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Size Distribution, Sex Ratio and Size at Maturity of Mud Crab (*Scylla* spp.) in Ranong Province, Thailand

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Abstract

Mud crab samples were taken from landing sites in La-un, Muang and Kapoe Districts, Ranong Province, Thailand from April 1998 to March 1999 to examine size distribution, sex ratio and ovarian development of the population. Information on the fishing methods and the relationships between crab catches and environment were also obtained.

A total of 4,501 male and 3,735 female mud crabs were sampled from La-un, Muang and Kapoe districts of Ranong Province from April 1998 to March 1999. Relationships between carapace width (CW) and body weight (BW) were $BW = 0.119CW^{3.321}$ ($r^2 = 0.927$) for male crabs and $BW = 0.402CW^{2.685}$ ($r^2 = 0.912$) for female crabs. The modal classes of CW were 8.0 to 8.5, 8.5 to 9.0, and 7.5 to 8.0 cm in La-un, Muang and Kapoe Districts, respectively. Male to female ratios were 1:0.82, 1:0.76, and 1:0.90 while immature to mature female ratios were 1:0.51, 1: 0.82 and 1:0.26 in La-un, Muang and Kapoe Districts, respectively. Mean CW at sexual maturity (CW_m) for female crabs was approximately 8.6 cm. The gonadosomatic index for female crabs varied from April 1998 to March 1999, but with peaks in June and from August to October. The data also showed a recruitment of small crabs in June and July.

Introduction

The mud crab is one of the most valuable crustacean species caught in the Ranong mangrove ecosystem. Two species found in this area are *Scylla olivacea* and *S. paramamosain*. *S. olivacea* is more dominant than *S. paramamosain*. In the past, lift nets were used to catch crabs. The lift net is made of a long bamboo pole with a circular net containing a bait at the bottom. However, there are disadvantages in using this net such as: (1) only one crab can be caught at a time; (2) the lift nets have to be watched continuously; and (3) skilled fishermen are required to avoid the escape of crabs (Chonchuenchob and Pripanapong 1993). In 1987, a collapsible metal trap that catches several crabs at a time, was introduced and became very popular. However, this trap caused an overexploitation of the mud crab population, both in number and in size. At present, the crabs being collected are very small (100 to 200 g) and are still immature.

This study aimed to investigate size distribution, sex ratio, size at sexual maturity and spawning season of mud crabs caught in Ranong Province, Thailand. The history of crab fishing and current fishing methods, and the socio-economic aspect of the mud crab fisheries were also investigated.

Materials and Methods

Study sites

Crab samples were taken from three landing sites at a) La-un, b) Muang and c) Kapoe Districts in Ranong (Fig. 1) from April 1998 to March 1999. The landing site at La-un District is within the Kraburi River system, while that in Muang District is in the Kraburi river mouth area. The site in Kapoe District is in the coastal mangrove area towards the Andaman Sea.

Data collection

During spring tides at new moon, 200 to 300 crabs caught by local fishermen were sampled at random and measured for internal carapace width and body weight. Samples were classified into male and immature and mature female based on the morphology of the abdominal segment (Fig. 2).

About 30 mature female crabs were selected at random from each site every month for gonadosomatic index (GSI) measurement. The GSI can be used to assess ovarian development based on its direct relationship with the size of

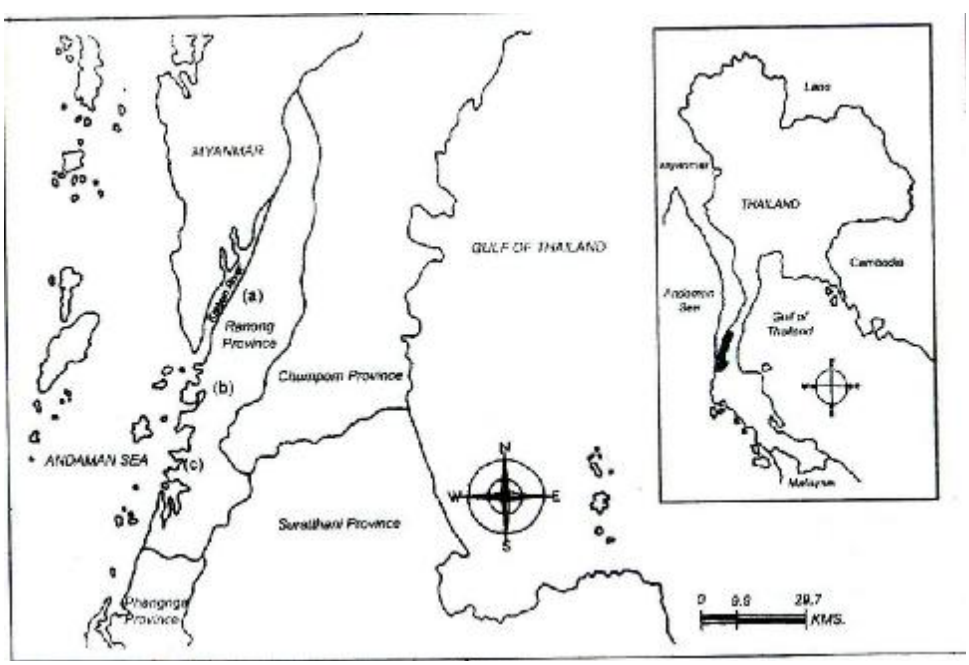

Fig. 1. Map of Ranong, Thailand showing the study sites at (a) La-un , (b) Muang and (c) Kapoe Districts

the ovary expressed as a percentage of the total weight of crab as follows:

% GSI = Ovary weight (g) / Crab weight (g) x 100

Fishermen were also interviewed regarding the fishing methods they used and their views on the relationships between crab catches and the environment.

Analysis of data

The relationship between carapace width and body weight in males and females was determined through regression analysis. A comparison of size distribution among the sampling sites was also conducted.

Results and Discussion

Size and sex distribution

A total of 4,501 male and 3,735 female crabs were sampled from the La-un, Muang and Kapoe Districts of Ranong. The relationship between the carapace width (CW in cm) and body weight (BW in g) was expressed as $BW = 0.119CW^{3.321}$ ($r^2 = 0.927$) for male and $BW = 0.402CW^{2.685}$ ($r^2 = 0.912$) for female crabs (Fig. 3). The ratio of body weight to carapace width in small male and female crabs are relatively equal. In larger crabs, the ratio become smaller in females than in males due to the large claws of the latter.

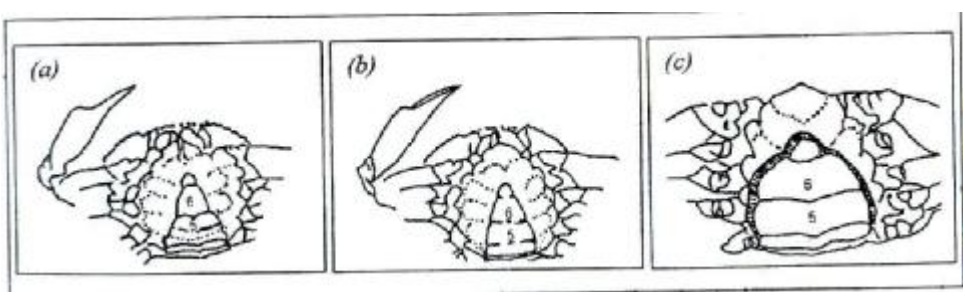

Fig. 2. Morphology of the abdominal segment used to identify the sexual maturity of *Scylla* spp. : a) male, b) immature female, and c) mature female. Position of abdominal segments 5 and 6 are indicated (Pripanapong 1993).

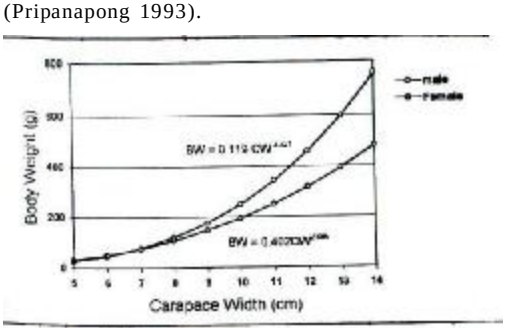

Fig.3. Relationship between carapace width (CW) and body weight (BW) of male and female mud crabs in Ranong, Thailand

The size distribution of male, and immature and mature female crabs in each district are shown in figures 4 A to C. Muang District had relatively larger crabs than the two districts. Modal classes of carapace width were 8.0 to 8.5, 8.5 to 9.0 and 7.5 to 8.0 cm, in La-un, Muang and Kapoe Districts, respectively. The ratio of males to females was 1:0.82, 1:0.76, and 1:0.90 while the ratio of immature to mature females was 1:0.51, 1:0.82 and 1:0.26 in La-un, Muang and Kapoe Districts, respectively. There were more males than females in every district. This may be due to the migration of females out of the mangrove area during the spawning period. The number of immature females was also higher than mature females in each district.

Of the three sites, Kapoe District had relatively smaller male and female crabs. About 80% of the total number of crabs sampled over a one-year period were immature females. Since Kapoe is situated closer to the Andaman Sea compared to Muang and La-un Districts, the higher ratio of immature to mature crabs could be due to the migration of young recruits in Kapoe. Most of the crabs collected were immature hence, fishermen should be educated and encouraged to catch only the bigger crabs, especially the females. Likewise, culture of small crabs should be promoted to increase their market value, thereby, utilizing the fisheries resources efficiently.

The size distribution of mud crabs in La-un and Kapoe Districts is skewed to the left (Figs. 4 A and 3 C) indicating that recruitment of juvenile crabs is insufficient to replace migration, fishing and natural mortality of the stock. One cause of the current overexploitation of mud crab population was the introduction of a collapsible trap in 1987. This trap has allowed fishermen to catch all sizes of crabs in large numbers in the mangrove area.

Size at maturity

Median carapace width at sexual maturity (CW_m), can be defined as the carapace width at which 50% of all individuals are sexually mature. Thus, CW_m could be estimated from the percentage of mature females in each size category (Fig. 5). Crabs started to attain maturity at 7.0 cm CW and all were found to be mature at 10.0 cm CW. In La-un and Kapoe Districts, crabs attained sexual maturity at relatively smaller size than in Muang District. In general, the estimated median size at maturity (CW_m) of female crabs in Ranong is at about 8.6 cm. Thus, catching crabs with carapace width smaller than 8.6 cm should be prohibited to enable at least half of them to reach maturity.

Spawning season

Gonadosomatic index (GSI) values varied from April 1998 to March 1999 (Table 1) with peaks in June and from August to October. The first peak (June) was observed only in Muang District at the beginning of the rainy season. The second peak (August to October) was observed in every

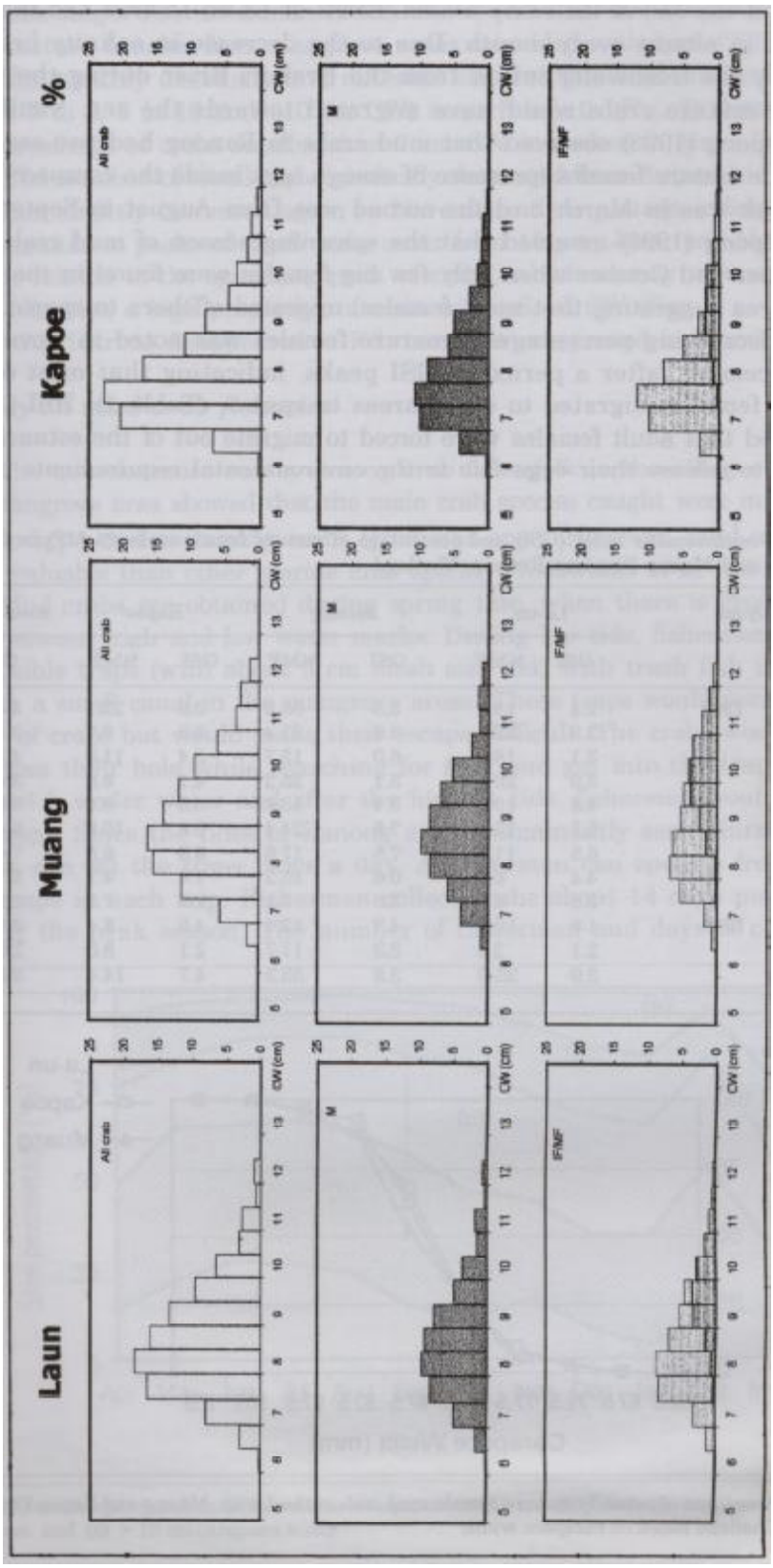

Fig. 4. Size distribution of male (M), immature (IF) and mature female (MF) mud crabs in La-un, Muang and Kapoe Districts, Ranong, Thailand

district at the end of the rainy season. Crabs at La-un District had the lowest GSI in almost every month. Due to the decrease in salinity brought about by the freshwater inflow from the Kraburi River during the rainy season, mature crabs could have migrated towards the sea. Similarly, Pripanapong (1993) observed that mud crabs in Ranong had two seasonal peaks for mature females (presence of orange eggs inside the carapace). The first peak was in March and the second was from August to September. Pripanapong (1993) assumed that the spawning season of mud crab is in September and October when only few big females were found in the mangrove area suggesting that most females, migrated offshore to spawn.

A decreasing percentage of mature females was noted in November and December, after a period of GSI peaks, indicating that most of the mature females migrated to other areas to spawn. (Table 1). Hill (1975) suggested that adult females were forced to migrate out of the estuaries to the sea to release their eggs due to the environmental requirements of the

Table 1. Gonadosomatic index (GSI) and percentage of mature female crabs (% MF) in the La-un, Kapoe and Muang Districts, Ranong, Thailand

Month/year		La-un		Muang		Kapoe		Average
		GSI	%MF	GSI	%MF	GSI	%MF	GSI
April	1998	2.4	19.3	3.8	30.9	3.9	22.1	3.37
May		2.9	22.3	3.3	21.4	3.3	9.7	3.17
June		3.1	16.8	6.0	13.7	3.4	11.3	4.17
July		3.0	20.1	3.1	25.2	4.1	8.8	3.40
August		4.8	10.3	5.4	13.8	6.3	6.1	5.50
September		5.7	17.1	7.8	24.4	5.8	10.8	6.43
October		6.5	11.8	7.5	17.6	8.8	6.8	7.60
November		4.4	6.8	0.6	15.2	1.4	4.1	2.13
December		2.9	9.7	3.3	7.1	1.9	7.2	2.70
January	1999	1.8	19.3	4.3	12.4	4.9	8.4	3.67
February		2.1	2.9	3.3	17.7	2.1	8.5	2.50
March		3.9	25.0	3.3	33.3	4.7	14.4	3.97

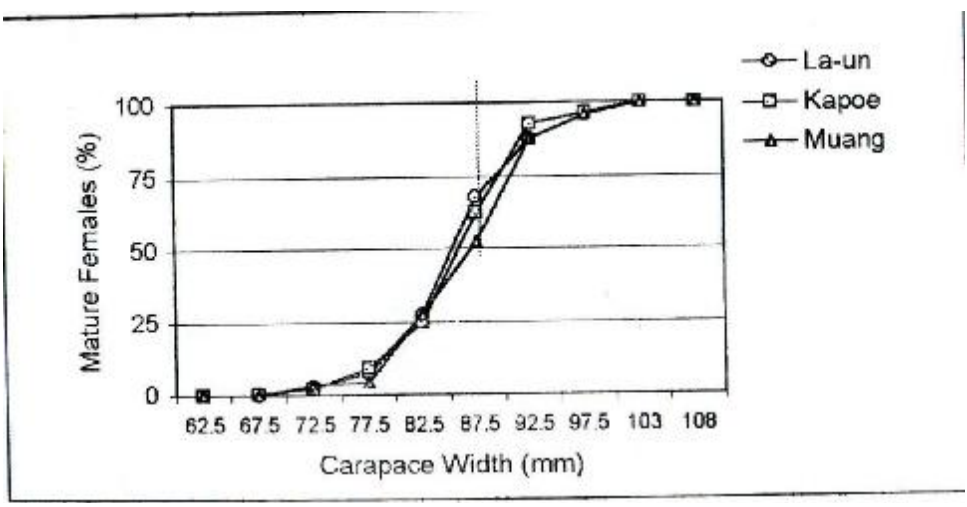

Fig. 5. Percentages of sexually mature female mud crab in the La-un, Muang and Kapoe Districts, Ranong, Thailand based on carapace width

first zoea stage. Poovachiranon (1992) also found that the disappearance of some mature females from mangrove areas coincided with high GSI values.

The monthly distribution of different size categories of mud crab (< 7, 7 to 8, 8 to 9, 9 to 10 and >10 cm CW) in each month (Fig. 6) showed that the percentage of crabs smaller than 7 cm CW increased in May, June and July. The number of small crabs gradually decreased from August to October, and then slightly increased again in November. This pattern indicates that two recruitment peaks of small crabs occur from May to June, and November. This is related to the spawning peak of crabs, which usually occurs twice a year. Likewise, a high proportion of crabs with >8 cm CW (Figs. 6 c, d and e) in all the districts disappeared in February but reappeared in March.

Survey on mud crab fisheries

The questionnaire survey among crab fisherfolk in the villages close to the mangrove area showed that the main crab species caught were mud crabs (*Scylla* spp.) and swimming crabs (*Portunus* spp.). However, mud crabs are more valuable than other marine crab species (Tookwinas et al. 1991).

Mud crabs are obtained during spring tide, when there is great variation between high and low water marks. During low tide, fishermen set the collapsible traps (with about 3 cm mesh size net) with trash fish inside as bait in a small canal in the mangrove areas. These traps would permit easy entry of crabs but would make their escape difficult. The crabs would come out from their hole while searching for food and get into the traps. After about 4 h under water and after the highest tide, fishermen would collect the traps. Since the tides in Ranong are predominantly semi-diurnal, fishermen can set the traps twice a day. A fisherman can operate from 50 to 100 traps in each trip. Fishermen collect crabs about 14 days per month during the peak season. The number of fishermen and days of collection

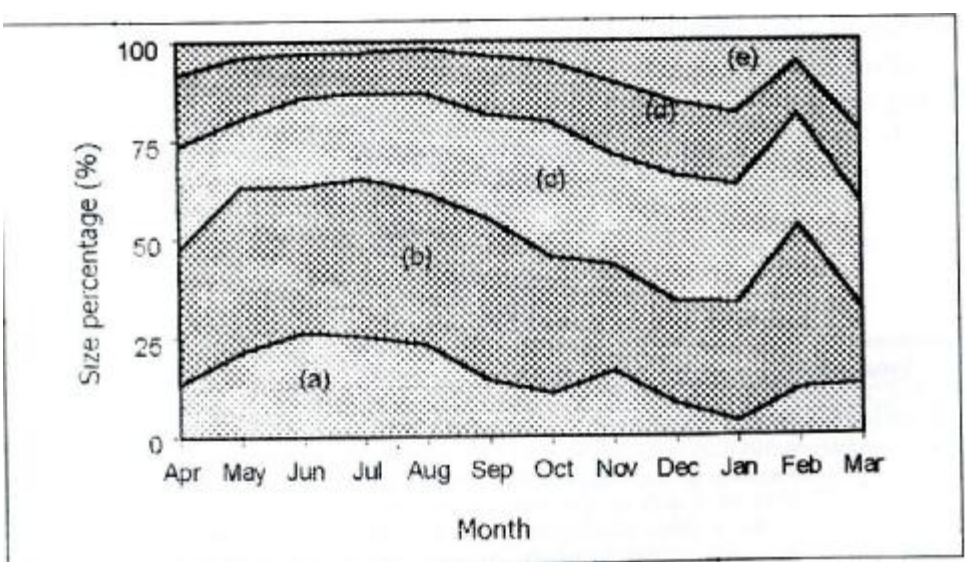

Fig. 6. Percentage of crab in different size categories (a) <7 cm, (b) 7 to 8 cm , (c) 8 to 9 cm , (d) 9 to 10 cm and (e) > 10 cm carapace width

are reduced during the low catch season or neap tide. During this period, some fishermen are engaged in other fisheries or aquaculture activities, or work in orchards, while some are jobless.

Pripanapong (1993) observed at a crab middleman site in Ranong that mud crabs were graded by weight as: small (100 to 200 g) and large crabs (over 200 g). At present, the average sizes of crabs caught are between 150 and 200 g. These are graded into three-size categories: small (< 100 g), medium (100 to 170 g) and large crabs (> 170 g). Crabs smaller than 50 g are usually released back into the mangrove since the size is not acceptable to middlemen. The prices are about 60 to 65 Baht·kg^{-1} (1US$ = 35.95 Baht), 30 to 37 Baht·kg^{-1} and 10 to 15 Baht·kg^{-1} for large, medium and small crabs, respectively. The large and medium crabs are exported or sold live in Bangkok. Crabs in the intermolt and postmolt are fattened, while small crabs are preferably used to produce soft-shell crabs. The price of crabs changes seasonally according to their availability. During the last five years, the price increased but the income of fishermen remained the same due to the decrease in catches. Fishermen could earn 1,200 Baht a month during the low catch season and up to 5,000 Baht a month during the high catch season.

Based on the survey, the fishermen emphasized the importance of conserving mangrove forests that serve as the habitat of mud crabs. The mangrove ecosystem provides shelter and food for crabs. A relatively greater number and larger sized-crabs were present in the Ranong Mangrove Forest Research Center, an area with better mangrove habitat, than the nearby degraded mangrove area.

Acknowledgment

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