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FECUNDITY OF BLUE SWIMMING CRAB, *Portunus pelagicus* LINNAEUS, 1758 FROM SEMATAN FISHING DISTRICT, SARAWAK COASTAL WATER OF SOUTH CHINA SEA

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ABSTRACT

A total of 57 pieces of ovigerous females were sampled through the study period of 14 months from the commercial catches that were made at the Sematan Fishing District, Sarawak coastal water. These ovigerous females were used to determine the crab fecundity through mean number of egg per crab. The present study shows that the mean number of egg is 2,132,924 with mean egg size (volume) 9.3×10-6 ml and mean egg size (diameter) 383.6 µm measured using volumetric sub sampling. Fecundity was significantly related to crab size with larger crabs producing a greater number of eggs through linear regression of the fecundity – carapace width relationship. The fecundity-carapace width relationship for *P. pelagicus* was estimated as follows; $y = 106804x + 375319$ (R2=0.0229; n=57). The study shows that the egg size is significantly larger ($P < 0.05$) as the eggs nearly about to hatch which is black in colour.

Key words: Fecundity, blue swimming crab, *Portunus pelagicus*

INTRODUCTION

The blue swimming crab, *Portunus pelagicus* Linnaeus, 1758 is distributed throughout the Indo-pacific region and is closely associated with sheltered near-shore marine water and estuaries (Stephenson 1962; Kailola *et al.* 1993). Studies showed that large numbers of portunid crabs including *P. pelagicus* frequently enter estuaries as juveniles and remain there for an extended period (Hill, 1975; Potter *et al.*, 1983; Perkins-Visser *et al.* 1996; Potter & de Lestang, 2000). Studies showed that female portunid crabs including *P. pelagicus* sometimes become ovigerous in estuaries; such individuals emigrate into coastal marine water, where they release their eggs (Van Engel, 1958; Metcalf *et al.*, 1995; Potter & de Lestang 2000). Other studies also show that portunid crabs that occupy marine embayment often do not leave these marine environments to spawn and, in cases where there is a salinity gradient, they spawn in the high salinity regions of those systems (Campbell, 1984; Sumpton *et al.*, 1994; Prager, 1996; Potter & de Lestang 2000).

The fecundity of fish is defined as the number of ripening eggs in the female prior to the next spawning period (Bagenal 1978). In portunid crabs the ripening egg mass was referred as 'berry' eggs contained a variable number of eggs depending on the size of the individual and the size of the berry (Pillay & Nair 1968). The number of eggs produced by females also varies between individuals of a similar size. Generally, larger females produce more eggs than smaller females (Warner 1977; Batoy *et al.* 1987; de Lestang *et al.* 2003a). Studies also show female crabs can produce two or more batches of eggs within a spawning period (Meagher 1971; de Lestang *et al.* 2003a).

Studies on the reproductive biology of *Portunus* spp. has been mostly conducted in Australia (Potter *et al.* 1983; Sumpton *et al.* 1994; Sumpton 2001; de Lestang *et al.* 2003a; de Lestang *et al.* 2003b; Kumar *et al.* 2003) and a few studies from other

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countries within the Indo-Pacific region such as India (Pillay & Nair 1971), Philippines (Batoy *et al.* 1987) and Taiwan (Lee & Hsu, 2003). Despite the high fishery potential of *P. pelagicus* in Malaysia, literature reviews show that no study has been done on the reproductive biology of this species of crab in any water bodies of Malaysia. The present study was conducted to determine the fecundity of *P. pelagicus* through mean number of egg per crab.

MATERIALS AND METHODS

The study was done within the shallow coastal water of the commercial fishing grounds for *P. pelagicus* of the Sematan Fishing District, which is located at the most western part of Sarawak, Malaysia stretching from Tanjung Dato to Sampadi. This shallow coastal water is within Talang-talang Island, centering at 1°53'N, 109°48'E.

A total of 57 ovigerous female crabs were sampled throughout the study period of 14 months from 14 fishing trips of the commercial catches. These ovigerous females were used for the determination of the crab fecundity. The samples were measured for carapace width and body weight. Carapace is measured as the external carapace width, which is the distance between the tips of 9th antero-lateral spines of the carapace. The carapace width is measured to the nearest 0.1 cm with vernier callipers. The vernier callipers unit model is Kernn Germany (150 × 0.05 mm), produced by Kernn Germany, Germany. Body weight of the crab is measured to the nearest gram by using a digital electronic balance of 0.1 gm sensitivity. The digital electronic balance unit model is DJ-6000P, produced by Shinko Denshi Co., Ltd., Japan.

The ovigerous females were then killed and the fresh eggs were stripped off from the broad abdomen of the crab pleopod. The weight of the stripped egg mass was also measured. The egg mass was washed with fresh water before being preserved in labelled 50 litres glass jars containing modified Gilson's fluid for counting later (Simpson 1951). This preservative has been used by many investigators and has been found to act satisfactorily with a wide range of species (Bagenal 1978). This preservative was prepared as follows; 100 ml of 60% alcohol, 880 ml of water, 15 ml of 80% nitric acid, 18 ml of glacial acetic acid and 20 gm of mercuric chloride.

The preserved egg mass was shaken vigorously and left for 24 hr after which, repeated shaking was done to help separate the eggs from egg tissues and assist the penetration of the preservative (Bagenal 1978). The egg mass was preserved for 3 months (Ikhwanuddin 2001). After three months the preserved egg mass was washed with water before enumeration using volumetric sub sampling (Bagenal 1978) as follows: The cleaned eggs were poured into a 250 ml measuring cylinder in which they soon settled down (Kandler & Pirwitz 1957). The total volume of eggs was noted. One ml of eggs volume was then removed and transferred into a 100 ml measuring cylinder containing 99 ml volume of water to mark-up the volume to 100 ml. For the purpose of egg counting, one ml of the egg suspension was drawn out using a 3 mm diameter feeding tube attached to a 10 ml syringe. During sucking, the egg suspensions were shaken and stirred using glass rod to make sure they were well dispersed. The fecundity was estimated as the mean of five counts.

RESULTS

The fecundity parameters of the female crab included crab carapace width (CW), number of egg per crab and crab egg size (volume and diameter). The mean number of egg was 2,132,924 ± 723, 956 with mean egg size (volume) 9.3×10-6 ± 4.7×10-6 ml and mean egg size (diameter) 383.6 ± 102.3 µm (Table 1). Fecundity was significantly related to crab size with larger crabs producing a greater number of eggs. The fecundity-carapace width relationship of linear regression for *P. pelagicus* was estimated as follows; $y = 106804x + 375319$ (R2=0.0229; n=57) (Figure 1).

Generally there were three colours of the crab egg sampled, yellow-orange, brown and black (Table 2). Newly laid eggs were yellow-orange in colour and nearly hatched eggs were black in colour. The study shows that the mean egg size (diameter) were 390.3 µm, 383.2 µm and 373.4 µm for egg colour of black, brown and yellow-orange, respectively (Table 2). This study shows that the egg size was significantly larger as the eggs were about to hatch which is black in colour ($P < 0.05$).

DISCUSSION

To the best of the authors' knowledge, there has been no comparable data in the literature on the

reproductive biology of *Portunus* spp. in Malaysia available. Table 3 shows a summary of available data on the fecundity of *P. pelagicus* from other studies by de Lestang *et al.* (2003a), Batoy *et al.* (1987) and Potter *et al.* (1983).

The number of eggs produced per ovulation in the present study is very large and varies with the size of the crab and between females. The trend was observed in the present study where larger crabs with larger carapace width produce more eggs than smaller ones with smaller carapace width, the same trend has been suggested by Warner (1977). This trend has also been described by other researchers such as de Lestang *et al*, . (2003), Potter *et al.* (1983) and Batoy *et al.* (1987) (Table 3). Additionally,

Table 1. Mean, maximum, minimum and standard deviation (Sd) values for the fecundity parameters of the female crab of *P. pelagicus*

	CW (cm)	No. of egg per crab	Egg size	
			Egg volume (ml)	Egg diameter (µm)
Mean	16.5	2,132,924.0	9.3×10-6	383.6
Max	19.3	3,376,666.7	2.4×10-5	633.1
Min	14.4	213,333.3	1.9×10-6	179.9
Sd	1.0	723,956.0	4.7×10-6	102.3

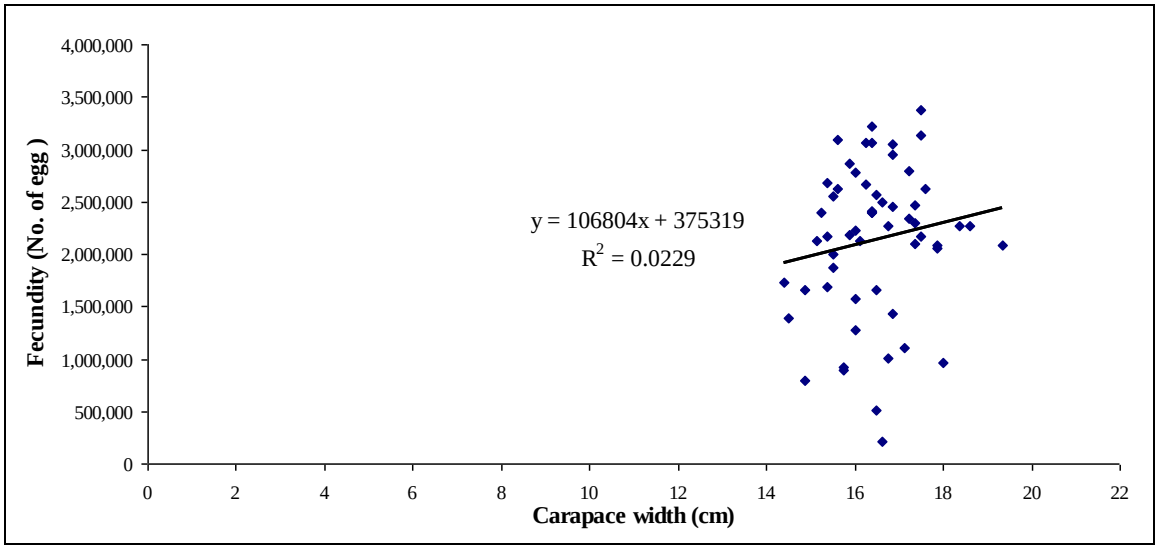

Figure 1. Relationship between crab fecundity and crab carapace width for *P. Pelagicus.*

Table 2. Egg colourations and size (diameter) of *P. pelagicus*

Egg colour	Egg size (diameter, µm)			Samples number (n)
	Mean	Maximum	Minimum	
Black	390.3	633.1	202.6	27
Brown	383.2	538.4	266.8	13
Yellow-orange	373.4	522.0	179.9	17

report by Kumar *et al.* (2003) has revealed that fecundity increased 83.9% with an increase of carapace width from 10.5 to 12.5 cm. The later study also shows that fecundity of female *P. pelagicus* initially increased with carapace width, reaches maximum at a carapace width of 13.4 cm, and decreased thereafter. The present study also show that size and fecundity in female *P. pelagicus* are directly related only up to 16-17 cm CW where the mean CW of ovigerous female crabs sampled are 16.5 cm (Table 1).

The fecundity estimate of crabs presented in the current study is comparatively higher than the other studies as in Table 3. It was also noted that all the ovigerous female crab specimens of the other studies were taken from either an estuary or a bay with wide seasonal fluctuations in temperature and salinity as compared to the present study with water temperature, 28-30^{o}C and water salinity, 28-31 ppt (Potter *et al.* 1983; Batoy *et al.* 1987; de Lestang *et al.* 2003a; de Lestang *et al.* 2003b; de Lestang *et al.* 2003c; Ikhwanuddinb 2007). This might have affected the reproductive capacity of *P. pelagicus* from the estuary and bay as study by Potter *et al.* (1983) provided strong evidence that these crabs prefer higher salinities between 30-40 ppt.

This explanation is consistent with the results of other studies, which have shown that water temperature influences ovulation and egg development in *P. pelagicus* and other decapods where the higher water temperature will fasten the ovulation and egg development period (Rahaman 1980; Campbell 1984; Pollock 1995; de Lestang *et al.* 2003a; Kumar *et al.* 2003). However, the ovigerous female crab specimens of the present study were taken from the shallow coastal water within Talang-talang Island, which is about 10.5 km from Sematan estuary. The shallow coastal water within Talang-talang Island did not shows wide seasonal fluctuations in temperature and salinity as compared to the other studies mention earlier. The fecundity value of the present study is higher than the other studies as mentioned earlier because the present study site does not experience any wide seasonal fluctuation in temperature and salinity (Ikhwanuddin 2007).

Table 3. Fecundity estimate of *P. pelagicus* from various studies

Locality	CW (cm)		Fecundity (No. of egg / crab)		Source
	Mean	Range	Mean	Range	
Sarawak, Malaysia	16.5	14.4-19.3	2,132,924	213,333 – 3,376,666	Present study
Western Australia	11.9	8.4-15.4	196,445	68,450 – 324,440	de Lestang *et al.* (2003a)
Western Australia	11.9	10.2-13.6	509,433	270,183 – 847,980	Potter *et al.* (1983)
Leyte & Bohol, Philippines	5.55	4.1-7.0	894,284	420,976 – 1,312,238	Batoy *et al.* (1987)

The colour and size of the crab eggs may well indicate its 'age'. As the embryos develop, the colour of the eggs change through yellow-orange to brown and from brown to black as the egg yolk was used up. The eggs swell as they develop and nearly double their newly laid volume by the time they are ready to hatch (Batoy *et a.,* 1987). The mean diameter of the egg in the present study also support this observation with the older eggs are significantly larger than the newly laid eggs.

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