

SIZE AT MATURITY OF BLUE SWIMMING CRAB (*Portunus pelagicus*) FOUND IN SARAWAK COASTAL WATER

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Abstract: A total 1,093 blue swimming crabs (*Portunus pelagicus*) comprising of 532 females and 561 males of various sizes were randomly sampled from Sematan Fishing District of Sarawak. The study was carried out from 2003 to 2004. Size at maturity that is the size when 50 % of the crab was sexually matured (CW₅₀) occurred at 9.5 cm CW for female and 8.5 cm CW for the male. The results suggest that the Legal Minimum Carapace Width (LMCW) for the *P. pelagicus* should be considered. To ensure sustainability of the wild stock resource, it is proposed that the LMCW for *P. pelagicus* commercial fishery in Sarawak, should be greater than 9.5 cm for *P. pelagicus* female and greater than 8.5 cm for *P. pelagicus* male.

KEYWORDS: Size at maturity, Blue swimming crab, *Portunus pelagicus*

Introduction

Blue swimming crab, *Portunus pelagicus* 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). The FAO fisheries statistics shows that the commercial crab fishery catches in Malaysia have been growing rapidly from 1997 to 2003 (FAO, 2006). There was a 30% increase in crab catches between 1997 (5959 metric tonnes) and 1998 (8581 metric tonnes). Catches in 2003 amounted to 8381 metric tonnes (FAO, 2006).

Despite the high potential of *P. pelagicus* in Malaysia (Ikhwanuddin, 2007), literature review shows lack of studies on the reproductive biology of *P. pelagicus* in water bodies of Malaysia except by Ikhwanuddin (2007). Robertson and Kruger (1994) showed that sizes at sexual maturity, mating and spawning periods are among the important parameters for fishery management. Studies in Australia show that *P. pelagicus* can attain sexual maturity in their first year of life (Fielder & Eales, 1972; Smith, 1982; Sumpton et al., 1994) and also at just over one year old (de Lestang et al., 2003a). Studies have shown that commercial or recreational fishing has lead to a reduction in size at sexual maturity in the spiny lobster (Polovina, 1989) and worse off for *P. pelagicus* in the west coast of Australia (de Lestang et al., 2003a; de Lestang et al., 2003b). Thus, the size at sexual maturity can act as an indicator for the fishing pressure status which is an important parameter for managing of *P. pelagicus* fishery. The main objective of this study was to determine the size at maturity of *P. pelagicus* found in Sarawak Coastal Water.

Materials and Methods

A total 1,093 crabs (532 females and 561 males) of various sizes were randomly sampled ranging from 70 to 80 crabs per month during July 2003 to August 2004. The study was done within the shallow water biotopes of the commercial fishing grounds of the Sematan Fishing District, Sarawak. This shallow water biotopes is within Talang-talang Island, centring at 1°53'N, 109°48'E. The

Sematan Fishing District is located at the most western part of Sarawak, Malaysia stretching from Tanjung Dato to Sampadi (Figure 1).

Crab size is measured as the external carapace width, which is the distance between the tips of 9th antero-lateral spines of the carapace (Figure 2). The carapace width is measured to the nearest 0.1 cm using vernier callipers. Crab weight is measured to the nearest gram using a digital electronic balance of 0.1 gm sensitivity.

Crabs are separated into male and female based on the shape of the abdomen (Figure 3). The female crab has a wider and globular abdomen. In younger female, the abdomen is invariably triangular. The male crab has a narrow and straight abdomen.

Crabs are classified as juveniles and immature if the abdominal flap is firmly attached to the thorax (Van Engel, 1958). A female crab that has undergone pubertal (or maturity) will moult with the abdominal flap changing from a triangular to oval shape and from being tightly to loosely fix to the cephalothorax are classified as matured (Figure 4) (Ryan, 1967; Fielder & Eales, 1972; Ingles & Braum, 1989; Fisher, 1999; de Lestang et al., 2003). The male samples are examined and classified based on their external appearance of vas deferentia. In mature male the anterior vas deferens (AVD) and middle vas deferens (MVD) are enlarged and white in colour. As shown in Figure 5, the posterior vas deferens (PVD) enlarged and convoluted but was still opaque (de Lastang et al., 2003b).

Data are presented as mean and Microsoft excel are used for plotting the graphs. The size when 50 % of the crab was sexually matured was chosen as an appropriate measure of the size at maturity (CW_{50}) in both male and female crabs following (Quinn & Kojis, 1987; de Lestang et al., 2003b). The CW_{50} was determined using linear regression at any carapace width ranges that shows percentage of maturity.

Results

From a total of 532 female samples, 427 crabs were classified as matured (Table 1). The largest immature female encountered was 11.0 cm carapace in width (CW) and the smallest matured female was recorded as 9.3 cm CW. As shown in Table 2, size at maturity in females based on matured abdomen was most frequently found in size range of 12.0 cm CW (19.0%) and 16.0 cm CW (18.3%). Using the changes in abdominal flap as an indicator of crab maturity, the percentage of matured female crabs was calculated for each 1 cm CW interval from CW range of 3.0 cm (the smaller size range of the crab sampled) to CW range of 19.0 cm (the largest size range of the crab sampled). Using linear regression at the three smallest carapace width ranges that shows percentage of maturity (CW range = 9.0 cm, 10.0 cm and 11.0 cm), CW_{50} occurred at 9.5 cm CW in the female crabs with $y = 34.286x - 3.1373$ and $R^2 = 0.9833$ (Figure 6 and Figure 7).

From a total of 561 male samples, only 467 male crabs were classified as matured based on enlarged and white anterior vas deferens (AVD), middle vas deferens (MVD) and enlarged convoluted posterior vas deferens (PVD) (Table 1). The largest immatured male encountered was 9.8 cm CW and the smallest matured male was 7.1 cm CW. Size at maturity in males based on the presence of enlarged and white anterior vas deferens (AVD), middle vas deferens (MVD) and enlarged convoluted posterior vas deferens (PVD) was most frequently found in size range of 16.0 - 16.9 cm CW (22.5%) (Table 2). Using the present of AVD, MVD and PVD as an indicator of male crab maturity, the percentage of male crabs that matured was calculated for each 1 cm CW interval from CW range of 3.0 cm (the smaller size range of the crab sampled) to CW range of 19.0 cm (the largest size range of the crab sampled). Linear regression analysis at the three smallest carapace

width ranges that shows percentage of maturity (CW range = 7.0 cm, 8.0 cm and 9.0 cm), shows that the size at maturity, CW_{50} occurred at 8.5 cm CW in the male crabs with $y = 29.832x - 23.599$ and $R^2 = 0.9065$ (Figure 8 and Figure 9).

Discussion

Studies on the reproductive biology of *Portunus* spp. have been mostly conducted in Australia (Potter et al., 1983; Sumpton et al., 1994; Sumpton, 2001; de Lastang et al., 2003b; de Lastang et al., 2003c; Kumar et al., 2003). Within the Indo-Pacific region the study locations include India (Pillay & Nair, 1971), the Philippines (Batoy et al., 1987) and Taiwan (Lee & Hsu, 2003). Table 3 shows a summary of available data on size when 50% of crab at maturity (CW_{50}) of *P. pelagicus*. The study was conducted by de Lestang et al. (2003b).

CW_{50} from the present study is larger than those reported by studies conducted in the west coast of Australia for both female and male crabs (Table 3). This phenomenon is attributed to fishing pressure. Pressure from commercial or recreational fishing has led to a reduction in CW_{50} in the spiny lobster (Polovina, 1989) and far greater for *P. pelagicus* in the west coast of Australia (de Lestang et al., 2003a; de Lestang et al., 2003b). In Australia, the commercial activities or fishing of portunid have increased greatly during the last 20 years where *P. pelagicus* is the main catches in Western Australia (de Lestang et al., 2003a). In Sarawak fishing of *P. pelagicus* started less than 11 years ago with the recorded catch statistics recorded since 1996 (Sarawak Marine Fisheries Department, 1996). The commercial catch of *P. pelagicus* in Western Australia for financial year 1999-2000 was 673 metric tones (Department of Fisheries, Western Australia, 2002), where as only 26.25 metric tones for year 2000 for Sematan Fishing District, the present study site (Sarawak Marine Fisheries Department, 2000). This statistics suggests that the *P. pelagicus* fishing pressure is greater for the Western Australia of the Indian Ocean, Australia compared to Sarawak of the South China Sea, Malaysia.

Heavy exploitation of immature crab may affect the sustainable yield. In Thailand, ovigerous mud crabs (*Scylla* spp.) are prohibited from being harvested between October and December (Poovachiranon, 1992). Therefore, some guidelines for the conservation of the wild stock resource should be considered for the *P. pelagicus* commercial fishery in Sarawak, Malaysia. In Queensland, Australian fishing of *P. pelagicus* females and undersize males of carapace with width of less than 15.0 cm is prohibited (Sumpton et al., 1994). It is suggested that one of the consideration to be put up in future is to introduce the LMCW for the *P. pelagicus* fishery for the state of Sarawak and Malaysia in general. In principal the LMCW should be more than the crab size at maturity, only mature size crab is allowed and harvesting of undersize crabs is prohibited for both recreational and commercial fishery.

With the size at maturity (CW_{50}) of 9.5cm for female and 8.5cm for male crabs and to ensure the wild stock resource sustainability, the study proposed that the LMCW for *P. pelagicus* commercial fishery in Sarawak, Malaysia should be greater than 9.5 cm for *P. pelagicus* female and 8.5 cm for *P. pelagicus* male.

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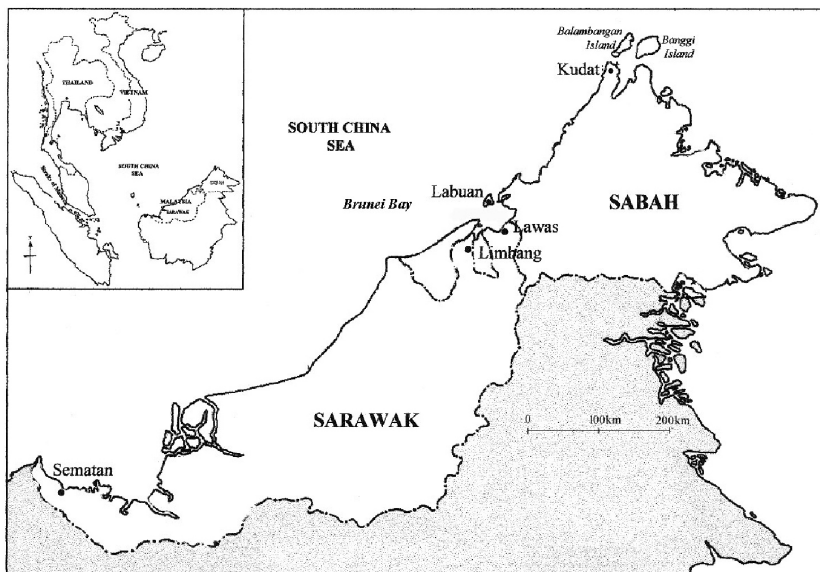


Figure 1 Location of the study site at Sematan Fishing District, Sarawak coastal water of South China Sea.

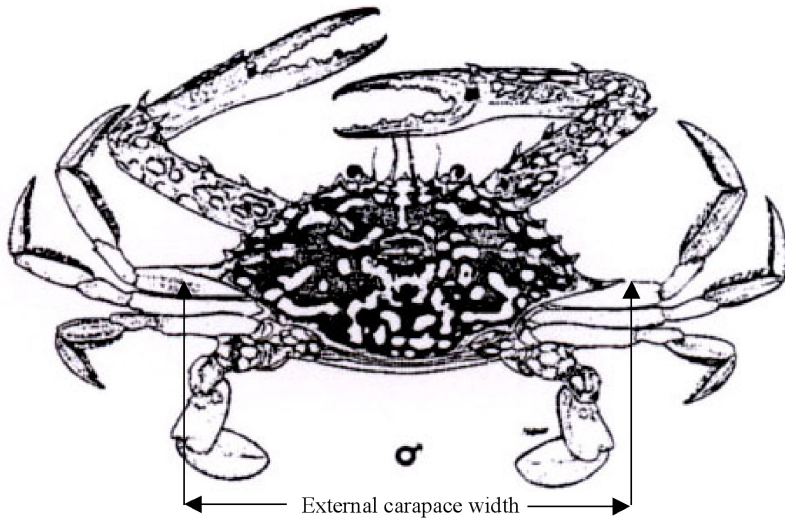


Figure 2. Crab size is measured as the external carapace width, which is the distance between the tips of 9th antero-lateral spines of the carapace. Illustration of male *P. pelagicus* by Ng (1998).

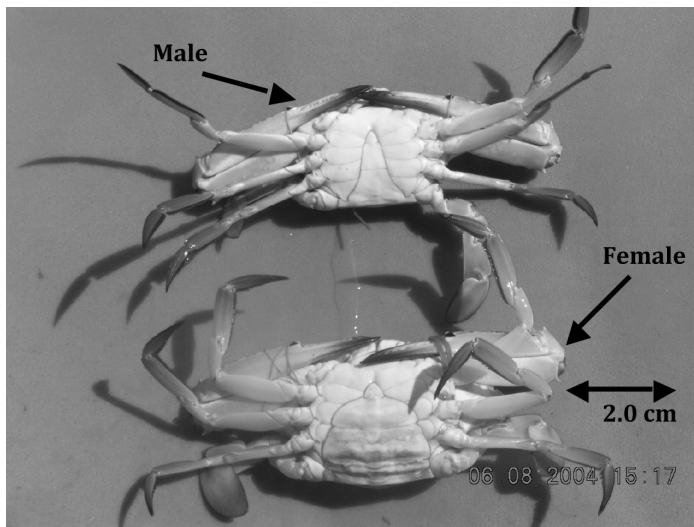


Figure 3. Structure of abdominal flap showing the difference between male and female crab of *Portunus* spp. The female crab has a wider and globular abdomen (Bottom position crab) and the male crab has a narrow and straight abdomen (Top position crab).

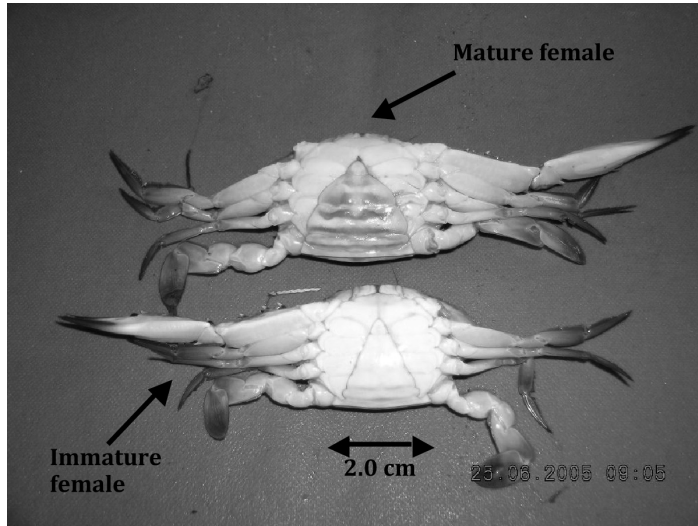


Figure 4. Mature female of *P. pelagicus* with the abdominal flap oval in shape and loosely fix to the cephalothorax (Top position crab). Immature female of *P. pelagicus* with the abdominal flap triangular in shape and tightly fix to the cephalothorax (Bottom position crab).

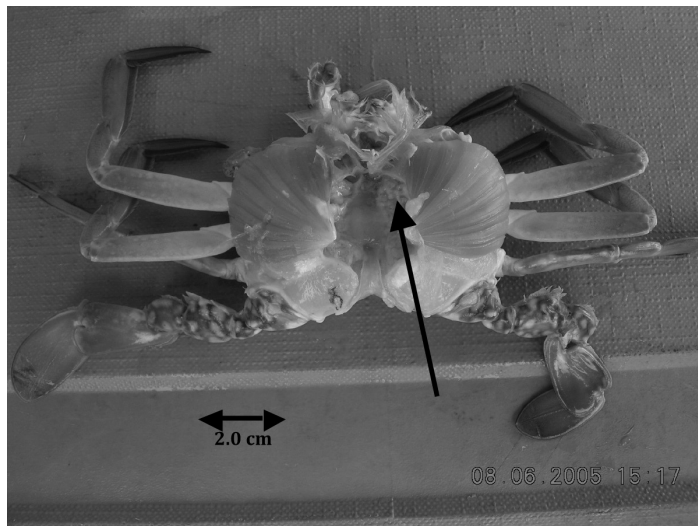


Figure 5. The external appearance of vas deferens of mature male crab of *P. pelagicus* with vas deferens enlarged and white (Pointed black arrow).

Table 1. Mean, maximum and minimum size of carapace width (cm) at maturity in female and male crabs of *P. pelagicus*.

| | Female carapace width (cm) | | Male carapace width (cm) | |
|--------------|----------------------------|------------------|--------------------------|------------------|
| | Mature abdomen | Immature abdomen | Mature abdomen | Immature abdomen |
| Mean | 14.7 | 6.9 | 15.3 | 6.3 |
| Max | 19.1 | 11.0 | 19.4 | 9.8 |
| Min | 9.3 | 3.2 | 7.1 | 3.1 |
| N | 427 | 105 | 467 | 94 |
| Total sample | 532 | | 561 | |

Table 2. Size range of carapace width (cm) frequency number and frequency percentage of mature female and mature male crab of *P. pelagicus* sampled.

| Size range | 7-7.9 | 8-8.9 | 9-9.9 | 10-10.9 | 11-11.9 | 12-12.9 | 13-13.9 | 14-14.9 | 15-15.9 | 16-16.9 | 17-17.9 | 18-18.9 | 19-19.9 | Total |
|-----------------------|-------|-------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| Mature female Freq. | | | 4 | 12 | 34 | 81 | 62 | 34 | 44 | 78 | 57 | 19 | 2 | 427 |
| Mature female Freq. % | | | 0.9 | 2.8 | 8.0 | 19.0 | 14.5 | 8.0 | 10.3 | 18.3 | 13.3 | 4.4 | 0.5 | 100 |
| Mature male Freq. | 2 | 6 | 10 | 1 | 20 | 45 | 31 | 47 | 77 | 105 | 93 | 25 | 5 | 467 |
| Mature male Freq. % | 0.4 | 1.3 | 2.1 | 0.2 | 4.3 | 9.6 | 6.6 | 10.1 | 16.5 | 22.5 | 19.9 | 5.4 | 1.1 | 100 |

Note: Freq. - Frequency; Freq. % - Frequency percentage.

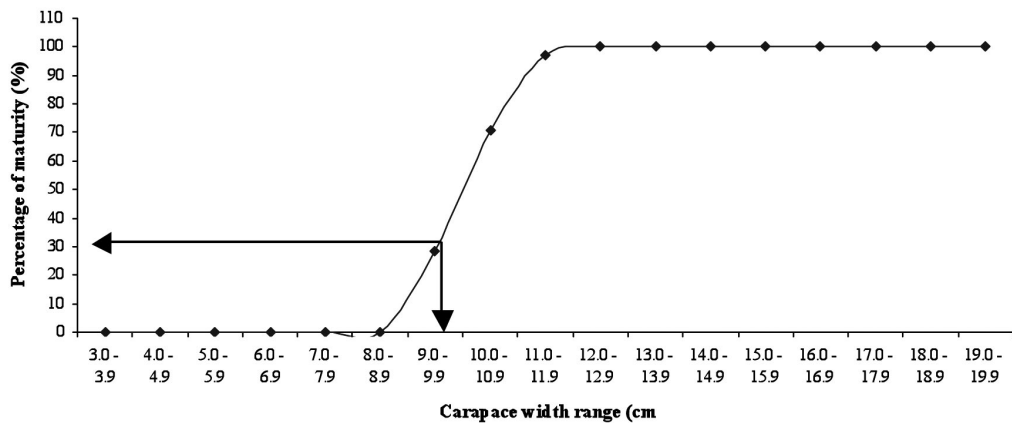


Figure 6. Female crab of *P. pelagicus* size at maturity.

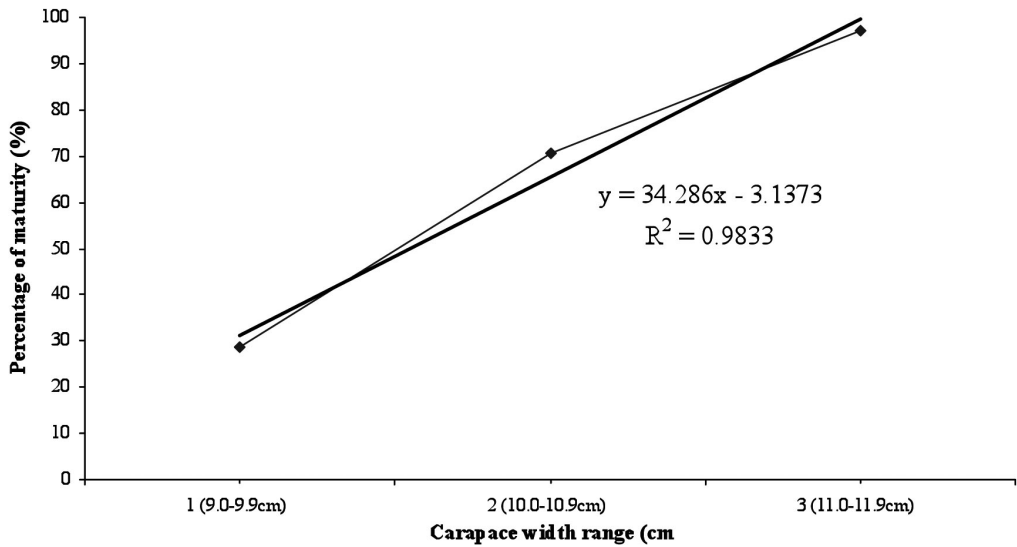


Figure 7. Linear regression of female crab of *P. pelagicus* size at maturity adopted from Figure 6 with 3 point only at carapace width range of 9.0-9.9 cm, 10.0-10.9 cm and 11.0-11.9 cm.

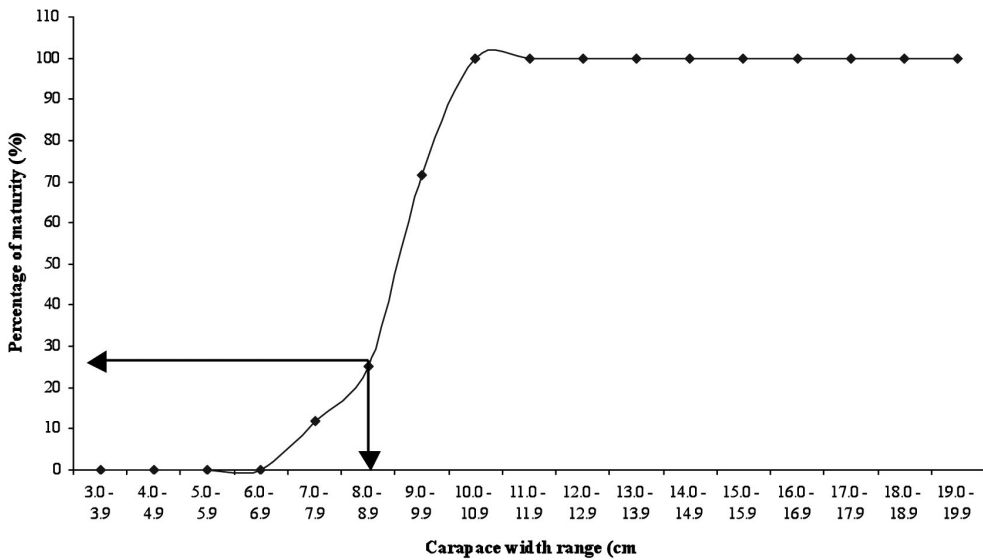


Figure 8. Male crab of *P. pelagicus* size at maturity.

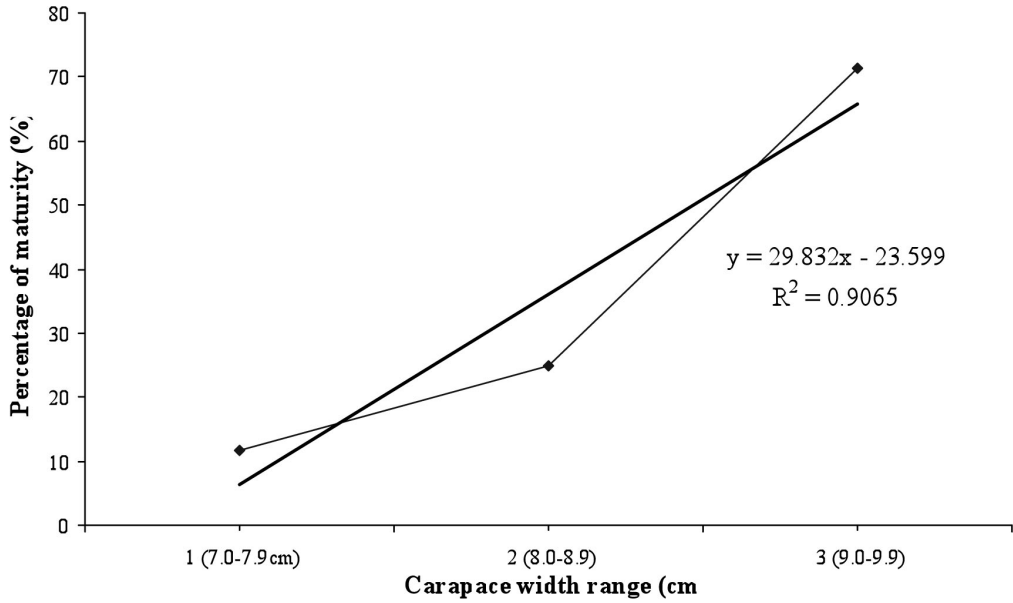


Figure 9. Linear regression of male crab of *P. pelagicus* size at maturity adopted from Figure 8 with 3 point only at carapace width range of 7.0-7.9 cm, 8.0-8.9 cm and 9.0-9.9 cm.

Table 3 Size when 50% of crab at maturity (CW_{50}) in *P. pelagicus* from other studies.

| Locality | Latitude | Female | Male | Source |
|-----------------------|------------------------|----------------------|----------------------|---------------------------|
| Sarawak, Malaysia | 1 ⁰ N | 9.5 cm | 8.5 cm | Present study |
| West Coast, Australia | 25 – 30 ⁰ S | 8.64 cm ¹ | 7.21 cm ¹ | de Lestang et al. (2003b) |
| | | 8.69 cm ² | 7.62 cm ³ | |
| | | 9.20 cm ³ | | |

Note: Study site from West Coast, Australia; ¹Cockburn Sound, ²Koombana Bay and ³Shark Bay.