0.082 in female prawn. The lowest value was recorded in the month of October in both the sexes (0.023±0.981 in male and 0.341±0.383 in female). From October onward a trend of increase in the DI value was recorded indicating the maturation of gonads in both the sexes and the highest value was noticed in the month of April (1.583±0.562) in male and (5.456±0.082) in female. The variation trend was found parallel to GSI values in male as well as female a prawn which reflecting the direct relationship between breeding biology intensity and the maturation of gonads.

Conclusion

During the present study the size of *Macrobrachium assamense peninsulare* was recorded in the range of 23-70 mm in male and 22-55 mm in female during the study periods. It is



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cleared from the data obtained of GSI and DI that maximum value in both indices was found in the month of April and first fall was recorded in the month of May which indicate that the prawn start

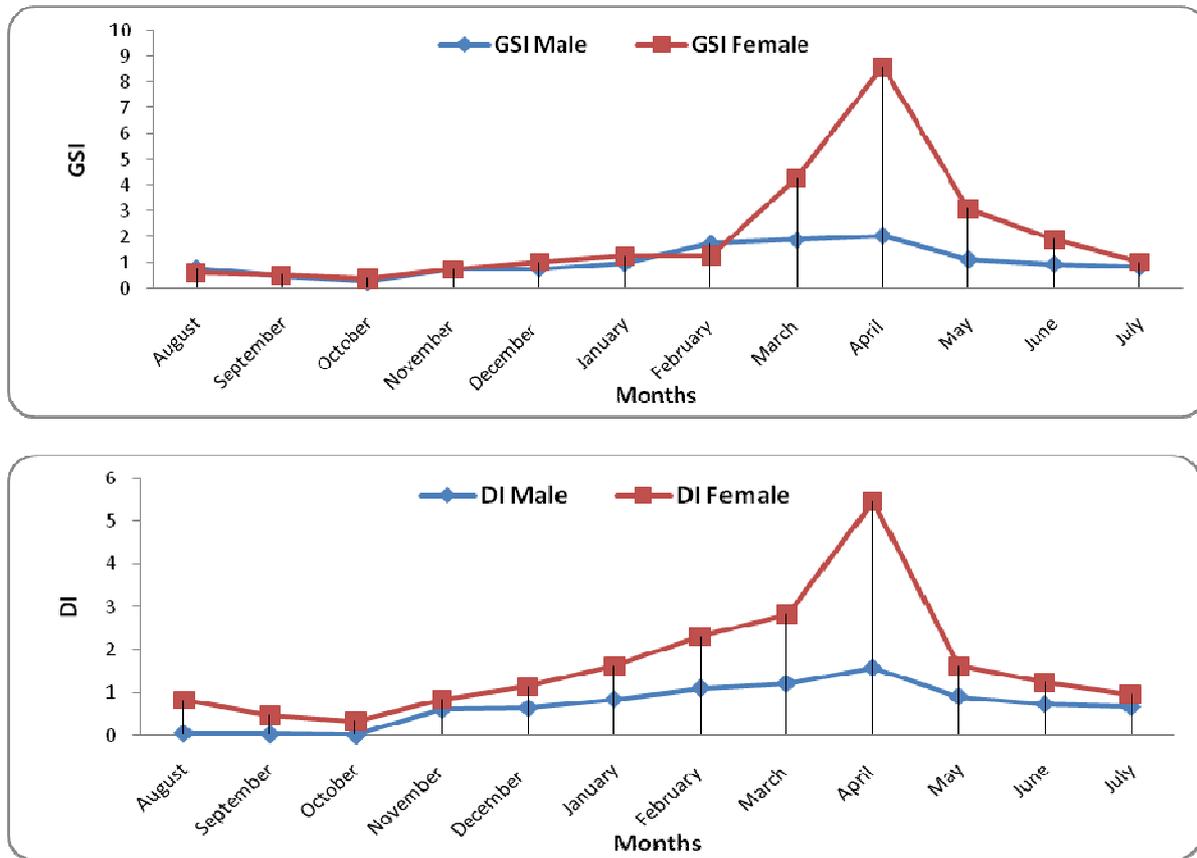


Figure 1 (a) Gonado-Somatic index (GSI) (b) Dobriyal Index (DI)

Table 1 Mean±SE data of Gonado-Somatic index (GSI) and Dobriyal index (DI) of *M. assamense peninsulare* in Rawasan Stream during 2013-2015

Months	GSI		DI		Remarks
	Male	Female	Male	Female	
August	0.792±0.12	0.637±0.78	0.065±0.089	0.842±0.032	Decreasing
September	0.475±0.34	0.534±0.56	0.039±0.075	0.485±0.062	Decreasing
October	0.281±0.56	0.382±0.76	0.023±0.981	0.341±0.383	Lowest peak
November	0.748±0.34	0.744±0.46	0.61±0.782	0.860±0.673	Increasing
December	0.775±0.46	1.029±0.56	0.651±0.541	1.154±0.754	Increasing
January	0.973±0.49	1.278±0.87	0.852±0.652	1.632±0.095	Increasing
February	1.741±0.23	1.306±0.77	1.113±0.784	2.313±0.766	Increasing
March	1.875±0.45	4.263±0.09	1.221±0.672	2.836±0.983	Increasing
April	2.039±0.77	8.583±0.86	1.583±0.562	5.456±0.082	Highest peak
May	1.132±0.31	3.105±0.26	0.914±0.034	1.634±0.030	Decreasing
June	0.944±0.22	1.922±0.47	0.743±0.562	1.242±0.072	Decreasing
July	0.836±0.43	1.025±0.13	0.675±0.652	0.961±0.364	Decreasing



spawning in the month of May and slightly increase in the month of June heftier in the month of July and set off to the month of September. According to Lagler (1956) the fluctuation in the spawning was produced by alteration in temperature, pH, dissolved chemical, and present studies are in agreement with these clarifications. Monthly fluctuation in the values of GSI and DI shows that the breeding period of this species is mainly affected by the environmental factors including the habitat ecology and physico-chemical parameters of the water. Similar fluctuation in the reproductive cycle of *M. acanthurus* was noticed by Carvalho (1978) and Sharma and Subba (2005) in *Macrobrachium lammarrei* in Nepal. According to Singh and Roy (1994) *M. brimanicum choprai* show continues breeding and maximum breeding occurred was in the monsoon months. Pillay and Nair (1971) also reported that the rainy season is suitable for breeding in the crabs. However some observations of Gyananath (1982), Victor (1984) and Sarojani & Rajani (1987) on different species of freshwater prawn supported the present study which determined that rainfall help to prepare for the breeding activates in the freshwater prawns. Arimoro and Jacob (2007) reported that *M. brimanicum chopari* spawn during the rainy season. Present observations are not in consonance with the finding of the Nagabhushanam et al. (1987), who have observed that rainy season reduces the breeding activities of *Metapenaeus affinis*. Singh et al. (2012) reported that *Macrobrachium gangeticum* in River Ganga around Varanasistart breeding in May which continues till October and similar remark were seen in *Macrobrachium assamense peninsulare*.

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References

Arimoro FO and Meye JA 2007. Some aspects of the biology of *Macrobrachium dux* (Lenz, 1910) (Crustacea:

Decapoda: Natantia) in River Orogoda, Niger Delta Nigeria. *Aata Biol Colomb* 121(1):111-122.

Booolootian RA, Giese AC, Farmanfarmaian A and Tucker J 1959. Reproductive cycle of five west coast crabs. *Physiol Zool* 32:213-220.

Carvalho HA 1978. Ciclo sexual de *M. acanthurus* (Wiegmann, 1836) (Crustacea:Decapoda) relacoes com fatores abioticos eciclo de intermudas. Ph. D. Thesis

Cavalli RO, Lavens P and Sorgeloos P 2001. Reproductive performance of *M. rosenbergii* females in captivity. *J World Aqu Soci* 32 (1) 60-67.

Conides A, Glamuzina B, DulCic J, Kap Iris K, Ju G-DujakovIc J and C. Papaconstantinou C . 2008. Study of the reproduction of the karamote shrimp peneaus (Melicertus) Kerathurus In Amvrakikos Gulf, Western Greece. *Actaadriat* 49(2): 97-106.

Cummings WC 1961. Maturation and spawning of the pink shrimp, *panaeus duorarum* Burken road, Trans. *Amer Fish Soc* 90: 462-468.

Dobriyal AK, Rautela KK and Rautela AS 1999. Invention of a new index for the determination of sexual maturity in fishes. *Uttar Pradesh J Zool*19:207-209.

Giese AC 1959. Comparative physiology: Annual reproductive cycle of marine invertebrates. *Ann Rev Physiol* 21:547-576.

Gyananath G 1982. Reproductive biology of the *Macrobrachium kistenisis* Maratwada University, Aurangabad, India. Ph.D. Thesis.

Gyananath G and Sarojini R 1986. Annual reproduction cycle of the prawn *M. lamerii*. Proc 1st Nat Sysmp Comp Endoct Invert 56-60.

Kingdom T, Erondy ES 2013. Reproductive biology of African river prawn *Macrobrachium vollenhovenii* (Crustacea: Palaemonidae) in the Lower Taylor Creek, Niger Delta, Nigeria. *Ecologia Balkanica* 5(1):49-56.

Koshal Kumar, Kotnala CB, Anita Rawat Rana 2015. Sex composition of *Macrobrachium assamense peninsulare* (Tiwari, 1958) from Rawasan stream, Garhwal Himalaya Uttarakhand, India. *J Mountain Res* 10:29-33.

Kulkarni GK and Nagabhushanam R 1982. Reproductive biology of female penaeid prawns, *Parapenaeopsis hardwickii* (Miers) (Crustacea: Decapoda: Penaeidae). *J Ani Morphol Physiol* 29:55-63.

Lagler KF 1956. Fresh water fishery biology, 2nd Ed., Bubuque, Lowa Wm. C. Brown 421 pp.



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- Lawrence AB, Ward D, Missler S, Brown A, MacVey J and Middleditch BS 1979. Organ indices and biochemical levels of ova from penaeid shrimp maintained in captivity versus those captured in the wild. Proc 10th annual meeting, **World Mariculture Soc** (10):453-463.
- Magalhaes T, Mossolin EC and Mantelatto FL 2012. Gonadosomatic and hepatosomatic indexes of the freshwater shrimp *Macrobrachium Olfersii* (Decapoda: Palaemonidae) from Sao Sebastiao Island, Southeastern Brazil. Pan-American. **J Aqu Sci** 7(1):1-9.
- Nagabhushanam R, Sambasiva Rao S, Sarojani R and Jayalakshmi K 1978. Annual reproductive cycle of female *Macrobrachium affins*. **Nat symp on phy of Crust**, pp 39-44.
- Parvaiz AP and Sikdar M 2014. Influence of bilateral eyestalk ablation on gonads of freshwater prawn *M dayanum*. **J Env Biol** 35:821-825.
- Pillay NK and Nair NB 1971. Annual reproductive cycle of *Uea annulipes* and *Metapenaeus affins* form the south west coast of India. **Mar Biol** (11) 152-166.
- Raman K 1967. Observation of the fishery and biology of the giant freshwater prawns *Macrobrachium rosenbergii* de Man. **Proc Symp Crust Mar Biol Ass India** Part-2 pp 649-669.
- Rao RM 1967. Studies on the biology of *Macrobrachium rosenbergii* (de Man) of the Hoogly estuary with notes on its fishery. **Proc Biol Sci** (33):252-279.
- Sarojani, SR and Rajani J 1978. Reproductive cycle of female fresh water prawn *Caridina rajdhari*. **Adv in Biosc** (6):115-123.
- Sethi SN, Ram N and Venkatesan V 2014. Reproductive biology of *Macrobrachium lar* (Fabricius, 1798) in Andoman Islands. **Indian J Geo Mar Sci** 43(12):1-8.
- Sharma A and Subba BR 2005. General biology of freshwater prawn, *Macrobrachium lamarrei* (H. Milne-Edwards) of Biratnagar, **Nepal. Our nature** 3(1):31-41.
- Singh AK, Tiwari RK, Kanaujia DR, Pandey JP and Mishra P 2012. Growth and breeding Behavior of *Macrobrachium gangeticum* in River Ganga Around Varanasi. **Ecologia** 2(2) 31-42
- Singh R and Roy D 1994. Reproductive cycle of the fresh water *Macrobrachium brimanicum choprai* (Tiwari). **Asian Fis Sci** (7):77-89.
- Subramanayam, CB 1963. A note on the annual reproductive cycle of the prawn *Penaeus indicus* (Milne Edwards) of Madras coast. **Current Sci** (32):165-166.
- Victor B 1984. Reproductive biology of female freshwater prawn *Caridinara jdhari*. Maratwada University Aurangabad, India D. Phil thesis.

