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# 4. Study of Reproductive Biology of the Freshwater Female Prawn, *Macrobrachium* rosenbergii in Relation to the variations in the Gonadosomatic & Hepatosomatic Indices

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**Abstract**

The Study of reproductive biology of edible species is very essential for the expansion of aquaculture. Considering the importance of freshwater female prawn, Macrobrachium rosenbergii its annual reproductive cycle was investigated using the gonadosomatic (GSI) and hepatosomatic indices (HSI) as a criterion. Annual reproductive cycle of M. rosenbergii was carried out from October - 2004 to September - 2005. Highest gonadosomatic index (5.287 ± 1.75) was observed in the month of August, whereas highest hepatosomatic index (8.303 ± 0.24) was observed in the December. Lowest GSI was recorded in the month of February(0.404 ± 0.14) and lowest HSI was recorded in the month of August (2.961 ± 0.47). It was observed that the commencement of ovary maturation takes place in the month of March continuing further showing distinct breeding activity during June to July indicating highest peak in August. GSI recorded during September to December indicated decreased pattern representing spawning period. The spent stage which is almost immature stage showed lowest GSI during January to March. Annual reproductive cycle shows continues breeding pattern having single highest breeding peak in August.

**Keywords:** Gonadosomatic index, Hepatosomatic index, Macrobrachium rosenbergii.

## Introduction

Crustaceans provide a good substitute for human consumption to meet the need of protein rich food for ever increasing human population. Development of crustacean culture on commercial scale basically depends upon the reproductive performance of the particular species. So it becomes very essential to study the reproductive biology which is the fundamental and vital

physiological process of any living organisms. So number of workers has studied reproductive cycle in decapods crustaceans using gonadal indices as criteria. Notable studies were, Pillai and Nair (1971) Kyomo, 1988; Reigada and Negreiros-Fransozo, 2000; Tapellaet al., 2002; Costa et al., 2006; Kale, 2007. Nagabhushanam et al., (1987) reported two reproductive phases in the annual reproductive cycle in female prawn, Metapenaeus affinis. Castiglioni and Fransozo (2006) investigated the gonad development of Uca rapax throughout annual reproductive cycle for achieving the size at onset of its sexual maturity. Tripathi et al.(2019) studied seasonal changes in reproductive cycle of female fresh water prawn, Macrobrachium dayanum. They noticed cyclic reproductive activities in M. dayanum, which breeds continuously throughout the year but with two distinct peaks one major in the month of May-July and one minor in the month of January - February.

Macrobrachium rosenbergii have large market demand due its nutritional value & deliciousness, hence present study was undertaken to determine its reproductive biology by considering the changes in gonadosomatic and hepatosomatic indices. This kind of fundamental research will provide useful information for the application and management programs for commercially important crustacean species.

**Materials and Methods**

Freshwater prawns, Macrobrachium rosenbergii were collected monthly from October - 2004 to September – 2005 from the "Girna Dam", located at Malegaon, Nasik in Maharashtra State. Collected animals were brought in the laboratory in the first week of every month on fixed date and time to avoid fluctuations if any. From the collection, only healthy female prawns were selected and immediately sacrificed to record the gonadosomatic index and hepatosomatic index. The GSI and HSI were calculated according to the formula given by, Farmanfarmaian et al.,(1958).

G.S.I. = (Wet weight of gonad) / (Wet weight of animal) X 100

H.S.I. = (Wet weight of hepatopancreas) / (Wet weight of animal) X 100

The mean values of the indices for 10 female prawns were calculated for every month.

**Results**

The variations in the gonadosomatic and hepatosomatic indices of female prawns, M. rosenbergii were recorded monthly for one year from October - 2004 to September – 2005 and represented in Table-1and Fig.-1.Highest gonadosomatic index (5.287 ± 1.75) was observed in the month of August and highest (8.303 ± 0.24) hepatosomatic index was observed in the

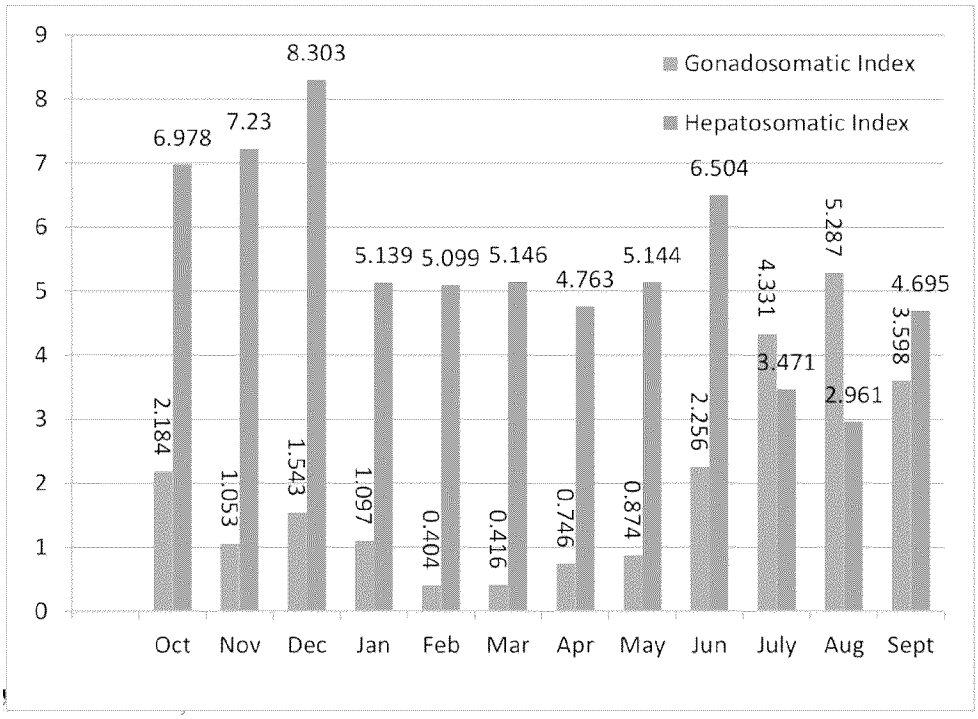
December. Lowest GSI (0.404 ± 0.14) was recorded in the month of February and lowest HSI (2.961 ± 0.47) was recorded in the month of August. As per the gonadosomatic and hepatosomatic indices observed, it is evident that the commencement of ovary maturation takes place in the month of March and continues further. During June to July breeding activity was distinct and showed its highest peak in August; immediately followed by decrease in GSI during September to December indicating spawning period. The spent stage which was almost in immature stage showed lowest GSI during January to March.

Annual reproductive cycle of M. rosenbergii showed inverse relation between gonadosomatic and hepatosomatic indices. High HSI were observed during October to December indicating synthesis phase of organic nutrients in the hepatopancreas. The low HSI were observed from July to September which is high breeding activity.

Table-1: Showing monthly changes in the gonadosomatic indices and hepatosomatic indices in the freshwater female prawn, Macrobrachium rosenbergii from October - 2004 to September – 2005.

| Month | GonadosomaticIndex± S.D. | HepatosomaticIndex± S.D. |
|---|---|---|
| Oct | 2.184 ± 0.58 | 6.978 ± 0.59 |
| Nov | 1.053 ± 0.35 | 7.230 ± 0.59 |
| Dec | 1.543 ± 0.28 | 8.303 ± 0.24 |
| Jan | 1.097 ± 0.17 | 5.139 ± 1.69 |
| Feb | 0.404 ± 0.14 | 5.099 ± 1.77 |
| Mar | 0.416 ± 0.05 | 5.146 ± 0.89 |
| Apr | 0.746 ± 0.02 | 4.763 ± 1.00 |
| May | 0.874 ± 0.02 | 5.144 ± 0.41 |
| Jun | 2.256 ± 0.11 | 6.504 ± 0.96 |
| July | 4.331 ± 0.04 | 3.471 ± 0.37 |
| Aug | 5.287 ± 1.75 | 2.961 ± 0.47 |
| Sept | 3.598 ± 0.47 | 4.695 ± 0.40 |

Fig. 1: Showing monthly changes in the gonadosomatic indices and hepatosomatic indices in the freshwater female prawn, Macrobrachium rosenbergii from October - 2004 to September – 2005.




## Discussion

In crustaceans, the annual reproductive cycle may be assessed by various methods like observations of spawning, the percentage of ovigerous female against time and presence of ripe gametes in gonad, gonadosomatic index etc. Bennett and Giese (1955) were the first to report the gonadal index as a function of reproductive cycle of aquatic invertebrates. Gonadal index is the ratio of gonad size to body weight and considered as a measure to find out average reproductive stage of reproductive population Giese(1969).The ratio of gonad size to body weight gives a relation to gonad maturity and gonad development. This method has been widely used in other invertebrates like molluscs and echinoderms (Giese, 1959; Giese, 1969) and in crustacean (Subrahmanyam, 1963; Shih, 1993; Shih,1997; Fernando and Adilson, 1999).Results found in the present investigation of reproductive biology of freshwater female prawn, M. rosenbergii using GSI & HSI as criteria is represented in Table-1 & Fig.1.Accordingly, four maturity stages were recognized; immature, maturing, mature and spent. The commencement of ovary maturation takes place in the month of March and continues further during June and July

showing distinct breeding activity with single highest peak of GSI in August(5.287 ± 1.75) while lowest HSI (2.961 ± 0.47) was recorded in the this month. Lowest GSI (0.404 ± 0.14) was recorded in the month of February whereas, highest hepatosomatic index (8.303 ± 0.24) was observed in the December. Spawning was noticed in the months of September, October, November and December. The spent stage which was almost in immature stage showed lowest GSI during January to February and March. The present study clearly indicates that M. rosenbergii breed continuous throughout the year and the peak breeding activity is during monsoon. Similar results were reported by, Diwan and Nagabhushanam, 1974; Tan-Fermin and Pundadera, 1989; Dallet al., 1990;) Kunju (1968) also suggested continuous breeding in prawn, Solenoceraindica. His observations were based on the record of female prawn in different stages of maturity in the monthly samples. In the present study Macrobrachium rosenbergii, exhibited maximum breeding activity during August to September, as it showed significant increased ovarian index during these months over remaining period of the annual reproductive cycle. Low breeding activity was observed during January to March, it might be due to some environmental factors that may be inhibiting the gametogenic cycle in the present prawn. Possibly, food may not be available in abundance during the observed low breeding activity. However, higher breeding activity during August and September correlates with heavy planktonic blooms, which appear during these months in "Girna Dam" in Nasik. Goodbody (1965) attributed availability of food for adults as an important factor controlling breeding in tropical invertebrates. He suggested that continuous breeding species are relatively unspecialized in their food requirements and are either suspension feeders for browsers often with an abbreviated plankton larval stage.

Crustacean hepatopancreas, originally considered only as digestive gland, is now known as center of intermediately metabolism and as an important storage depot like insect fat body and vertebrate liver and adipose tissue. Different cell types with diverse functions like absorption, storage and secretion have been reported in the hepatopancreas (Adiyodi, 1969; Momin and Rangnekar, 1975). High HSI were observed during October to December indicating synthesis phase of organic nutrients in the hepatopancreas. The low HSI were observed from July to September i.e. during high breeding activity indicating mobilization of organic constituents required for the ovarian maturation. High HSI showed inverse pattern with GSI. Variations in the HSI throughout the year and during maturation did not seem to corroborate in general pattern among decapods, which the storage of organic reserves in the hepatopancreas and utilization of these reserves in the ovarian development (Gibson and Barker, 1979). Rosa and Nunes (2002)

reported that both GSI and HSI increase with the ovarian maturation suggests that the hepatopancreas resources are not depleted, and according to Tuck et al., (1997) if resources are mobilized from this organ, than they seem to be compensated by those gain from feeding.

In the present study monthly gonadosomatic index and hepatosomatic index was recorded to know the reproductive periodicity and it was concluded that freshwater female prawn, M. rosenbergii is continuous breeder showed highest peak of reproductive activity in the months of July to September and lowest reproductive activity in the month of February. In conclusion, the use of practical scale proposed including GSI and HSI might be a useful tool to better describe the reproductive periodicity of M. rosenbergii under commercial aquaculture

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