# Growth and Sexual Maturity of Blue Swimming Crab (*Portunus pelagicus* Linnaeus, 1758) Reared in Earthen Ponds

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## ABSTRACT

Growth, sexual maturity and survival rate of larvae of the blue swimming crab (*Portunus pelagicus*) reared in earthen ponds were studied for 180 days. Results showed that average daily growth (ADG) was 0.05±0.01 cm/day (width) and 0.62±0.01 g/day (weight), specific growth rate (SGR) was 1.32±0.04%/day (width) and 3.95±0.01%/day (weight), and average survival rate was 36.75±9.49%. Berried female crabs (12.73% all female crab) were found after 90 days of alteration. The berried female crab (*P. pelagicus*) with a smaller size at maturity than that of the wild stock affected survival rate of zoea stage (1 day after hatching), but not the survival rate of megalopa and first crab stages. This study recommends that female crabs reared in earthen pond for at least 120 days could be used as broodstock.

**Key words:** blue swimming crab, *Portunus pelagicus*, growth, sexual maturity

## INTRODUCTION

The blue swimming crab (*Portunus pelagicus*), a commercially important species, is distributed throughout the coastal waters of the tropical regions of the western Indian Ocean and the eastern Pacific (Xiao and Kumar, 2004). Exporting pasteurized blue swimming crab meat to the United States, Japan and Singapore generates a multi-million dollar revenue for Indonesia annually. To meet the increasing market demands for soft-shell crabs (*P. pelagicus*), crabs have been individually held in compartments within a recirculating system to produce soft-shell crabs in Australia (Romana and Zeng, 2006). In Thailand, blue swimming crabs for direct consumption and for use as raw material in the food processing industry are caught from the Andaman Sea and the Gulf of Thailand. In 2004, the production of blue swimming crabs was 29,500 tons, a decrease of 8.67% from the production in 2003, and the downward trend is continuing (Department of Fisheries, 2005). Therefore, the culture of blue swimming crab is considered as a way to increase productivity without posing pressure on the wild stock.

Currently, blue swimming crab culture in Thailand has developed methods of

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breeding, nursing and rearing to gain higher productivity and survival rates (Tanasomwang *et al*., 2002; Tanasomwang *et al*., 2007; Thepphanich *et al*., 2008). The method of rearing blue swimming crab broodstock in earthen ponds is also well developed (Oniam *et al*., 2009). However, studies on the production of blue swimming crab broodstock to replace wild broodstock are limited. Therefore, the objective of this experiment was to study the growth and sexual maturity of crab reared in captivity. Survival rate of crab larvae from different sizes of berried female crabs reared in earthen ponds was also determined to find the optimal size of broodstock.

## MATERIALS AND METHODS

### Source of experimental crabs

Blue swimming crab broodstock were caught using crab traps used by small scale fishermen in the coastal area of Prachuap Bay, Prachuapkhirikhan Province, Thailand. Female crabs with dark grey eggs were placed in 200-L fiber tanks to allow them to release the eggs for hatching. During this period they were not fed. After hatching, crab larvae were transferred outdoors to 3,000-L concrete tanks to nurse them at densities of 100 crabs/L. Newly hatched larvae were initially fed with rotifers (*Branchionus* sp.) and *Chaetoceros* sp. From zoea II stage onwards they were fed with *Artemia* nauplii. Upon larval metamorphosis to the first crab stage they were fed with minced trash fish for about 10-12 days until the experiment commenced.

### Experimental design and set-up

Crabs with carapace width of 0.5-1 cm (about 30 days old) from the nursing concrete tanks were transferred to 400 $m^2$ earthen ponds at Kasetsart University's Klongwan Fisheries Research Station, Prachuapkhirikhan Province. They were randomly assigned to 3 earthen ponds at a density of 3 crabs/$m^2$. They were fed with trash fish at 5% of body weight per day, twice a day at 9.00 a.m. and 4.00 p.m. for 180 days. Random samples of 50 crabs from each earthen pond were collected using crab traps and were used to evaluate crab growth and sexual maturity every 30 days. Sexual maturity was determined according to Jindalikit *et al*. (2008). All berried female samples were transferred to and placed individually in 200-L fiber tanks for hatching. Then the crab larvae were transferred to 3,000-L concrete tanks for nursing. Survival rates of zoea I (1 day after hatching), megalopa and first crab stages from berried females reared in earthen ponds were determined.

During the rearing period, water was changed once a week at 20% of the total volume. In larval nursing, water exchange was done every three days at about 20-30% of total volume during the zoea I to megalopa stages, and daily water exchange (about 20 -30%) was done during the megalopa to first crab stages. Water quality was analyzed twice a week. Salinity was measured by a refractometer Prima tech, pH by pH meter Cyber Scan pH 11, temperature and dissolved oxygen concentration (DO) by oxygen meter YSI 550A, transparency by Secchi disk, total

ammonia by Koroleff 's Indophenol blue method, nitrite by colorimetric method, and alkalinity by titration method (APHA *et al*., 1995).

At the end of the rearing period, the remaining crabs were counted, weighed and measured to assess survival rate (SV), average daily growth (ADG), and specific growth rate (SGR) according to Brown (1957). Data were analyzed using analysis of variance (ANOVA) and the difference between means was tested using Duncan's new multiple rang test (DMRT) at 95% level of confidence.

## RESULTS AND DISCUSSIONS

### Growth and survival rate

The study of the blue swimming crab reared in earthen ponds was conducted for 180 days. The 1st rearing was during March 2008–September 2008, the 2nd rearing was during October 2008–April 2009, and the 3rd rearing was during February 2009– August 2009. The average initial and final carapace widths, initial and final body weights, average daily growth (ADG), specific growth rate (SGR) and survival rate are shown in Table 1.

Table 1. Growth and survival rate of blue swimming crab (*P. pelagicus*) reared in earthen ponds at densities of 3 crabs/$m^2$, fed with trash fish at 5% of body weight/day, for 180 days (Mean±SD)

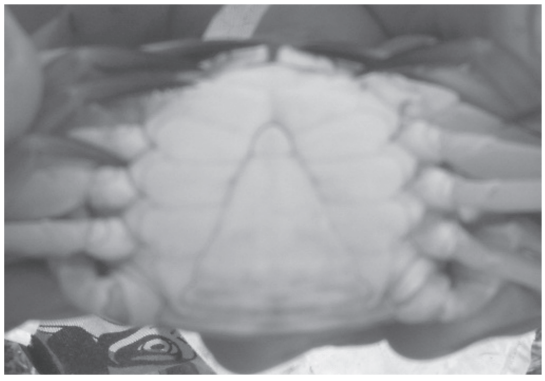
| Parameters | Mar-Sept 08 | Oct 08-April 09 | Feb-Aug 09 |
|---|---|---|---|
| Initial carapace width (cm) | 0.97±0.08 | 0.98±0.13 | 1.00±0.10 |
| Initial body weight (g) | 0.09±0.02 | 0.09±0.02 | 0.09±0.02 |
| Final carapace width (cm) | 11.17±1.27 | 9.97±0.63 | 10.99±0.65 |
| Final body weight (g) | 116.95±32.73 | 111.21±31.82 | 111.54±36.27 |
| ADG of width (cm/day) | 0.05 | 0.04 | 0.05 |
| ADG of weight (g/day) | 0.64 | 0.62 | 0.62 |
| SGR of width (%/day) | 1.35 | 1.28 | 1.32 |
| SGR of weight (%/day) | 3.97 | 3.95 | 3.95 |
| Survival rate (%) | 37.67 | 26.83 | 45.75 |
| Average ADG-width | | 0.05±0.01 cm/day | |
| Average ADG-weight | | 0.62±0.01 g/day | |
| Average SGR-width | | 1.32±0.04%/day | |
| Average SGR-weight | | 3.95±0.01%/day | |
| Average survival rate | | 36.75+9.49% | |

In this study, growth and survival rates of the crabs (*P. pelagicus*) were similar to studies reported earlier with a harvest of 26.74-140.50 kg/1600 $m^2$, body weight of 66-119 g and survival rate of 2.97-59.59% (Kedmuean *et al*., 2004; Thepphanich and Chumworrathayee, 2005; Thepphanich *et al*., 2008). Maheswarudu *et al*. (2008) reported that factors that contribute to low survival of crabs were Moult Death Syndrome (MDS, death associated with moulting) and cannibalism. While MDS may have occurred in the ponds, cannibalism was the main factor affecting mortalities in the present study.

**Sexual maturity**

Sexual dimorphism could be observed at 60 days after the experiment with a sex ratio of 1:1 (Figure 1.). Berried female crabs were first found on day 90 (12.73% all female crab) with the prominent peak on day 150 (38.99% all female crab) of rearing period. At day 150, the percentage of yellow, brown and dark grey coloured eggs were 41.11, 34.44 and 24.45%, respectively. The percentage of non-sexual mature females, internally egg-bearing (pre-berried) and externally egg-bearing (berried) are shown in Figure 2.

Male blue swimming crab attains maturity earlier than female crabs (Josileen and Menon, 2005). Kedmuean *et al*. (2004) reported that in the 4$^{th}$ month (120 days) of blue swimming crab rearing, there were some coupling pairs and berried females in the earthen ponds. Maheswarudu *et al*. (2008) reported that 32% of female crabs harvested from grow-out ponds at 135 days were sexually mature. In the present study, maturity attained by *P. pelagicus* in earthen ponds was noteworthy as it elicited an easy



(a) non-sexual maturity

(b) pre-berried

(c) berried

Figure 1. Abdomen characteristics of female blue swimming crab (*P. pelagicus*) reared in the earthen ponds: non-sexual maturity (a) and sexual maturity (b-c).

way for broodstock development, which is a vital requisite to any potential species for aquaculture in Thailand.

**Survival rate of crab larvae**

In this study, larval development from zoea I to megalopa stages took 10-12 days and from megalopa to first crab stages took 5-6 days. A similar result for this species was reported by Arshad *et al*. (2006). Zoea produced by female broodstock younger than 120 days had a significantly lower survival rate ($P<0.05$) compared to those produced by older female broodstock (Table 2). In the present study, the size of females reared for 90 days was smaller than the size at first maturity reported for wild stock (carapace width of 9.47 cm or about 144 days old, Jindalikit *et al*., 2008). However, average survival rates of megalopa and first crab stages from berried female crabs (*P. pelagicus*) at different ages were not significantly different (Table 2).

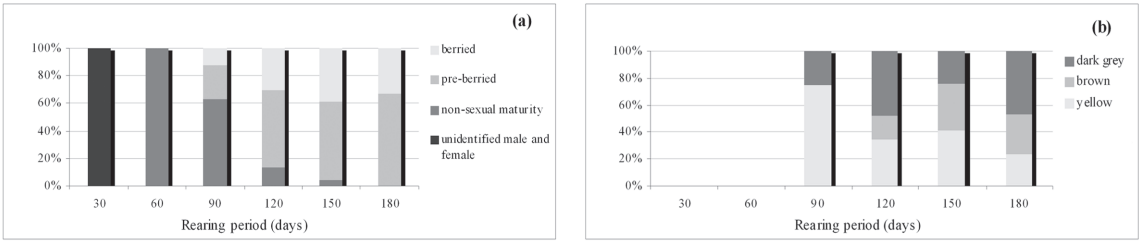



Figure 2. Percentage composition of female blue swimming crab (*P. pelagicus*) reared in the earthen ponds: female sexual maturity (a) and berried female (b)

Table 2. Survival rate of crab larvae from berried female blue swimming crab (*P. pelagicus*) reared in earthen ponds (Mean±SD)

| Rearing (days) | Body size of berried female | | | Survival rate of larvae | | |
|---|---|---|---|---|---|---|
| | CW (cm) | CL (cm) | BW (g) | Zoea I | Megalopa | First crab |
| 30 | nd | Nd | nd | nd | nd | nd |
| 60 | nd | Nd | nd | nd | nd | nd |
| 90 | 8.17±0.68$^{a}$ | 4.05±0.38$^{a}$ | 43.75±13.76$^{a}$ | 59.95±10.49$^{a}$ | 25.53±8.55$^{a}$ | 0.22±0.35$^{a}$ |
| 120 | 9.63±1.10$^{b}$ | 4.73±0.57$^{b}$ | 73.46±18.18$^{b}$ | 81.92±10.48$^{b}$ | 30.28±19.13$^{a}$ | 0.59±0.62$^{a}$ |
| 150 | 10.76±0.97$^{c}$ | 5.44±0.80$^{c}$ | 105.29±32.08$^{c}$ | 82.91±11.83$^{b}$ | 29.20±17.27$^{a}$ | 0.76±0.73$^{a}$ |
| 180 | 11.28±1.32$^{c}$ | 5.61±0.57$^{c}$ | 103.33±33.68$^{c}$ | 80.39±10.49$^{b}$ | 32.70±13.74$^{a}$ | 0.74±0.50$^{a}$ |

Note : Means within the same column with different superscripts are significantly different ($P<0.05$).
nd = no data (non-berried female).

**Water quality**

Water quality during the rearing and nursing periods did not affect growth and survival rate of crabs (Table 3) Lignot *et al.*, 2000; Romana and Zeng, 2007; Maheswarudu *et al.*, 2008).

Table 3. Water quality during rearing and nursing of blue swimming crab (*P. pelagicus*)

| Parameters | Crab rearing in earthen ponds | Crab nursing in concrete tanks |
|---|---|---|
| Salinity (ppt) | 31-35 | 30-32 |
| Temperature ($^{o}$C) | 30.0-34.3 | 26.8-29.8 |
| Dissolved oxygen (mg/l) | 4.03-8.96 | 5.18-7.24 |
| pH | 8.18-9.29 | 8.00-8.39 |
| Alkalinity (mg/l as $CaCO_3$) | 105-136 | 118-143 |
| Total ammonia (mg-N/l) | 0.000-0.036 | 0.000-0.321 |
| Nitrite (mg-N/l) | 0.000-0.020 | 0.009-0.918 |
| Transparency (cm) | 35-70 | - |

## CONCLUSION

This study recommends that female crabs (*P. pelagicus*) can be reared in earthen ponds and used as broodstock. However, it is necessary to further study the factors which affect survival rate of broodstock.

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