

# MORPHOLOGICAL IDENTIFICATION AND REPRODUCTIVE CONDITIONS OF PRAWNS (DECAPODA: PALAEMONIDAE) FROM TRIBUTARIES OF THANLWIN RIVER, KAYIN STATE

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## Abstract

Freshwater prawn *Macrobrachium* species (Bate, 1868) is a large and cosmopolitan crustacean genus of high economic importance worldwide. The present study was investigated the morphological identification of freshwater prawns of the genus *Macrobrachium* in the Thanlwin River, Kayin State and their abundant were studied from June 2016 to May 2018. A total of 16 species belonging to two genera under the family Palaemonidae were recorded. Among them, five species; *Macrobrachium rosenbergii*, *M. villosimanus*, *M. malcolmsonii*, *M. birmanicum* and *M. idea* were selected to study the seasonal changes of their reproductive condition. *Macrobrachium lanchesteri* and *M. lamarrei* were carrying eggs throughout the year while *M. malcolmsonii*, *Macrobrachium rosenbergii* and *M. villosimanus* carried egg from May to November, 2018. The highest numbers of eggs in all prawn species were found in August and September, rainy season. The reproductive condition of the studied prawn species give valuable informing for breeding design and resource conservation programs for *Macrobrachium* in Myanmar.

**Keywords:** Thanlwin river, freshwater prawn, *Macrobrachium*, fecundity, morphological identification

## Introduction

Prawns and shrimps are widely distributed in marine, fresh and brackish water environments ranging from tropical to polar regions. Most of prawns and shrimps belonging to the family Penaeidae are able to live in brackish waters with a very low salinity, while most members of the family Palaemonidae inhabit freshwater, but tolerate brackish and even marine environments (Jones, 1965). Both families belong to the order Decapoda, showing five pairs of legs.

A total of 3,047 species of prawns and shrimps are so far recoded worldwide (Jones, 1965). Of these, the most commercially important species belong to the superfamily Penaeoidea (Dore and Frimodt, 1987), while less than 300 species are of economic interest at all. Only about 100 species constitute significantly to the annual world catch (Chan, 1998). The taxonomy of the palaemonid freshwater prawns of Myanmar were reviewed by Cai and Ng (2002) and 19 species were recorded. These belong to three genera, with 17 species of *Macrobrachium* and one species of each, *Palaemonetes* and *Leptocarpus*.

In Myanmar, freshwater prawns are of economic importance for inland fisheries and an economically important food for local consumption. A total of 26 *Macrobrachium* species was found in Myanmar and of which one species was recorded as a new species. Hla Phone and Suzuki (2004) reconfirmed ten species of the genus *Macrobrachium* from Myanmar and recorded the new species of *Macrobrachium patheinense*. Twenty-seven species of *Macrobrachium* were reported up to date from Myanmar.

*Macrobrachium rosenbergii* De Man, 1879, is one of the most valuable freshwater species in Myanmar. While many freshwater taxa are important as sources for artisanal fisheries (Holthuis, 1980), *M. rosenbergii* is especially noteworthy, being an important aquaculture species in many countries in Asia-Pacific, such as Bangladesh, China, India, Malaysia, the Philippines, Vietnam and Thailand (New, 2005).

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It is necessary to further investigate the occurrence, life cycle, reproduction and growth rates as well as the habitat utilization of *Macrobrachium* species in different area of Myanmar, since research and development efforts of freshwater prawns have been principally conducted in delta regions of Myanmar.

Thanlwin River located Karin States and it is important river for fisheries sectors in the area. The river is about 2,815 kilometres long that flows from the Tibetan Plateau into the Andaman Sea in Southeast Asia. In Myanmar, it crosses northeastern Myanmar, Shan, Kayah, Mon and Kayi States before entering the Andaman Sea. Thanlwin River and its tributaries has deposition of top soil due to flooding and it provided the feeding and breeding ground supporting species richness of Palaemonidae. Although prawn resources have been exploited for many years, there is not much scientific information available on the areas. Freshwater prawns are very common in this region and are often dominant in all kinds of local water bodies. They are ecologically significantly important and several species are commercially important for human consumption (Than Than Soe, 2012).

The present study was undertaken to collect, identify and reproductive condition of prawn species occurring in Thanlwin River, Kayin State

## **Materials and methods**

### **Study area and study site**

Thanlwin River, Ma Gyi Kyun village was selected as the study area. The Thanlwin River which flows through Hpa-an Township is the 2815 km long. It is commercially useful for navigation, fishery and sand extraction. Ma Gyi Kyun is important river bank in Thanlwin River as it provides the productive agricultural land for the farmers residing villages along the bank of the river and as well as for the fishermen (Fig. 1).

### **Study period**

The field survey and specimens collection were carried out from June 2016 to May 2018.

### **Specimen collection to estimate the population of prawn species**

To estimate the population of prawn at study sites, the biggest prawn wholesale in the study site was selected. In the early morning of sample day, when fishermen came back from the fishing ground and sold the prawn to the wholesale, the total weight were noted for the day. Out of their weight, 3.2 kg of shrimp was randomly collected from the pile of prawns from wholesale. Shrimps were separated according to their species and number of individuals was also counted.

### **Morphological Identification of the species**

Collected prawn species were identified according to Holthuis (1950), Holthuis (1980) and Jayachandran (2001) and Cai and Ng (2001). Extra features of shrimp are carefully checked. The key characters of prawns were done by examining the shape and size of the second pleopod, number of rostrum teeth in dorsal and ventral of rostrum. The length of second periochopods and telson were measured. For telson, present and absent of spines were recorded (Fig. 2).

The total length (from tip of rostrum to posterior end of telson) of the prawns was measured in centimeters (cm) with a plastic ruler and individual weight was taken in grams (g) using a digital balance.

**Determination of Sex ratio**

Five shrimp species, *M. rosenbergii*, *M. malcolmsonii*, *M. villosimanus*, *M. lamarrei* and *M. lanchesteri* were selected to study the sex ratio. Initially a total of 20 individuals from each species were selected and measured their length.

The sex of each specimen was determined by visual observation at the base of the fifth pair of periopods (Hart *et al.*, 2003). In males, the base of the fifth pair of periopods approximates to the middle while that of females is wide (Plate 2). All prawns were sexed by examination the shape of the endopod of the second pleopods (swimming legs) and the present or absent of the appendix masculine (Plate 2). The numbers of collected male and female specimens were recorded.

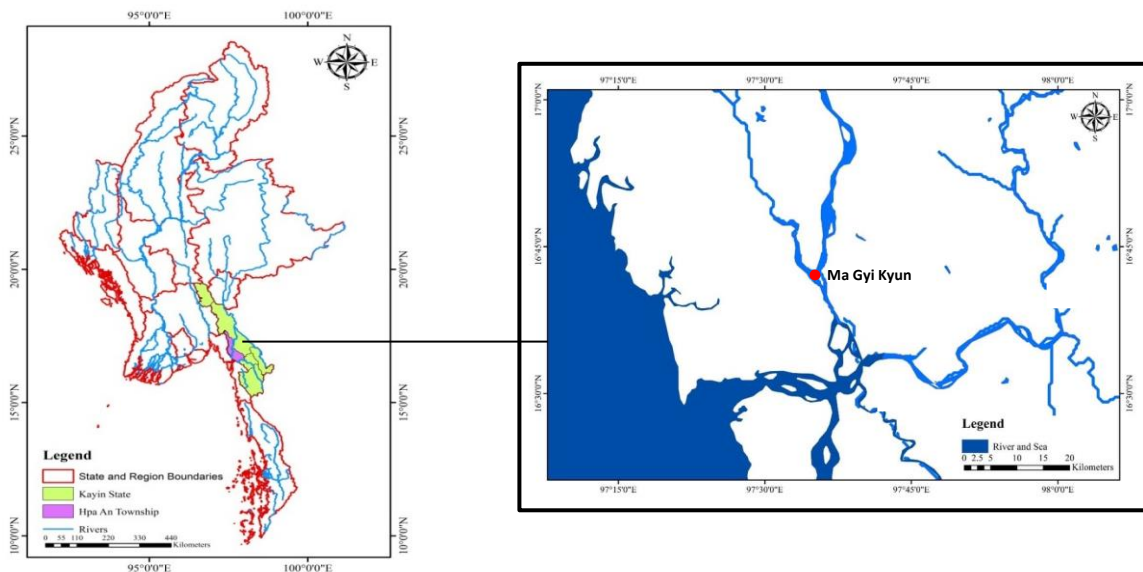
**Egg size**

During their breeding period, twenty eggs from each ovigerous female were randomly selected and the diameter of eggs was measured. Mean length and width were also calculated.

**Fecundity estimation**

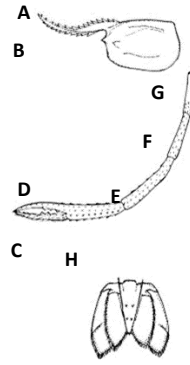
Ovigerous females were collected and were individually packed in plastic bags and transferred to laboratory. The weights of the prawns were noted and eggs were removed by forceps and blotted with filter paper to remove the excess of water. To estimate fecundity, all eggs were removed from the pleopods and weighted. Then the eggs were weighed accurately on possible nearest to 0.1g. And then, the number of eggs was counted by using the stereo microscope to facilitate visualization and counting (Plate 3). The fecundity was also estimated. From the weight of the egg mass, the total number of egg present in the brood was calculated using this formula (Zar, 1999).

$$F = \frac{\text{Number of eggs}}{\text{Weight of the sample}} \times \text{Total egg mass weight}$$



(Source: Geography Department, University of Yangon)

**Figure 1** Map of study site. Thanlwin River (Ma Gyi Kyun)



**Figure 2** Descriptive characters of *Macrobrachium rosenbergii*. A. number of teeth of upper rostrum, B. number of teeth of lower rostrum, C. length of finger, D. length of palm, E. length of merus, F. length of carpus, G. length of ichium, H. present and absent of spine in telson.



Narrow space fifth pair of pereopods  
(Male)



Wider space Fifth pair of pereopods  
(Female)

**Plate 1** Differentiation characters of male and female prawn



Male



Female

**Plate 2** Comparison of second pleopods (Male and Female)

**Environmental conditions at study area**

Environmental conditions such as rainfall and temperature were recorded during the study period, 2016-2018.

## Results

### Occurrence of prawn species during the study period

A total of 16 prawn species and 2 genera belonging to one family were recorded from tributaries of Thanlwin River. The recorded 16 species were described in Table 1 and Plate 3.

**Table 1 Occurrence of freshwater prawns (Palaemonidae) in tributaries of Thanlwin River during the study period**

Sr No.	Scientific name	Common Name
1	<i>Macrobrachium birmanicum</i>	Birma river prawn
2	<i>Macrobrachium dayanum</i>	Kaira river prawn
3	<i>Macrobrachium equidens</i>	Rough river prawn
4	<i>Macrobrachium idae</i>	Slender river prawn
5	<i>Macrobrachium inflatum</i>	Not available
6	<i>Macrobrachium javanicum</i>	Java river prawn
7	<i>Macrobrachium lamarrei</i>	Kuncho river prawn
8	<i>Macrobrachium lanatum</i>	Not available
9	<i>Macrobrachium lanchesteri</i>	Riceland Prawn
10	<i>Macrobrachium malcolmsonii</i>	Monsoon river prawn
11	<i>Macrobrachium mirabile</i>	Short leg river prawn
12	<i>Macrobrachium neglectum</i>	Shrimps Shrimps
13	<i>Macrobrachium palaemonoides</i>	Not available
14	<i>Macrobrachium rosenbergii</i>	Gaint river prawn
15	<i>Macrobrachium villosimanus</i>	Dimue river prawn
16	<i>Leptocarpus fluminicola</i>	Gange delta prawn



*Macrobrachium birmanicum* (♂)



*Macrobrachium dayanum* (♀)



*Macrobrachium equidens* (♀)



*Macrobrachium idae* (♂)



*Macrobrachium inflatum* (♀)



*Macrobrachium javanicum* (♂)



*Macrobrachium lamarrei* (♀)



*Macrobrachium lanatum* (♂)



*Macrobrachium lanchesteri* (♀)



*Macrobrachium malcolmsonii* (♂)

**Plate 3** Recorded prawn species in the tributaries of the Thanlwin River, Kayin State



*Macrobrachium mirabile* (♀)



*Macrobrachium neglectum* (♀)



*Macrobrachium palaemonoides* (♀)



*Macrobrachium rosenbergii* (♂)



*Macrobrachium villosimanus* (♀)



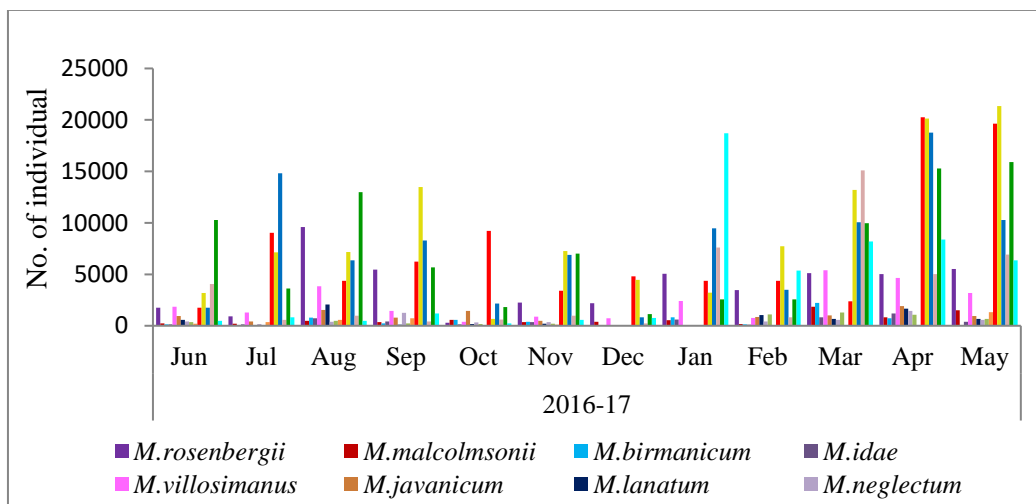
*Leptocarpus fluminicola* (♀)

**Plate 3** Recorded prawn species in the tributaries of the Thanlwin River, Kayin State (Continue)

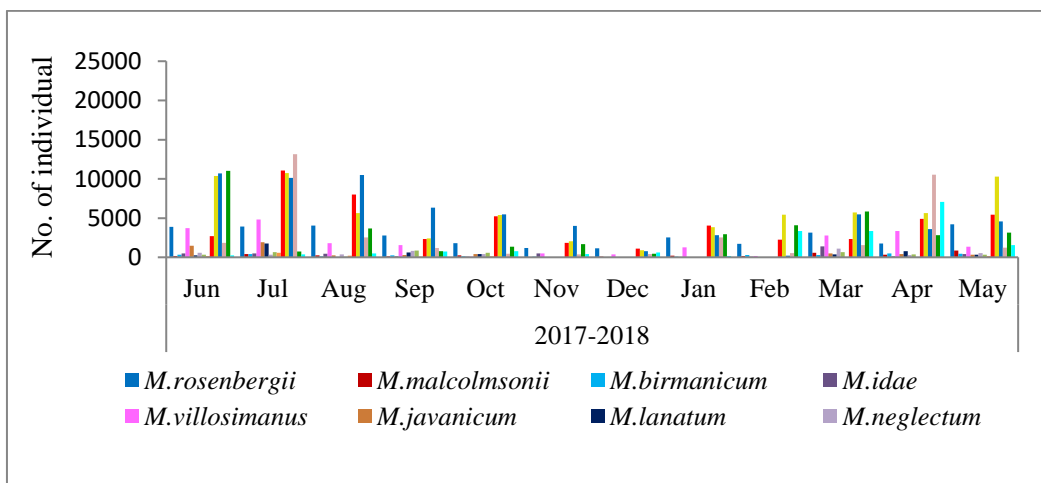
**Seasonal variation of prawn species in different study sites**

In Ma gyi kyun, a total of 16 species with 962,862 individuals of prawns were observed from June 2016 to May 2018. The highest number of individuals of *M. lamarrei* (21,340 individuals) was found in May 2017 and the lowest number of individuals of *M. malcolmsonii* (28 individuals) was recorded in November 2017 during the study period.

Among study species, *M. rosenbergii*, *M. malcolmsonii*, *M. birmanicum*, *M. idae*, *M. villosimanus*, *M. lanchesteri*, *M. lamarrei*, *M. dayanum*, *M. mirabile*, *M. palaemonoides* and *Leptocarpus fluminicola* were recorded throughout the year. The remaining species; *M. javanicum*, *M. lanatum*, *M. inflatum*, *M. neglectum* were not found from December 2016 to January 2017 and November 2017 to February 2018. *M. equidens* was not recorded from December 2016 to April 2017 and November 2017 to April 2018. The number of individual in all situations decreased in 2018 when it was compared to 2016 and 2017(Fig. 3nd 4).



**Figure 3** Seasonal variation of freshwater prawns (Palaemonidae) in Ma gyi kyun (2016-2017)



**Figure 4** Seasonal variation of freshwater prawns (Palaemonidae) in Ma gyi kyun (2017-2018)

**Reproductive condition of *Macrobrachium* species**

Among the recorded species, five economically important species *M. rosenbergii*, *M. malcolmsonii*, *M. villosimanus*, *M. lamarrei* and *M. lanchesteri* were selected and their reproductive condition such as sex ratio, fecundity and egg size were recorded.

**Sex ratio of collected species in Ma Gyi Kyun**

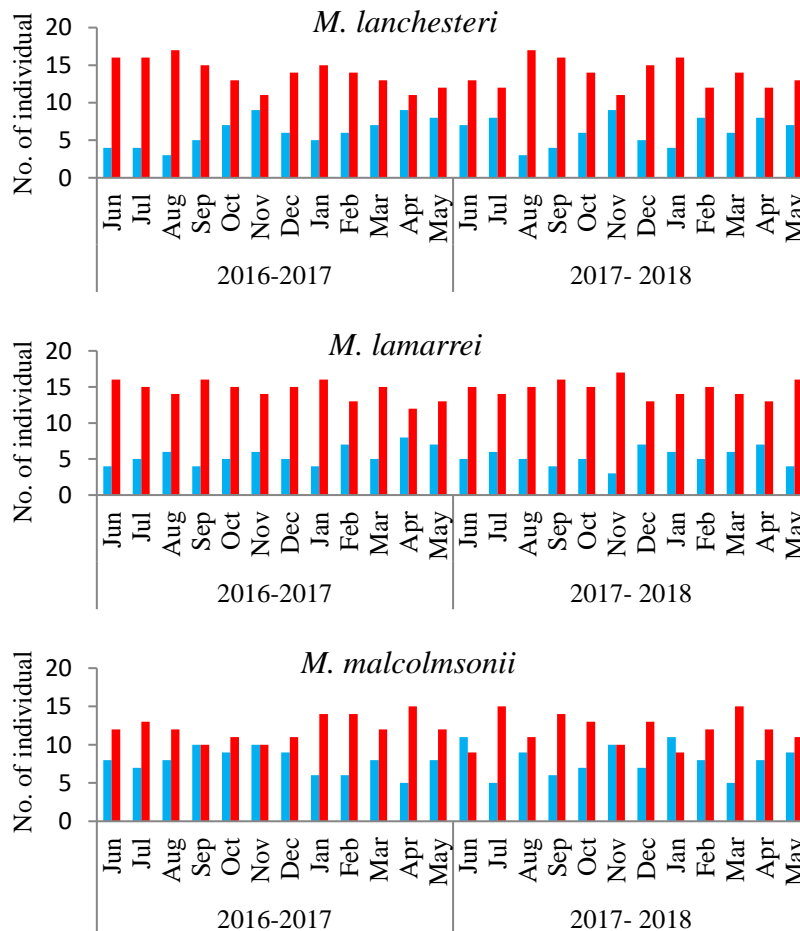
In Ma gyi kyun, a total of 148 males and 332 females of *Macrobrachium lanchesteri* were collected during June 2016 to May 2018. Female individuals were higher than that of male in all observed months. The highest significant different sex ratio of male and female (1: 6) was observed in August 2016 and 2017 (Fig. 5).

A total of 129 males and 351 females of *Macrobrachium lamarrei* were recorded during June 2016 to May 2018. Female individuals also dominated during study period. The highest significant different sex ratio of male and female (1: 6) was observed in November 2017.

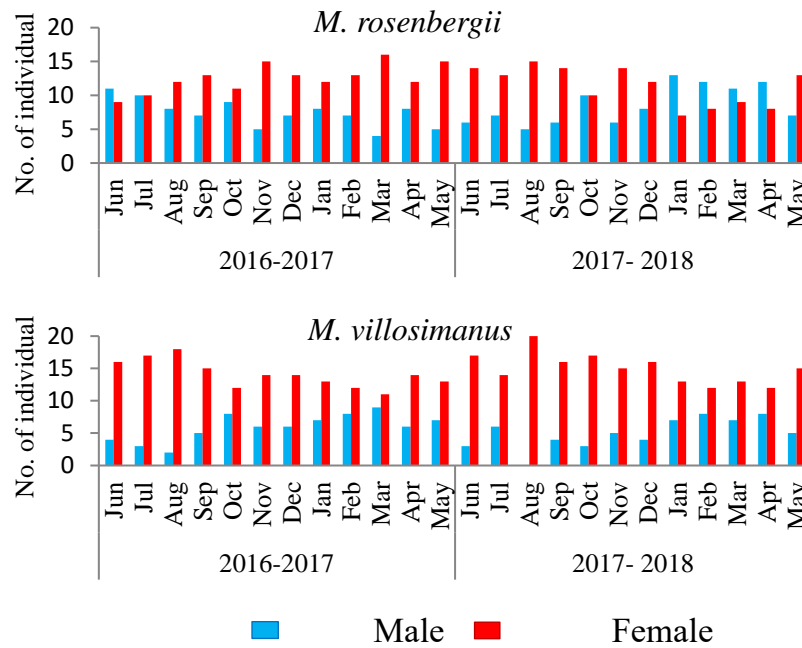
A total of 190 males and 290 females *Macrobrachium malcolmsonii* was found during June 2016 to May 2018. Female individuals were observed higher than male except in June 2017 and January 2018. The same individuals of male and female were recorded in September and November 2016 and November 2017. The highest significant different sex ratio of male and female (1: 3) was observed in April and July 2017 and March 2018.

A total of 192 males and 288 females *Macrobrachium rosenbergii* was recorded during June 2016 to May 2018. Female individuals were observed than male except in June 2016 and January to April 2018. The highest significant different sex ratio of male and female (1: 4) was observed in March 2017.

A total of 131 males and 349 females *Macrobrachium villosimanus* was collected during June 2016 to May 2018. Female individuals were observed higher than male in all months during study period. The highest significant different sex ratio of male and female (1: 9) was observed in August 2016 (Fig. 5).







**Figure 5** Sex ratio of collected species in Ma Gyi Kyun

**Fecundity and egg size of selected species**

Fecundity (total number of eggs carried) of five *Macrobrachium* species (*M. rosenbergii*, *M. malcolmsonii*, *M. villosimanus*, *M. lanchesteri* and *M. lamarrei*) was estimated through random sampling using egg counting method. Besides, to measure the diameter of egg of selected species, 20 egg were randomly collected and their diameter were measured.

In Ma Gyi Kyun, the high number of eggs in *M. lanchesteri* ( $280.8 \pm 80.61$ ) was found in July 2017 and the small amount of egg ( $82.4 \pm 32.66$ ) in April 2017 and 2018. The mean diameter of egg size (Short axis  $\times$  Long axis) was  $0.812 \pm 0.035\text{mm} \times 0.847 \pm 0.005\text{mm}$ . The mean fecundity of *M. lanchesteri* was  $204 \pm 96$  eggs (Fig. 6).

The high number of eggs in *M. lamarrei* ( $299.2 \pm 28.44$ ) was found in November 2017 and the small amount of egg ( $107.6 \pm 24.43$ ) in February 2018. The mean diameter of egg size (Short axis  $\times$  Long axis) was  $0.852 \pm 0.007\text{mm} \times 0.922 \pm 0.170\text{mm}$ . The mean fecundity of *M. lamarrei* was  $219 \pm 91$  eggs.

The high number of eggs in *M. malcolmsonii* ( $28078 \pm 277919.6$ ) was found in June 2016 and the small amount of egg ( $6669.8 \pm 3472.73$ ) in May 2018. The ovigerous females were not found in November 2016 to April 2017 and November 2017 to April 2018. The mean diameter of egg size (Short axis  $\times$  Long axis) was  $0.507 \pm 0.051\text{mm} \times 0.597 \pm 0.054\text{mm}$ . The mean fecundity of 60 ovigerous females was  $13935 \pm 12476$  eggs.

The high number of eggs in *M. rosenbergii* ( $67419.2 \pm 13652.03$ ) was found in August 2016 and the small amount of egg ( $17614.8 \pm 7254.473$ ) in November 2017. The mean diameter of egg size (Short axis  $\times$  Long axis) was  $0.515 \pm 0.038\text{mm} \times 0.610 \pm 0.042\text{mm}$ . The mean fecundity of 70 ovigerous females was found  $30250 \pm 22463$  eggs.

The high number of eggs in *M. villosimanus* ( $34814 \pm 20745.8$ ) was found in June 2017 and the small amount of egg ( $5878.8 \pm 4638.457$ ) in August 2016. The mean diameter of egg size (Short axis  $\times$  Long axis) was  $0.491 \pm 0.023\text{mm} \times 0.573 \pm 0.043\text{mm}$ . The mean fecundity of 70 ovigerous females was  $14981 \pm 13893$  eggs (Fig. 6 and plate 4).

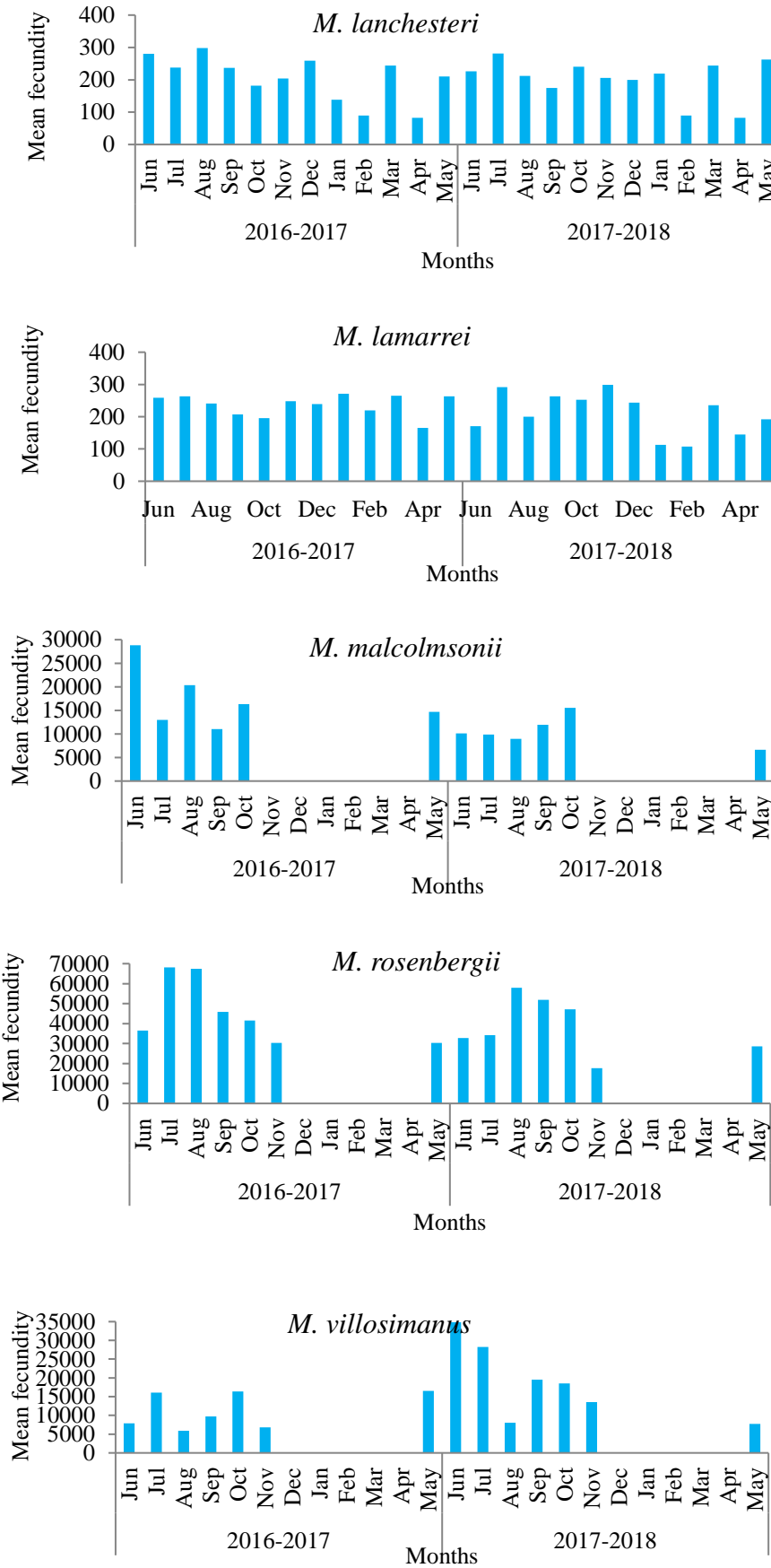
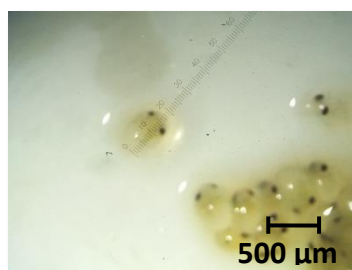


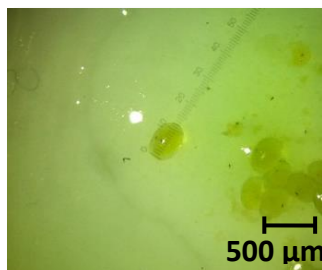
Figure 6 Mean fecundity of *Macrobrachium* species in Ma Gyi Kyun

**Table 2** Egg diameter (mm) of *Macrobrachium* spp. in Ma Gyi Kyun

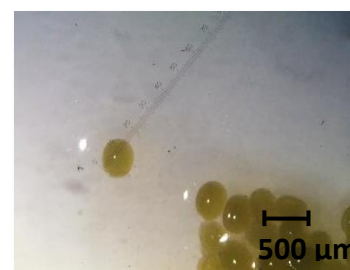
	<i>M. lanchesteri</i>		<i>M. lamarrei</i>		<i>M. malcolmsonii</i>		<i>M. rosenbergii</i>		<i>M. villosimanus</i>	
	Short Axis	Long Axis	Short Axis	Long Axis	Short Axis	Long Axis	Short Axis	Long Axis	Short Axis	Long Axis
Mean	0.812	0.847	0.852	0.922	0.507	0.597	0.515	0.610	0.491	0.573
±	±	±	±	±	±	±	±	±	±	±
SD	0.035	0.005	0.007	0.170	0.051	0.054	0.038	0.042	0.023	0.043
Min	0.830	0.830	0.830	0.872	0.415	0.830	0.498	0.581	0.415	0.498
±	±	±	±	±	±	±	±	±	±	±
Max	0.747	0.855	0.863	1.660	0.581	0.747	0.581	0.664	0.498	0.664



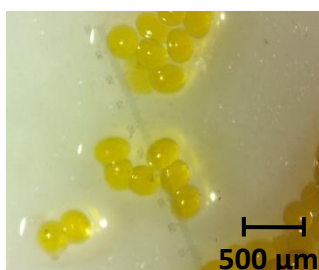
*M. lanchesteri*



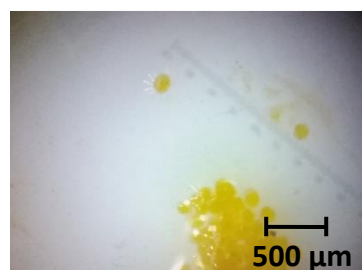
*M. lamarrei*



*M. malcolmsonii*



*M. rosenbergii*



*M. villosimanus*

**Plate 4** Egg size of *Macrobrachium* spp. in Ma Gyi Kyun

**Environmental conditions at studied area**

Environmental conditions such as rainfall and temperature were recorded during the study period. Temperature ranged from 20.5 to 24.5° C. The rainfall was up to 36.2 to 43.02 mm during the rainy season (Table 3).

**Table 3 Environmental conditions of rainfall and temperature during 2016-2018**

Months	2016-2017		2017-2018	
	Mean temperature (°C)	Rainfall (mm)	Mean temperature (°C)	Rainfall (mm)
Jun	24.4	29.34	24.57	24.93
Jul	24	29.65	24.76	43.02
Aug	24	36.23	24.31	28.51
Sep	24.3	27.51	24.97	29.49
Oct	24.2	11.97	26.64	12.72
Nov	23.1	0.24	27.30	TR
Dec	21.3	0	27.96	0.63
Jan	20.59	2.12	20.5	0
Feb	18.97	0	20	0
Mar	21.55	0	22.5	0
Apr	24.89	3	24.7	1.5
May	25.43	12.63	24.7	9.7

### Discussion

The morphological identification of freshwater prawns in the tributaries of Thanlwin River and Gyaing River, Hpa-an Township, Kayin State were carried out from June 2016 to May 2018. A total of 16 species belonging to two genera under the family Palaemonidae were recorded in the present study.

Than Than Soe (2012) observed the biology of prawn and shrimp populations in Thanlwin River Mouth and Adjacent Coastal Waters. She recorded 46 species of freshwater and marine water shrimp fauna belonging to 14 genera and 6 families. Of which, 26 species of Caridea: 22 Palaemonidae, 3 Atyidae, 1 Hippolytidae and 19 species of Penaeidea: 18 species of Penaeidae and 1 Solenoceridae and 1 species of Sergestidae were recorded. Among 22 Palaemonidae, seventeen species of *Macrobrachim* and *Leptocarpus fluminicola* were collected.

The present finding was agreement with Than Than Soe (2012) who stated that the highest number of species was recorded in family Palaemonidae along Thanlwin River mouth and adjacent Coastal Waters.

Win Win Myint (1988) described some freshwater and estuarine prawns of Mon State. She recorded six species of estuarine prawns and ten species of freshwater prawns. Khin Nwe Mu (1980) also studied the taxonomic characters of some prawns from Ngawun River Mouth, Pathein. She recorded ten species of freshwater prawns and nine species of brackish water prawns in her study area.

Thanlwin River has deposition of top soil due to flooding and it provided the feeding and breeding ground supporting species richness of Palaemonidae. In the present study, 16 species of Palaemonidae were recorded. It may be due to the fact that the present study focused on wide range of study site in Thanlwin River. The number of individuals in all situations decreased in 2017-2018 when it was compared to 2016-2017. It may be due to higher water level in Thanlwin River and its tributaries because of the heavy rainfall in Hpa-an environs during 2017-2018.

A total of 9,600 specimens from four study site, in which five species (1655 male and 3145 female) were recorded in 2016-2017 and (1591 male, 3209 female) in 2017-2018. From natural population, proportion between male and female was changed monthly in the studied species at all study sites. Occurrence of seasonal changes in population proportion was observed in all studied

prawn species. The different sex ratio was occurred in all seasons. Number of all female prawn species was greater than that of the male in all study sites during study periods.

Tawari-Fufeyin *et al.*, (2005) reported that sex ratio may not always be static, as they vary from season to season or from year to year within the same population. Shwe Lei Win (2013) stated that since the occurrence of the highest female sex-ratio coincided with highest percentage of ovigerous female, the reproductive period of *M. naso* could be determined from January to March (end of cool and commencement of hot seasons) and wet season in Inle' Lake. Oh *et al.*, (2002) reported that the sex ratio in *Exopalaemon modestus* population was favour to females. Sex ratio may be related to the growth and longevity of shrimp population.

Fecundity of five economically important of prawns was recorded two years study periods (June 2016 to May 2018). Fecundity was estimated by volumetric methods and by direct counting of the number of eggs found on the pleopods of a berried female.

The fecundity of *M. malcolmsonii* has been reported to range from 3500 - 94000 of 54 - 165mm female (Ibrahim, 1962, Rajyalakshmi, 1980: cited by Sharma and Subba, 2005). New and Singholka (1982) reported that *M. rosenbergii* hatch between 100,000 - 700,000 eggs during the spawning season when they are mature. Rao (1998) estimated the fecundity of *M. rosenbergii* by counting the number of eggs on the pleopods and it ranged between 20,000 and 70,000 eggs.

In the present work, the mean fecundity of *M. rosenbergii* was lower number in 3,433 to 107,254. Similarly, the mean fecundity of *M. malcolmsonii* was ranged from 4,200 to 63,550 while it was 800 to 40,060 in *M. villosimanus*. The fecundity of above three freshwater prawns was found to be relatively low when compared to Sharma and Subba, (2005) and New and Singholka (1982). Freshwater shrimps exhibit variation in fecundity from species to species. Fecundity also varies according to hydrographic region (Mashiko, 1990). In addition, the efficiency of egg production, i.e. the number of egg produced per female unit body weight, may be age and/or size dependent and is generally assumed to increase with female size (Malecha, 1983). The different geographical region and food availability may be influence on the fecundity of prawn.

In this study, ovigerous females of *M. lanchesteri* and *M. lamarrei* might be the dominant species because it was abundantly found in study site and this species is capable of reproducing throughout the year. However, in other three species, *M. rosenbergii*, *M. malcolmsonii* and *M. villosimanus*, ovigerous females were found only from May to November. Among the five *Macrobrachium* species, *M. rosenbergii* is the most economically important species and they are culture widely in Yangon and Ayeyarwaddy Divisions. Fecundity of *M. rosenbergii* was highest among the studied species. Because of high fecundity, producing of post larvae within the limited period is higher than other species. Mass production post larvae of *M. rosenbergii* can be produced in hatchery because of its high fecundity rate.

In the present study, morphology, fecundity and egg size of *M. malcolmsonii* is very similar to *M. rosenbergii*. *M. malcolmsonii* will be potential candidate for aquaculture farmer in the future.

### Conclusion

This study has demonstrated the morphological parameters for the classification of *Macrobrachium* species. A total of 16 prawn species and 2 genera belonging to one family were identified and recorded from tributaries of Thanlwin River. Among them, five species *Macrobrachium rosenbergii*, *M. villosimanus*, *M. malcolmsonii*, *M. birmanicum* and *M. idea* were economic important species with high market demand. Reproductive biology of five species was also studied to estimate their fecundity during the spawning period. The number of females was higher than the number of males in all species. The most economically important species, *M. rosenbergii* has highest fecundity among the studied species.

## Acknowledgements

I am deeply indebted to Dr Aye Mi San, Professor (Head), Department of Zoology, University of Yangon, who permitted to do this research. We would like to express our special thanks to Professors and Associate Professors, Department of Zoology, University of Yangon.

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