Title	Female reproductive Biology of Freshwater River Prawn, Macrobrachium malcolmsonii(H. Milne Edwards, 1844) from AYEYAWADY River
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Female Reproductive Biology of Freshwater River Prawn *Macrobrachium malcolmsonii* (H.Milne Edwards, 1844) From Ayeyarwady River

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Abstract

A total of 300 female freshwater prawns *Macrobrachium malcolmsonii* were sampled from April 2004 to December 2005. The breeding season of the female prawn was observed to be from April to August and peak in April to June. Five stages of ovarian development were oogonia (white), previtellogenesis (pale yellow), early vitellogenesis (yellow), vitellogenesis (green), and vitellogenesis (deep green) were recorded. The Gondosomatic Index GSI values were correspondence with ovarian development and cell diameter. The (GSI) value of the prawn was inversely related to the Hepatosomatic Index (HSI) value. In fecundity, the total number of eggs ranged from 1170 to 30104 eggs were observed. The condition factor of the female prawn was the highest in April (1.3 $\pm$ 0.002). It can be concluded that the breeding season of *M.malcolmsonii* was observed from April to August according to GSI values of female prawns. Five stages of ovarian development of *Macrobrachium malcolmsonii* were observed in this study.

Introduction

Resource conservation is very important for sustainable economic development and awaring the obligation to the future generation of a country. Income from fisheries, especially shrimp and prawn production plays a major role in gaining foreign exchange of a country's economy.

Myanmar has a long coastline of 2832 kilometers. The total area of swamps along the coast is a million hectares which provides a very good basis for the development of shrimps and prawn culture. The continental shelf covers 228, 781 sq: kilometers and Myanmar's exclusive economic zone (E.E.Z) is 486,000 sq: kilometers wide. According to surveys and research undertaken in marine fisheries, the Maximum Sustainable Yield (MSY) of the Union of Myanmar is estimated at about 1.05 million metric tons per year. Myanmar exported 205, 463 tons of fishery products in the fiscal year ending March, 31, 2004 (Asian Economic News, 2005). To culture a species it is needed to know the reproductive cycle of the species.

The reproductive biology of the present species was studied by Rajyalakhmi (1964) and Patwardham (1937). According to Rajyalakshmi, the spawning period of this species in Hooghly river is, however shorter during the months of May to August, and according to Patwardhan (1937), the breeding season is still shorter, during May, June and July.

The study of reproduction forms a basic part of aquaculture industry. To culture a species, it is needed to know the reproductive cycle of the candidate species. Therefore, the present study aim to investigate the female reproductive biology of *M. malcolmsonii* from Ayeyarwady river.

The objectives of this research are: (1) to understand the reproductive season of *M. malcolmsonii* in this study area, (2) to understand the different stages of ovarian development during the breeding season and (3) to understand the fecundity of this species in the study area.

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Materials and Methods

Collection of Specimens

Macrobrachium malcolmsonii were collected monthly from April 2004 to December 2005, from three stations (A; Shame-ma-gar, B; Ma-yan-chan, and C; Shwe-kyet-yet banks) along Ayeyarwady rivers of Mandalay environs. Five specimens were sampled from each station, totally 15 specimens were sampled monthly. The specimens were caught by fishermen using a trap. A total of 300 females were sampled. Identification was as followed after Holthuis (1950).

Preservation

The ovaries of specimens were removed by dorsal incisions through carapace and preserved in 5 % formalin for later examination and then, the colour and size of the gonads were recorded for determination of developmental stages. If the female prawn has eggs attached in peleopod during breeding season, the colour and stages of the eggs were recorded and then the eggs were preserved in 5% formalin for fecundity calculation. Preserved ovaries and eggs were weighed to nearest 0.001 g on a balance (Setra EL Series).The present study defined gonad developmental stages through histological examination according to Chang and Shih (1995) . Hundred cells diameters of the ovaries were measured for determination of mean diameter for each developmental stages.

Fecundity determination

The potential fecundity was calculated by using Gravimetric methods (Lagler, 1962), when it was determined by removing of 0.5 g of eggs and then calculated the total number of eggs attached in peleopods. The eggs were counted under a binocular microscope.

The gonadosomatic index (GSI) and hepatosomatic Index (HSI) were calculated by the following formula,

$$\text{GSI} = \frac{\text{Gonad weight}}{\text{Body weight}} \times 100 \quad \text{and} \quad \text{sHSI} = \frac{\text{Liver weight}}{\text{Body weight}} \times 100$$

The Coefficient of condition, K was determined by the following formula. $K = \frac{W}{L^3} \times 100$ (where W = Body weight in gram and L = Body length in centimetre).

Results

Morphology of the ovary

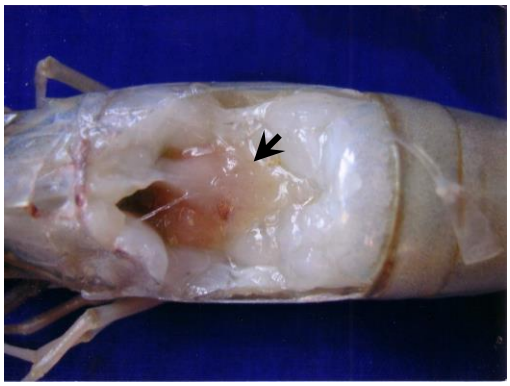
The ovary of *M. malcolmsonii* is a paired, sickle-shaped structure situated above the hepatopancreas and below the pericardial sinus and heart. Both the anterior and posterior ends of the ovaries touching each other and leaving a gap in the middle of immature ovary. The shape, size and colour of the ovaries vary according to the season (Fig.1).

Maturity of the ovary

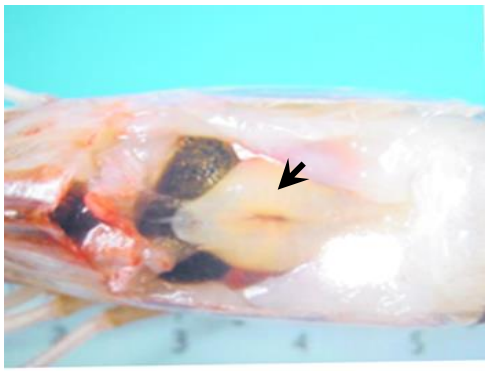
Ovarian maturity of *M. malcolmsonii* was divided into five stages based on the colour and size of the ovaries (Fig. 1).The changes of the developing oocytes of*M. malcolmsonii* can be divided into five stages based on the histological observation (Fig.2)

Fecundity

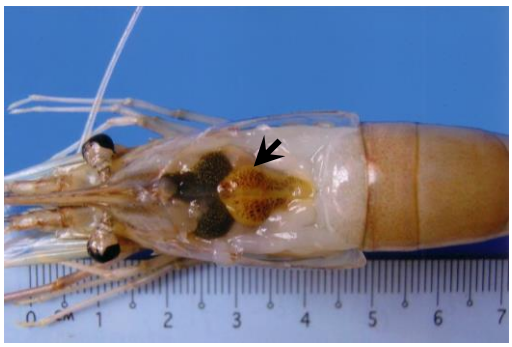
In the present study, fecundity is considered as the number of eggs present within the peleopods of the abdomen. The total number of eggs observed were ranged from 1170 to 30104 eggs and the sizes ranged from 120 to 176 mm (Table 4). The colour of egg stages were pale yellow, yellow, grey colour with eye stalk. The grey eggs were ready for hatching within four or five days. Seasonal changes of condition factor was as shown in Table 1. Length-weight relationship of female prawn was high correlation (r^2 = 0.72) (Fig.4).



A. Stage I



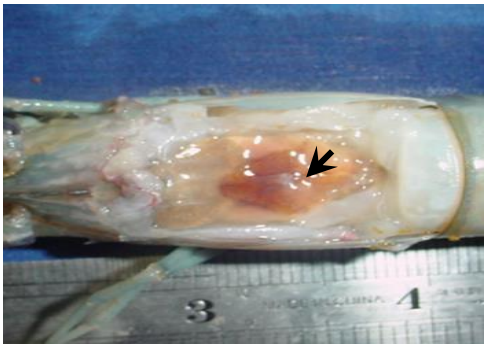
B . Stage II



C. Stage III

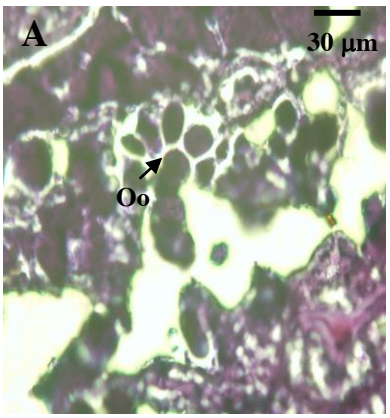
D.Stage IV

E .Stage V

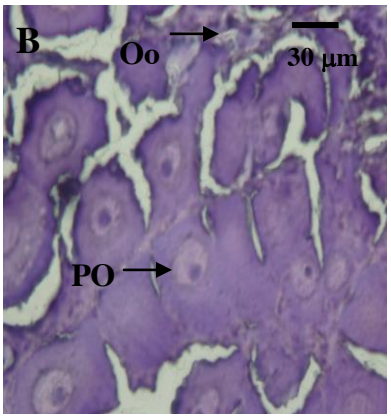


F. Postovulatory phase

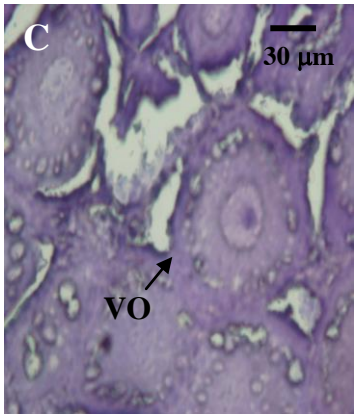
Fig 1 - Maturity stages based on the colour and size of the ovaries of *M malcolmsonii*



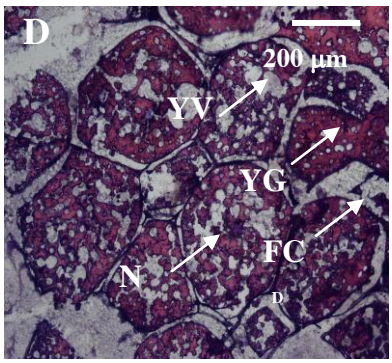
A.Oogonia (Stage I))



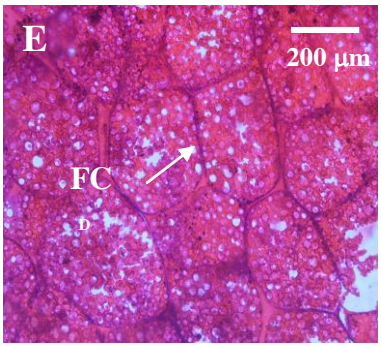
B.Previtellogenic oocytes (Stage I)



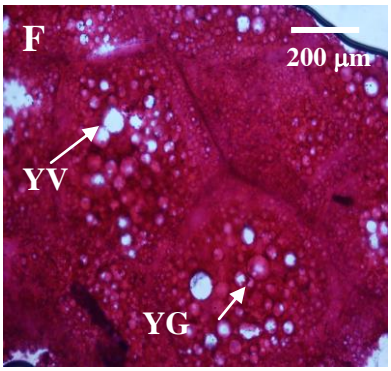
C.Early Vitellogenic oocytes (Stage III)



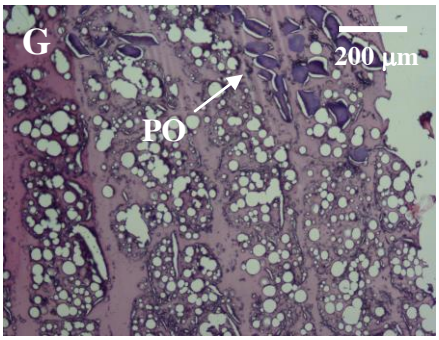
D: Vitellogenic oocytes with thick follicle cells (Stage III)



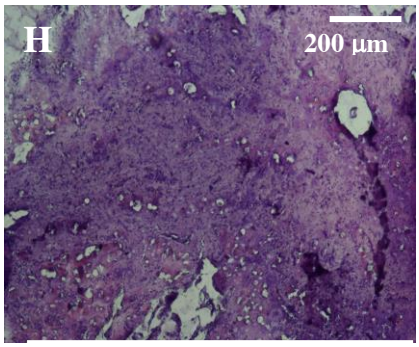
E. Vitellogenic oocytes with thin follicle cells (Stage IV)



F. Late Vitellogenic oocytes (Stage V)



G . Postovulatory oocytes with previtellogenic oocytes



H. Postovulatory oocytes without any ocytes

Fig 2. - Histological changes in the ovaries of *Macrobrachium malcolmsonii*
Oogonia (Oo), Previtellogenic oocytes (PO), Vitellogenic oocytes (VO), Follicle cells (FC), Yol(k vesicle (YV), Yolk globules (YG) , Nucleus (N) .

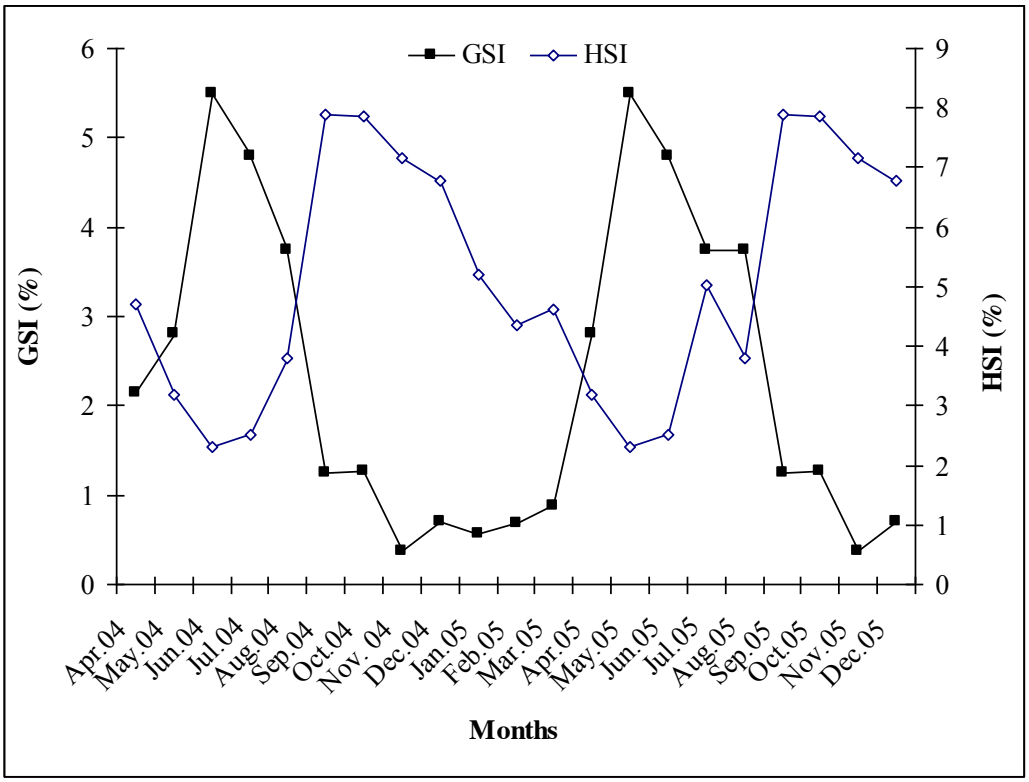


Fig . 3. Seasonal changes in GSI and HSI values of female prawn *M. malcolmsonii* during 2004-2005

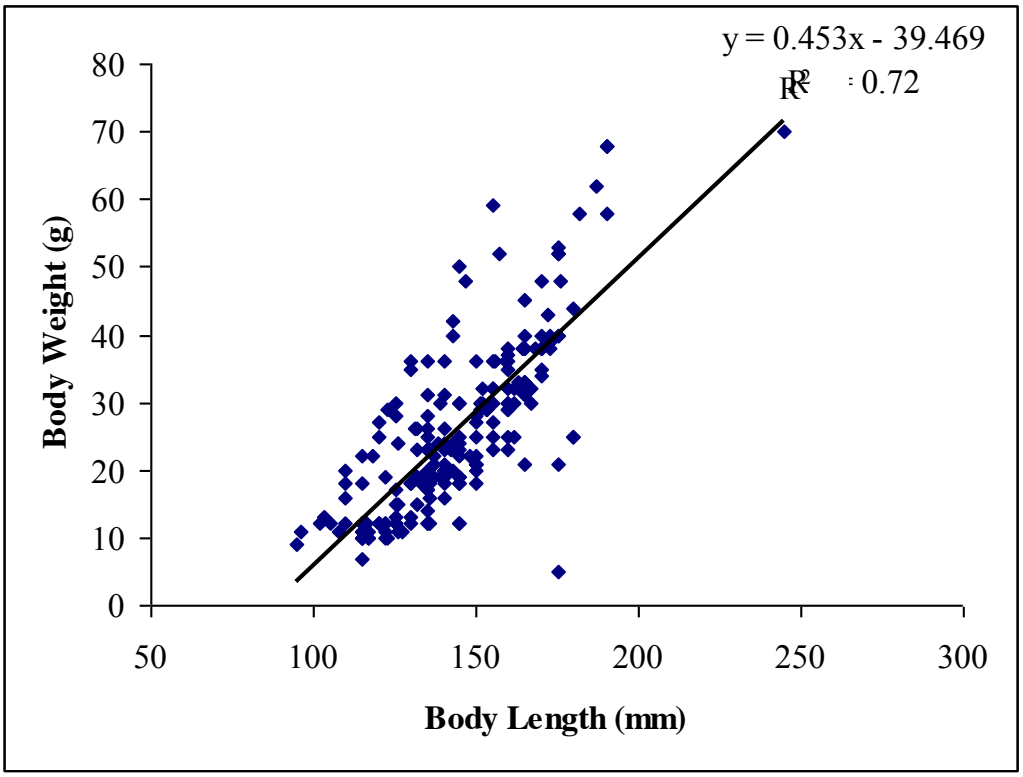


Fig .4 . Length –weight relationship of female prawn *M. malcolmsonii*

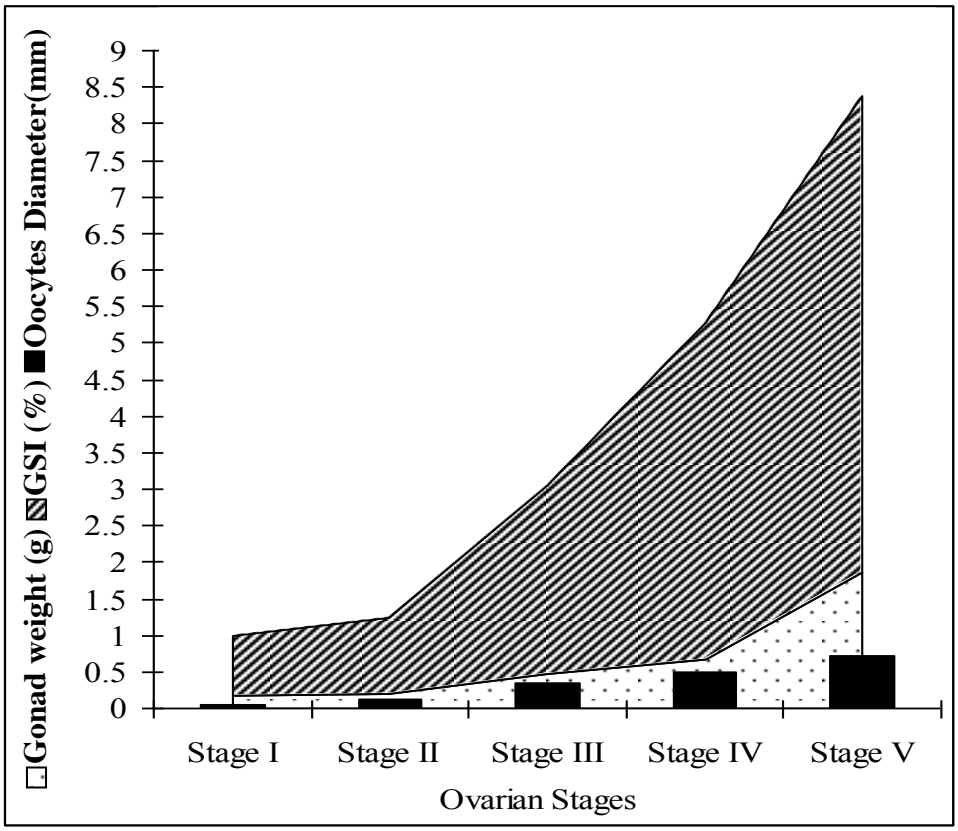


Fig.5. Relationship of ovarian development with ovary weight, GSI and Oocytes diameter of *M.malcolmsonii*

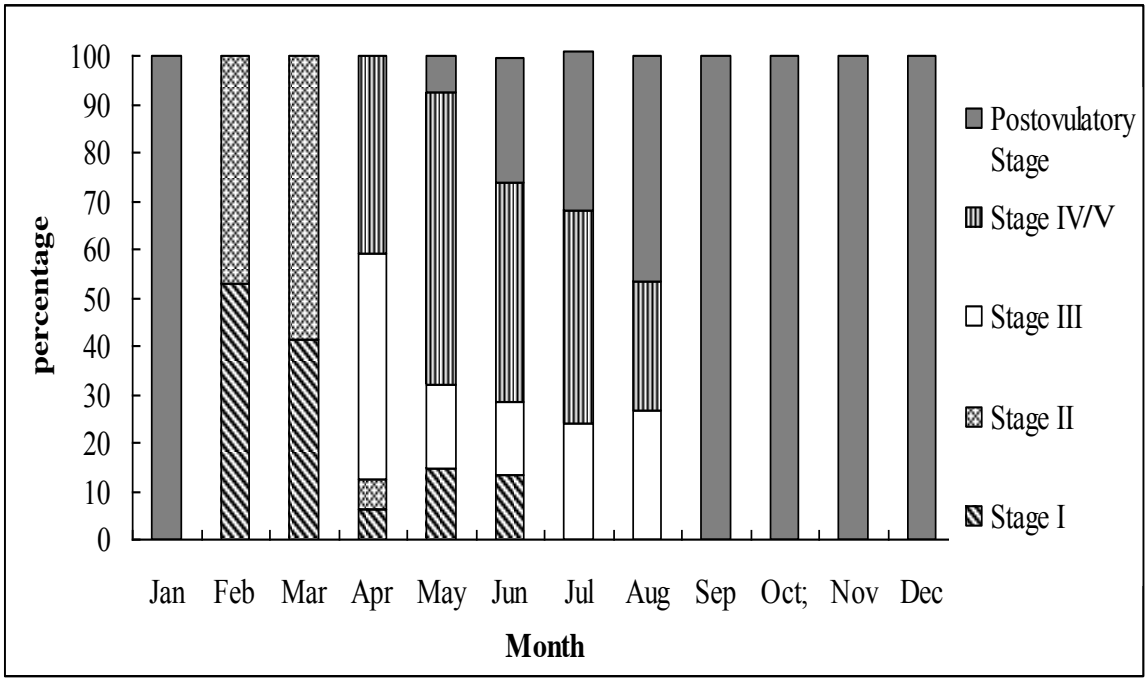


Fig. 6. Seasonal changes in ovarian development of *M.malcolmsonii* during 2004-2005

Table 1. Seasonal Changes in GSI, HSI and condition factors of female *M malcolmsonii* during 2004-2005

Months	No. of specimens	Body weight (g)*	Body Length (mm)*	GSI[a] (%)*	HSI[b] (%)*	Condition factor*
Jan	15	32.6 ±16.9	156.6 ± 18.6	0.57± 0.6	5.2± 3.6	0.8 ± 0.5
Feb	15	25.3 ± 13.6	139.3 ± 14.4	0.38 ± 0.1	5.5 ± 3.2	0.9 ± 0.5
Mar	15	17.8 ± 2.9	143.5 ± 11.9	1.04 ± 1.4	5.6 ± 1.8	0.6 ± 0.5
Apr	37	27.7 ± 15.03	126.0 ± 17.6	2.14 ± 2.2	4.7 ± 1.9	1.3± 0.06
May	45	28.1 ± 10.8	136.5 ± 18.1	3.5 ± 3.5	2.3 ± 1.1	1.1± 0.001
Jun	45	28.6 ± 8.6	152.6 ± 12.9	5.5 ± 4.1	4.7 ±1.8	0.8± 001
Jul	40	28.6 ± 18.2	148.7 ± 31.9	3.8 ± 2.4	5.02 ± 3.6	0.8 ±0.001
Aug	40	30.5 ± 5.2	158.9 ± 9.5	3.8 ±3.9	3.8 ± 2.1	0.8 ±0.5
Sep	30	32.5 ± 8.1	162.9 ± 14.7	1.3 ± 1.9	7.9 ± 3.6	0. 7 ± 0.5
Oct	20	27.1 ± 11.9	149.5 ± 24.5	1.3 ± 2.4	7.9 ± 4.2	0.9 ± 0.001
Nov	17	33.2 ± 16.1	149.8 ± 22.8	0.4 ± 0.2	7.2 ±1.6	0.9 ± 0.001
Dec	30	24.9 ±8.6	146.5 ± 14.4	0.7 ± 1.6	6.8 ± 1.9	0.8 ± 0.6

* Data were shown in mean ± SD

[a] GSI : Gonadosomatic Index

[b] HSI : Hepatosomatic Index

Table 2. The Characteristics of different stages of ovarian development in freshwater prawns *Macrobrachium malcolmsonii*

Ovarian Stages	Ovarian Colour	Reproductive stage	Ovary weight (g)*	GSI[a] (%)*	Oocytes Diameter (mm)*
Stage I	Creamy White	Oogonia Phase	0.17± 0.09	0.81± 0.03	0.06 ± 0.04
Stage II	Pale Yellow	Previtellogenesis	0.2 ± 0.19	1.04 ± 0.4	0.13 ± 0.07
Stage III	Yellow	Vitellogenesis	0.46 ± 0.7	2.6 ± 0.9	0.35 ± 0.05
Stage IV	Green	Vitellogenesis	0.68 ± 0.04	4.6 ± 0.05	0.5 ± 0.04
Stage V	Deep green	Vitellogenesis	1.87± 0.17	6.5 ± 0.6	0.71± 0.07

* Data were shown in mean ± SD [a] GSI : Gonadosomatic Index

FIg.3. Different developmental stages of ovary of berried females and egg colour of *Macrobrachium malcolmsonii* during 2004-2005

Month	Female with eggs (%)	Female without eggs (%)	Ovarian Stages in berried female prawn			Egg colour	
			StageIII (%)	StageIV/V (%)	Postovulatory (%)	Yellow without eyespots	Grey with eye spots
Apr	40.5	59.45	46.6	53.33	-	86.6	13.33
May	73.52	26.47	8	92	-	62.9	37.03
Jun	51.28	48.71	-	75	25	56.5	43.7
Jul	73.33	26.66	4.54	50	45.45	44.4	55.5
Aug	37.5	62.5	16.66	33.33	50	20	80

Table 4.- Fecundity of *M. malcolmsonii* during 2004-2005

Year	Body weight (g)*	Body length (mm)*	Carapace length (mm)*	Fecundity
2004	26.31 ± 10.4	136.5 ± 18.12	34.8 ± 6.7	4332 to 27500 eggs
2005	28.05 ± 10.8	148.6 ± 16.5	37.9 ± 8.3	1170 to 30104 eggs

* Data were shown in mean ± SD

Discussions

The present study investigated in the reproductive biology of the freshwater prawn *M. malcolmsonii*. Seasonal changes in gonadal development of female prawns were studied based on the morphological and histological observations, fecundity, Gonadosomatic index (GSI), Hepatosomatic index (HSI), spawning seasons and condition factors.

In the present study, the breeding period of the female prawn was observed from April to the August and the peak season was observed in June and the oocytes very few were observed in August. However, according to Patwardgam (1937), the breeding season is still shorter during May, June and July, that is the months of May to August by Rajyalakshmi (1964) and George (1969) that was observed from April to November. Therefore, the breeding season of this species in this study was earlier than those of Patwardgam (1937) and Rajylalakshmi (1964). The end of the breeding season observed by George (1969) was later than that of this study. This may be due to environmental variable of the study area.

On the morphological observation, the classification of developmental stages (1-V) of this species were based on the colour and size of the ovary, it was in correspondence with the developmental stages of the histological observations . In *M. rosenbergii*, the colour of the ovarian stages III and IV were orange and that of stage V was reddish in colour whereas the colour of the ovarian stage III was yellow (Chang and Shih 1995) and in the present study those of stage IV and V were green in colour in the present study. The ovarian developmental stages of this prawn are in correspondence with the oocytes diameter, ovarian growth and GSI value .

On the histological observation, only the stage I and II ovaries were observed in February and March . In April, all developmental stages (I-V) were observed. In the months of April and May, the ovarian developmental stage III, IV and V and postovulatory ovaries together with previtellogenic oocytes were observed in the ovaries of the berried females . In July and August, any oocytes was not observed in these stages. Therefore, the female prawn spawn more than once during the breeding season. This is the same result recorded by Ibrahim (1962) that the resting time were observed from August to January.

The GSI value of the female increased from April to August . The GSI value of female was the highest in June and the lowest in November. The HSI value of the female was the highest in September and the lowest in May . Therefore, the GSI values of female prawns are inversely proportional to the HIS value. A similar GSI values of the species was observed for both year .

In the present study the total number of eggs ranged from 1170 to 30104 eggs and the sizes ranged from 120 mm to 176 mm. According to George (1969) the total number of eggs ranged from 3465 to 63080 in the size ranging from 54 mm to 164 mm. In

M rosenbergii, the total number of eggs ranged from 7000 to 111400 eggs (Rajyalakshmi, 1961). The fecundity of *Macrobroachium* prawns is very variable, the highest fecundity in species of this genus was observed in *M.rosenbergii* and *M.acanthurus* in which females can lay between 80,000 to 100,000 eggs in each spawning period when they are fully mature. In the first spawning they can lay not more than 5,000 to 20,000 eggs (New, 2000).

The seasonal changes in the condition factors of the female prawn was the highest in April (1.3 ± 0.0002). The length-weight relationship of female prawns was highly correlated ($r^2 = 0.72$). Based from the resulting data, the breeding season of *Macrobrachium malcolmsonii* observed to be from April to August. Five stages of gonadal development were present in female prawns of the studied species.

Acknowledgement

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References

Chang, C. F. and T.W. Shih (1995). Reproductive cycle of ovarian development and vitellogenin Profiles in the freshwater prawns, *Macrobrachium* r*osenbergeii*. *Inverte Repro.Develop*.**27**(1) : 11-20.

Da, Silva, R. R., C. M. S; Sampaio and J. A Santos. (2004). Fecundity and fertility of *Macrobrachium amazonicum* (Crustacean, Palaemonidac) *Braz-J-Biol*, **64**(3A): 489-500

George, M. J. (1969). Genus *Macrobrachium* BATE in prawn fisheries of India *ICAR*. *Bull*. *Cent*. *Mar*. *Fish*. *Res*. **14** :179-215.

Holthuis L. B. (1950). *The Decapoda of the siboga Expedition*, Part X. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species I. Subfamily Palaemonidae, *E.J Brill*.

Holthuis L.B. (1980). Shrimps and pawns of the world. An annotated catalogue of species of interest to fisheries F.A.O species catalogue. *F.A.O Fisheries Synopsis*,1: **125**.

Ibrahim, K. H. (1962). Observations on the fishery and biology of the freshwater prawn *Macrobrachium malcolmsonii* of river Godavari. *Indian J*. *Fish*. **9**(2): 433-467.

New, M. B. (1995) . Status of freshwater prawn farming: a review *Aquaculture Research*. United Kingdom, *In:* M.B New & W.C Valenti (eds), 26:1-54.

New, M. B. (2000). History and global status of freshwater prawn farming. *In:* M.B New & W.C Valenti (eds), *Freshwater prawn culture*. Blackwell, Oxford.

Lagler, K. F, J. E. Bardach and P. R. Miller. (1962). *Ichthyology, the Study of Fishes*. John Wiley and Sons Inc. New York.

Jordan, E. L and P. S., Verma. (1996). *Invertebrate Zoology*. Sixth revised and Enlarged edition. S. Chand and Company. Ltd.

Rajyalakshmi,T. (1980). Comparative study of the biology of the freshwater prawn *Macrobrachium malcolmsonii*. of Giodavari and Hooghly river systems. *Proc*. *Indian Nat*. *Sci Acad*., **46** (1): 72-89.