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Short Communication: Fecundity of freshwater prawn (*Macrobrachium rosenbergii*) in selected rivers of Sarawak, Malaysia

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Abstract. *Khairul Adha AR, Nicholas FF, Long SM, Naqiuddin AS, Esa Y. 2016. Fecundity of freshwater prawn (*Macrobrachium rosenbergii*) in selected rivers of Sarawak, Malaysia. Biodiversitas 17: 498-502*. Giant freshwater prawn (Macrobrachium rosenbergii) is one of the important species of freshwater aquaculture in Malaysia. However, the sustainability of freshwater prawn farming is currently threatened by low production efficiency. In addition, the degradation of natural habitats and the use of illegal catching methods have caused great threats to freshwater giant prawn populations. Thus, the main objective of this study was to examine the wild population, ecology, and fecundity of giant freshwater prawn in natural water bodies in Sarawak's rivers namely Samarahan, Sadong and Kayan rivers. The mean values of the physicochemical water parameters, such as dissolved oxygen, pH values, conductivity, turbidity and temperature from three rivers surveyed were differenced significantly ($P< 0.05$). However, the characteristics of water quality measured were found to be within the ideal range for freshwater prawn to survive and grow. There were significant differences ($P < 0.05$) of total length, total body weight and eggs weight of prawn population among three rivers. There was no significant difference ($P > 0.05$) of prawn fecundity among the three rivers. The present study showed that berried female particularly from Kayan and Kerang river are suitable as potential brood stock from the wild population for breeding program.

Keywords: Giant freshwater prawn, *Macrobrachium rosenbergii*, fecundity, length and weight

INTRODUCTION

Giant freshwater prawn (*Macrobrachium rosenbergii*), which is indigenous to South and Southeast Asia, parts of Oceania and some Pacific islands has been farmed commercially both within and outside its natural range (Short 2004). In Malaysia, the giant freshwater prawn can be found in most inland freshwater areas including lakes, rivers, swamps, irrigation ditches, canals and ponds, as well as in estuarine areas (New 2002). This prawn requires brackish water in the initial stages of their life cycle, although some complete their cycle in inland saline and freshwater lakes (Ling and Merican 1961; New et al. 2000).

Due to the importance of *M. rosenbergii* for commercial fisheries and aquaculture, much is known about their ecology, biology physiology and behavior (Rao 1991; Cavalli 2001; Sithee et al. 2006). In addition, there are many publications and manual on the culture and growth development of freshwater prawn farming (Rao 1965; Ling 1969b; Costa 1980; Ang and Law 1991; Kurup et al. 1996; New and Valenti 2000; Krasindh et al. 2008; Pillai et al. 2011). With the widespread use of hatchery-reared seeds, the production and demand of farmed prawn has gradually increased (Department of Fisheries 2010). Despite the potential for increase production, the sustainability of freshwater prawn farming is currently threatened by low production efficiency and low quality of brood stock from grow-out ponds which resulting high levels of inbreeding (Mather and Bruyn 2003).

However, there is still a lack of studies about the fecundity, brood stock quality and ecology of freshwater giant prawn from natural habitat such as in the rivers of Sarawak. The fecundity study is not only important in estimating the reproductive potential of prawn brood stock development in the hatcheries but also as an assessment on the stock size of their natural population (Patra 1976; Lobão et al. 1985; Valenti et al. 1989; Ang and Law 1991).

Furthermore, the degradation of natural habitats, reclamation of mangroves, water pollution and the use of illegal methods for catching prawn have caused great threats to freshwater prawn and fish populations in Malaysia (Zakaria-Ismail 1994; Khairul Adha 2012). Thus, examining the environmental parameters may contribute to understanding the current status and population structure of this giant prawn in natural habitat throughout Sarawak.

MATERIALS AND METHODS

Description of study area

The studies were carried out in estuaries and the main river basin in Sarawak namely; Samarahan River (N 01° 27.286'E 110° 03.206'), Kayan River (N 1° 39.50 E 109°

Figure 1. Map showing four sampling locations in Sarawak. A. Kayan River, B. Samarahan River, C. Kerang River

51.13) and Kerang River (N 1° 11.02 E 110° 41.19) (Figure 1). All sampling locations were determined and relocated with a differentially corrected Global Positioning System (GPS) receiver (Model Garmin, GPS 76, SN 80308437, Olathe USA). Selections of these locations were made based on the representation of prawn habitat, accessibility, history, and the popularity of the location as giant prawn fishing ground.

Physicochemical water parameters

The characteristics of habitats chosen were recorded for all stations. A set of basic physicochemical water parameter variable including pH, temperature (°C), dissolved oxygen (D.O) (mg/L), conductivity (µS) and Turbidity (NTU)) were determined *in situ* using WP81 Waterproof pH-Conductivity-TDS-Temp meter (Model 121132/1), HANNA Dissolved Oxygen Meter (Model HI 9146), Eu-Tech Portable Turbidity Meter (Model ECTN 100 1R) and Eu-Tech ORP Testr10.

Prawn sampling and identification

Surveys were carried out from September 2014 to March 2015 when relative prawn density was highest. Surveys were focused on collecting only on the adult prawns. The prawn collections were made using cast nets, gill nets and traps as well as purchasing samples from local fishermen. This is reduced the sampling bias through the use of one collecting method. A cast net (3m long with 5 to10 mm mesh sizes) was used at shallow pool of the river systems. Approximately 10 throws of the cast nets were made at each station. Monofilament gill nets with different mesh sizes (0.5, 1.0, 1.5 and 2.0 cm) were applied in pool and deeper parts of study sites for 3 to 6 hours. The traditional fishing method such as trap with 150 m length and 3 meter height were mostly set parallel to the river banks during low water and submerged during high water. The traps were placed in the water for 12 hour period overnight.

Adult specimens were preserved in 70% ethanol before being identified using specific taxonomic keys according to classification developed by (Holthuis 1980; Ling 1969a; Wowor and Ng 2007). Total weight (g), total length (cm), sex (based on presence or absence of the male appendix on the second pair of pleopods) (Ismael and New 2000) and male morphotype stage (following the coloration of the claws: SM-transparent, OC-orange, BC-blue) (Kuris et al. 1987) was recorded for each individual. Gravid females (egg bearing females) were kept in separate plastic bags to prevent egg loss during transportation. The eggs adhered to the pleopods were removed and preserved in 70% ethanol (Glaúcia et al. 2011). The eggs were then added to 1 liter of

water, homogenized and sampled using a 10 ml pipette. The eggs were captured under stereomicroscope using Moticam 2.0.and counted by ImageJ software. Three subsamples were counted from each female. Fecundity was calculated using the formula: N=M/VP × VT (Glaúcia et al. 2011) where N = number of eggs, M = mean number of eggs across all sub-samples, VP = volume of the sub-samples and VT = total volume of the sample.

Data analyses

Descriptive statistics including minimum and maximum values, means and standard error of pH, Dissolved Oxygen (D.O), water temperature (°C), conductivity (µS), and Turbidity (NTU) from each survey station were calculated. Analyses of variance (ANOVA) were used to compare the differences in the physicochemical water parameters of all stations surveyed. For the morphometric analysis (body length, weight and egg weight) descriptive statistics were applied. Data were expressed in terms of mean and standard deviation. Chi-square test was used to test the significance of the sex ratio of the prawn collected. Pearson's linear regression was used to assess the correlation between prawn weight and fecundity and total length and fecundity. All statistical analyses were done using SYSTAT Version 7.0 (Wilkinson 1996). All differences are significant at $P < 0.05$, unless otherwise stated.

RESULTS AND DISCUSSION

Physicochemical water parameters

The mean values of the physicochemical water parameters from three habitats surveyed are summarized in Table 1. The highest pH was recorded in Kerang River and the lowest pH was in Samarahan River, with mean pH value 6.32 ± 0.21 and 5.33 ± 0.10, respectively. The dissolved oxygen (mg/L) concentration ranged from 4.59 ± 0.12 mg/L in Samarahan River to 6.11 ± 0.10 mg/L in Kerang River. The highest mean temperature recorded was in Kayan River and the lowest mean temperature was in Kerang River with mean value 33.45 ± 0.26°C and 22.87 ± 0.78°C, respectively. The conductivity (µS) ranged from 38.40 ± 1.76 µS in Kerang River to 80.30 ± 9.15 µS in Samarahan River. The highest Turbidity (NTU) value was recorded in Kayan River and the lowest turbidity value was in Kerang River with mean turbidity 240.49 ± 6.27 NTU and 125.60 ± 12.21 NTU, respectively.

Generally, there were significant differences ($P < 0.05$) of pH value, dissolved oxygen, turbidity, conductivity and water temperature among the river surveyed. Although the physicochemical water parameter measured is slightly significant differenced, the characteristics of water quality measured were found to be within the ideal range for freshwater prawn to survive and growth (Sampaio and Valenti 1996; New 2002; Alam and Alam 2014). Oben et al. (2015) found that the water quality parameters did not seem to have an influence on the variation in the natural population and composition of *M. vollenhovenii* collected from the Yoke River. However, the degradation of natural habitats, deforestation, reclamation of mangroves and peat swamps, water pollution, overexploitation of biological resources and the use of illegal methods for catching fish have caused great threats to freshwater fish populations in Malaysia (Khairul Adha 2012). For instance, Ho (1994) estimated that the catch of freshwater giant prawns had been reduced to about 25% in the Tanjung Tualang, Perak over the past 20 years, due to deterioration in water quality.

Fecundity of freshwater giant prawn population

A total of 680 individual freshwater giant prawn including 264 male, 350 female and 66 berried female were collected from the three rivers, namely Samarahan, Kayan and Kerang rivers. The overall sex ratio during sampling showed that female prawn significantly greater than male prawn population ($P < 0.05$). Table 2 shows the individual collection, mean total length, mean total weight, mean total eggs weight and fecundity for berried female from the three rivers. However, the mean length and weight of male and unberried female prawn were not included for detailed analyses.

The mean total length and weight of berried prawn were ranged from 13.27 ± 1.84 cm to 15.58 ± 2.25 cm and 25.98 ± 9.21 g to 43.72 ± 16.91g, respectively. The mean weight of eggs was ranged from 2.11 ± 1.36 to 4.06 ± 1.49 g. The prawn from Kerang River shows the greatest weight, length and eggs weight and the samples from Samarahan River is the least weight, length and eggs weight. There were significant differences ($P < 0.05$) of total length, total body weight and eggs weight of berried prawn population among the three rivers. The greatest fecundity of the berried prawn was recorded from Kerang river and the least fecundity was from Samarahan river with the fecundity value of 30633 and 23523, respectively. However, there were no significant differences ($P > 0.05$) of prawn fecundity among the three rivers. According to Graziani et al. (1993) the fecundity of *Macrobrachium* species associated with the female age and maturity. Bal and Rao (1990) also stated that individual of the same species produces varying number of eggs depending on their age, length, weight and environmental condition.

The differences of berried prawn fecundity in this study are almost similar reported in literature. According to Ling (1969b), Patra (1976) and Ang and Law (1991) the fecundity of *M. rosenbergii* of wild population is ranged from 60000 to 130000. The variations found in prawn fecundity may be attributed to the different conditions of female maintenance in the laboratory, female physiological conditions and season (Lobão et al. 1986). In addition, Babu (2014) stated that there was no significant variation of the fecundity of female prawn which was recorded from 2010-2012 in Bhairavapalem, India.

The correlation between fecundity with length and weight of *M. rosenbergii* from Samarahan, Kayan, and Kerang Rivers is shown in Table 3. The fecundity of prawn population from Samarahan, Kayan and Kerang showed positive correlation with the total weight and length. According to Mahapatra et al. (1996) fecundity was more closely related to weight than to length of the prawn. The present study indicated that the fecundity of the prawn

Table 1. Mean of physicochemical water characteristics of Samarahan, Kayan and Kerang rivers in Sarawak (Mean ± SD)

Parameters	Samarahan River	Kayan River	Kerang River
Dissolved oxygen (mg/L)	4.59 ± 0.12	4.61 ± 0.10	6.11 ± 0.10
Temperature (°C)	26.64 ± 0.10	33.45 ± 0.26	22.87 ± 0.78
pH	5.33 ± 0.10	5.67 ± 0.08	6.32 ± 0.21
Conductivity (µS)	80.30 ± 9.15	58.27 ± 0.06	38.40 ± 1.76
Turbidity (NTU)	142.00 ± 9.15	240.49 ± 6.27	125.60 ± 12.21

Table 2. Number of individual, mean total length (cm), mean total weight (g), mean total eggs weight (g) and fecundity of berried prawn collected from Samarahan, Kayan and Kerang rivers

	Location		
	Samarahan River	Kayan River	Kerang River
N	20	30	16
Total length (cm)	13.27 ± 1.84	14.22 ± 1.52	15.58 ± 2.25
Total weight (g)	25.98 ± 9.21	26.93 ± 8.63	43.72 ± 16.91
Total eggs weight (g)	2.11 ± 1.36	2.20 ± 1.21	4.06 ± 1.49
Fecundity	23523 ± 12175	28251 ± 11000	30633 ± 12068

Table 3. The correlation between fecundity with length and weight of *Macrobrachium rosenbergii* from Kayan, Kerang and Samarahan rivers, Sarawak

	Length vs fecundity ($ln\ F_T = b\ ln\ TL + a$)				Body weight vs fecundity ($ln\ F_T = b\ ln\ BW + a$)			
	a	b	r^2	*p*	a	b	r^2	*p*
Kayan River	1.220	3.369	0.516	< 0.05	6.350	1.172	0.607	< 0.05
Kerang River	4.892	1.958	0.471	< 0.05	7.320	0.792	0.626	< 0.05
Samarahan River	3.224	2.607	0.453	< 0.05	6.256	1.151	0.573	< 0.05

from the three rivers was correlated closely with weight than length. Sureshkumar and Kurup (1998) also found that fecundity of *M. rosenbergii* showed a positive correlation with total weight, total length and carapace length. In addition, Babu (2014) also stated that the fecundity and relation with length and weight of *Penaeus monodon* significantly varied from different geographical location. Bhuiyan et al. (2007) found that the number of eggs and the length of the female body in *M. dayanum* were positively correlated. The increase of fecundity with body size seems to be a rule that is applicable to many crustaceans (Oben et al. 2015).

The fecundity data can be used to access the reproductive potential of the prawn spawning stock (Ang and Law 1991). The present study showed that berried female particularly from Kayan and Kerang rivers are suitable as the potential brood stock from the wild population for prawn breeding. Khairul Adha et al. (2014) also found that the berried female of giant prawn from Kerang Rivers is one of the potential brood stocks for breeding programs. The wild stocks of giant prawn brood stock could be an important resource for genetic improvement of culture stocks in the future. Sourcing brood stock from grow-out ponds which resulting in high levels of inbreeding over time was believed to be the reason for growth decline in Thailand (Mather and Bruyn 2007). Thus, efforts should be done to exploit the reproductive output of wild broodstock of this species for breeding program. Although the physicochemical water properties measured were differed significantly among the three stations, the various size and growth stage of prawn found from the rivers have indicated that the freshwater giant prawn is still available and can be sustain for future resources.

The present study has showed relationships between fecundity and body weight, fecundity and total length, as well as between fecundity and eggs weight in *Macrobrachium rosenbergii* from the rivers in Sarawak regions. Differences of physicochemical water properties from three river studied probably not influence the variation of prawn fecundity, body weight, length and eggs weight of giant freshwater prawn in that habitat. However, the berried female of giant prawn from Kerang and Kayan rivers has a potential as brood stock resources from the wild for breeding program.

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