Body weight-carapace length and body weight-carapace width relationships of
blue swimming crab (*Portunus pelagicus*, Linnaeus, 1758) from Phuket
Province, Thailand.

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ABSTRACT

The blue swimming crab (*Portunus pelagicus*) is an important commercial species in Phuket Province, Thailand but it is difficult to handle these spiny crabs to measure their carapace length and width directly. On the other hand it is easy to measure their weight only as much handling is not needed in this case. The aim of this study was to make correlations between body wet weight and carapace length, as well as body wet weight and carapace width of blue swimming crabs from Andaman Sea, Phuket Province. We predicted that there should be positive significant correlations between body wet weight and carapace length, as well as body wet weight and carapace width. A total of 68 crab samples ranging from 8.38 to 12.20 cm in length, 3.60 to 5.90 cm in length and 41.55 to 95.38 g in weight were collected from Andaman Sea, Phuket Province and analyzed. In addition, these crabs were divided into two different size groups based on their carapace width (small size group: 8.38-9.91 cm and large size group: 10.00-12.20 cm). Highly positive significant correlations between crab body wet weight and body size (carapace length and width) were observed in case of both size groups. Now, it will be possible to calculate carapace length and width of blue swimming crabs from Phuket Province without measuring their carapace length/width but only weighing them.

Keywords: *portunus pelagicus*, phuket province, carapace length, carapace width, body wet weight

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Introduction

The blue swimming crab (*Portunus pelagicus*) is an important economic aquatic fauna in Thailand. These crabs are found throughout the Andaman Sea and the Gulf of Thailand and they are the major source of livelihood for small-scale fishermen in many parts of the Andaman Sea and Gulf of Thailand (Chaiyawat et al., 2008). In 2005, the blue swimming crab yield of Thailand was third in the world (FAO, 2008) and in 2004, the total yield was 42.2 MT with a value of 2,563.3 million Baht (= 35 million US$). However, in 2005 the exports fell off rapidly due to low crab production, and the size of crabs caught were smaller than in previous years (Department of Fisheries, 2005). So, probably crab sizes may indicate the present situation of a population stock. Crab catch reduced may be due to an increased number of efficient fishing gears and due to lack of proper knowledge about population stock management and conservation.

Information about body weight-carapace length/width relationships from a population is important for estimating the population size of a stock, and for the purpose of its exploitation (Josileen, 2011). The body weight-carapace length/width relationships are regarded as more suitable for evaluating crustacean populations (Phinney, 1977; Adegboye, 1981; Olmi & Bishop, 1983; Suhalya & Rashan, 1986; Prasad & Neelakantan, 1988; Prasad et al., 1989; Sukumaran & Neelakantan, 1997; Atar & Sector, 2003; Gorce et al., 2006; Sangun et al., 2009). In spiny and bladed clawed blue swimming crabs, it is difficult to measure their carapace length and width directly, and during measuring them there is a possibility for the investigators to get injured by the crab. On the other hand it takes a long time to measure these parameters (personal
observation). So, probably it is easy to know only the weight of the crabs and to convert them into carapace length/width. It is possible only if we can get significant correlations and regression equations between crab body wet weight and carapace length/width. These relationships are not needed only to measure the body sizes of crabs but also can be used to calculate the standing stock biomass, condition indices and several other aspects of crustacean population dynamics. On the other hand, for the conservation and proper management of a population stock, crabs can be caught and weighted individually or groups by fishermen, afterwards weight data can be converted into body size data (carapace length and width) and catches under the size limits can be returned to the population (Atar & Secer, 2003).

It is important to say that no detailed information regarding body wet weight and length/width relationships of blue swimming crabs is available from Phuket Province, Thailand. Previous research has been conducted on blue swimming crabs from Trang Province (Sawusdee & Songrak, 2009) in Thailand but not from Phuket province. Abdul Sahib (2012) did similar kind of research in case of Portunus pelagicus living in Arabian Gulf. So, now it is necessary to conduct this research in case of blue swimming crab from Andaman Sea, Phuket Province as these crabs are very much popular in this place and have great economic importance.

The objective of this study was to make correlations between blue swimming crab body wet weight and carapace length/carapace width with the objectives to establish some mathematical relationships between the variables, so that if one variable is known, the other could be computed approximately. Another aim was to see these correlations incase of two different size groups (large and small) thus we can understand whether the relationships between body weight and body sizes are same or different in different stages of life. In this study therefore, data on carapace length, carapace width, body weight, and relationships of body weight-carapace width and body weight-carapace length of blue swimming crabs from Andaman Sea, Phuket province were studied and analyzed.

**Materials and methods**

Sixty eight blue swimming crabs, ranging from 8.38 to 12.20 cm in width, 3.60 to 5.90 cm in length and 41.55 to 95.38 g in weight were used in this experiment those were collected from Andaman Sea, Phuket Province by a crab catching fisherman and provided in June, 2013 in
Phuket Marine Biological center, Thailand. Crabs were divided into two different size groups based on their carapace width (small size group: 8.38-9.91 cm and large size group: 10.00-12.20 cm). Forty three crabs were belonging to smaller size group and twenty five crabs were belonging to larger size group. Another aim of this study was to calculate the relationships between body weight and carapace length, as well as body weight and carapace width in relation to size differences. The crabs were kept in a cold room for the whole night and next day all the crabs were measured. Carapace length (CL) (cm), carapace width (CW) (cm) were measured by using Vernier caliper and body wet weights (BW) (g) were measured by using a digital balance. Carapace width (CW) was measured as the distance between the tips of the posteriormost lateral carapace spines. Carapace length (CL) was measured dorsally along the midline, between the frontal notch and the posterior margin of the carapace, followed to Josileen (2011).

**Statistical analysis**

Pearson correlation coefficients were calculated to determine the correlations between carapace length and carapace width, body wet weight and carapace length, as well as body wet weight and carapace width. Normality of all data was checked before analysis and no data transformation was needed. Statistical analyses of all data were performed using SPSS 17.0 software and tests were considered statistically significant at $P$-level < 0.05.

**Results and discussions**

**Size differences between two groups**

Carapace widths (cm) of two different size groups were significantly different (Table 1).

<table>
<thead>
<tr>
<th>Small group crab carapace width (cm) ($\bar{x} \pm SD$)</th>
<th>Large group crab carapace width (cm) ($\bar{x} \pm SD$)</th>
<th>Statistical test (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.10 ± 0.39</td>
<td>10.75 ± 0.13</td>
<td>$P &lt; 0.001$</td>
</tr>
</tbody>
</table>

Some previous studies made the relationships between crab body weight and body size based on total sampled crabs, they did not divide the sampled crabs into two size groups and did not show the relationships between body weight and body sizes of two different size groups (Sawusdee &
Songrak, 2009; Ehsan, et al., 2010). On the other hand, some researchers divided crabs based on sex differences (male/female) (Atar & Secer, 2003; Abdul Sahib, 2012, Olowatoyin et al., 2013) and showed the relationships between body weight and body sizes of different sex groups but nobody focused on body size differences of crabs and showed the correlations between body weight and body size of different size groups.

**Relationship between blue swimming crab carapace width and carapace length**

Significant positive correlations were observed between carapace widths and carapace lengths of crabs from two different size groups (Fig. 1)

![Graphs showing relationships between carapace width and length for small and large size groups.](image)

Fig. 1. Relationships between (A) carapace width and length of small size group crabs ($R^2 = 0.89$, $F_{1,41} = 366.50$, $P < 0.001$, $CL = 0.724 \times CW - 2.370$) and (B) carapace width and length of large size group crabs ($R^2 = 0.87$, $F_{1,23} = 153.48$, $P < 0.001$, $CL = 0.397 \times CW + 1.044$).

Previously positive correlations were observed between carapace width and carapace length in case of several crab species (*Ocypode cursor*, Tureli et al., 2009; *Chaceon fenneri*, Carvalho et al., 2009).

**Relationship between blue swimming crab body wet weight and carapace width**

In case of both different size groups, carapace widths were positively correlated with crab body weights (Fig. 2). This result indicates that carapace widths of small and large crabs increase with increasing of their body weights.
Fig. 2. Relationships between (A) body wet weight and carapace width of small size crab group ($R^2 = 0.87$, $F_{1,41} = 270.83$, $P < 0.001$, $CW = 0.048* BW + 6.562$) and (B) between body wet weight and carapace width of large size crab group ($R^2 = 0.93$, $F_{1,23} = 305.70$, $P < 0.001$, $CW = 0.071* BW + 5.170$).

**Relationship between blue swimming crab body wet weight and carapace length**

Positive significant correlations between crab body wet weights and carapace lengths were also observed in case of both different size groups (Fig. 3).

Fig. 3. Relationships between (A) body wet weight and carapace length of small size crab group ($R^2 = 0.93$, $F_{1,41} = 521.09$, $P < 0.001$, $CL = 0.038* BW + 2.216$) and (B) between body wet weight and carapace length of large size crab group ($R^2 = 0.87$, $F_{1,23} = 151.98$, $P < 0.001$, $CL = 0.029*BW + 3.016$).
Similar results were observed in case of many other crab species including blue swimming crabs (*Portunus pelagicus*). Abdul Sahib (2012) and Josileen (2011) divided *Portunus pelagicus* crab samples into two groups based on sex and observed significant positive relationships. Other researches also did research on this same issue in case of many other crab species such as *Callinecter sapidus*, Atar & Secer, 2003; *Callinecter pallidus*, Oluwatoyin et al., 2013; *Chaceon fenneri*, Carvalho et al., 2009.

In case of *Portunus pelagicus*, it is difficult and time consuming to handle them and to measure their carapace length and width. Sometimes it is also dangerous for the investigators to get injured by the crabs. It is more comfortable to measure their body weight compared to direct measuring of carapace length or width. It was quite easy method to make mathematical relationships (regression equations) between body wet weight and carapace length, as well as body wet weight and carapace width thus anybody can calculate the crab carapace length or width from body wet weight data by using regression equations. In addition, a relationship between carapace length and width was also made thus anybody can measure any one of these variables and afterwards can calculate another variable by using regression equation.

**Findings**

1. There was a highly significant positive correlation between blue swimming crab carapace width and carapace length.

2. There was a highly significant positive correlation between blue swimming crab body wet weight and carapace width.

3. There was a highly significant positive correlation between blue swimming crab body wet weight and carapace width.

These results were found in case of both smaller and larger sized (based on carapace width) blue swimming crabs (*Portunus pelagicus*) separately.

**Conclusion**

The estimated relationships between blue swimming crab body wet weight and body sizes (carapace length and width) from Phuket Province will be helpful for the crab biologists to
measure length and width of blue swimming crabs from Phuket Province those are only weighed but not measured. These results can be used during comparing the different stocks of the same species at different geographical locations inside and outside of Thailand. In addition, these results will be more helpful in case of doing sampling of those crabs that are needed to return back to their habitats after measuring them. During measuring carapace length and width of larger sized blue swimming crabs, not only the investigators but also the crabs can get injured and it is not wise to release the injured crabs back into their habitats. In this case crabs can be weighted only and released back to their habitats.

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