CHAPTER IV

DISCUSSION

The total of mud crab ***Scylla serrata*** at Klong Ngao mangrove forest was estimated to 109 tons or 109,000 kg. annually. This was comparable to the mud crab production reported by Poovachiranon (1987) at Bangla mangrove area, Phuket province in 1986 of 2,675 kg or 2.7 tons. It should be noted that of an estimated annual total of 109 tons of mud crabs sold through the village crab dealers, about 46 percent were smaller than 10 cm. in carapace width. Under laboratory conditions Ong(1966) found that ***S. serrata*** spawns for the first time when around 10 to 12 cm. in size. But in the Klong Ngao mangrove forest, the smallest ovigerous crab was 8.35 cm. On an average, the size at first sexual maturity for this female crab population was 9.94 cm. This data suggest that at least 50 % of the total catch do not get a chance to spawn before entering the fishery. Though push netting is illegal in Thai waters, it is a very common gear used for prawns and shrimps in and around Ranong mangroves. A large quantity of mud crabs were either harvested, killed or discarded by push netters. Most of the crabs from the trash catch of push net are usually juveniles will fall under the category of crabs smaller than 10 cm. These fishing pressures will have tremendous impacts on the mud crab population in the Klong Ngao mangrove forest.

Growth of *S. serrata*

Based on the comparisons of the length - weight relationship of both sexes, and the von Bertalanffy growth equation, the male ***S. serrata*** grew more rapidly than female ***S. serrata***. This also corresponded to the study conducted by Poovachiranon(1987). He studied the relationship between carapace width - weight of ***S. serrata*** at Bangla, Phuket Province. Carapace width (CW) to weight (W) relationship for male and female crabs from Bangla mangrove forest were male, logW = 3.2760logCW - 1.3751 and female, logW = 2.7285logCW - 0.4740. Harnoll (1982) reported that in crustacea, females generally grew less rapidly than males after puberty, presumably because gonadal growth and parental care (egg carrying) diverted more resources in females than in males. In addition parental care prolonged the intermolt period because eggs were attached to the exoskeleton.

Mortality

The catch data from Klong Ngao mangrove forest revealed that the male crabs were being caught more than females. Both sexes were caught more at the size range of 9 - 10 cm. The females in the size class of 10 - 12 cm. were approximately 25.98 % of the total catch. The males at this same size class were caught less of 17.36 %. Poovachiranon (in press) reported the percentage of catch of different size groups for mud crabs

from Phuket mangrove forests as followed: 53 % for size group of 9 - 11 cm., 22 % for size group of 11 - 13 cm., 23 % for size group of which smaller than 9 cm. and 2 % for size group of which larger than 13 cm.

Considering the estimation of growth by growth curve in *S. serrata* of both sexes, the female crabs reached the sizes at about 9.5 cm. which was the size at 50 % of the probability of capture within 10 - 11 months. The male *S. serrata*, on the other hand, took about 8 - 9 months to reach the sizes at about 8.6 cm., which was also the size at 50 % of chance which to be caught should be 9 months. It can be assumed from this that most crabs enter the Ranong fishery in their first year. The estimation of the average growth rate by the rearing experimentation of mud crab by Ong (1966) revealed that it took the crab 8 - 10 months to attain the 8 - 9 cm. size.

In the exploit population, total mortality (Z) is caused mainly by fishing mortality (F) while natural mortality (M) play a lesser role. Natural mortality is caused by all possible causes of death except fishing. In fish population dynamics, the exponential coefficient of natural mortality (M) certainly is one of the parameters for which it is most difficult to obtain good estimates. Direct estimates of M can be obtained only from completely unfished stocks (Pauly, 1980). Estimation of natural mortality in decapod is usually expressed annually, and ranges systematically with longevity from around 0.1 in long lived lobsters and

crab to M = 1.5 or even 2.0 + in short - lived penaeid shrimps (Cobb, 1989). The mortality determination routine in ELEFAN II, through catch curve analysis, gives estimate of natural mortality (M) based on the empirical relationship obtained from the study of Pauly(1980), of which dealing with many different fish stocks. The natural mortality generated from catch curve by ELEFAN II can be used to predicted reasonable value of M in any species of fish can be expected to generate equally reasonable estimates of M in mud crab, ***S. serrata***, as well. For the reason that crab and fish generally share the same habitats, resources, and predators. Estimation of natural mortality in male and female ***S. serrata*** yield the result as 1.938 and 1.481 respectively. The method presented here to estimate the natural mortality of ***S. serrata*** is risky in that it is based on data obtained from fish stocks. However, the M resultant of both sexes compared with the M from which Cobb(1989) reported (M = 1.5). The values of M generated from ELEFAN II which based on data obtained from fish stocks must be reasonable used in this study.

Recruitment

The spawning pattern of ***S. serrata*** which derived from Gonad - Somatic Index (GSI) data also reflected in the recruitment patterns derived from length - frequency data using ELEFAN II. The year - long recruitment of both sexes of ***S. serrata*** occurred because female crabs at sexual maturity could be observed throughout the year except November -

January. The spawning season of *S. serrata* fell on November to January. The peak in recruitment pattern of male *S. serrata* was projected on August and the main pulse of recruitment was in between June to October. On the other hand, there were two peak in recruitment pattern of female *S. serrata*. The first one was projected on May and the second in on February. Both two peak reflect the spawning behavior of the species. Recruitment pattern of female *S. serrata* can be explained that the first pulse of recruitment time came from the new cohort which spawned around May - June, and the second pulse came from the new cohort which spawned around October - January. The recruitment pattern in male *S. serrata* with the main pulse of recruitment time in between June - October, reflected that this cohort was from the population resulting from the major spawning season.

Reproduction

Sex - Ratio, Gonad - Somatic Index, and Spawning Season

The year - long investigation of sex - ratio between male : female mud crabs show that ratio between male : female is 1:0.82 and 45.20 % of female ratio. The percentage of female ratio declined between September to January. The declination coincided with decreased in a percentage of GSI values after reach the highest value in September.

Generally, Gonad - Somatic Index (GSI) used to determined a spawning season of aquatic animals. In Klong Ngao mangrove forest, there were two peaks of GSI value. The minor peak was in May and the major one was in September. From Gonad - Somatic Index investigation it can be noticed that gravid female or female at the 4^{th} stage disappeared from mangrove area in November, December and January, respectively. The mature stage of an ovary in female ***S. serrata***, however, were found almost throughout the year, except for November - December. Field surveys revealed that egg - berried female ***S. serrata*** were also frequently caught by trawl and push - net offshore along Klong Ngao mangrove forest during October - December. Thus the spawning migration occurred in gravid female ***S. serrata*** population in mangrove area during October - January. Hill(1974) reported that when female crabs reached at mature stage and ready to spawn their eggs, they migrated from estuarine area to find a suitable environment for their spawning activity in the sea. It can be assumed that the spawning activity of female ***S. serrata*** occurs throughout the year, but the major spawning season ranges from September to January and the minor pulse of spawning time is in May. This incident were coincided with biological studies for the mud crab ***S. serrata*** of mangrove ecosystem on Andaman sea by Poovachiranon (1990). He reported that the major spawning season of mud crab from the Andaman coastline ranged from October - February, and there are two pulse of GSI value. The first pulse was in May which yield the same result as this study, and the second one ranged from September - December. Poovachiranon (personal communication)

also reported the spawning route of the Phuket mangrove crabs can be as far as 80 km. offshore.

It was observed that the major spawning season of the female mud crabs occurred at the end of the rainy season in October. The female ratio corresponded with the rainfall data as in Figure 25. There were several factors contributing to the spawning migration of female crabs offshore. Hill(1974) reasoned that the mature female crabs migrated offshore to spawn due to the fact that the crab zoea needed to grow in less harsh or more stable environment as compared to the estuarine area, mangrove and coastal waters. The optimum temperature for larval development should not exceed 25 °C. The optimum salinity should not be lower than 17.5 ‰.. The temperature condition in the Klong Ngao water as reported by Rakkiew (in press) was quite stable throughout the year in the range of 28 - 30 °C. However the salinity showed seasonal variations. The low salinity was observed at the beginning of the rainy season in May with the minimum values in August and September. At the end of the rainy season in October, the salinity increased. Poovachiranon (in press) has postulated that the major spawning season for the Andaman mud crabs occurred after the rainy season or the Southwest Monsoon due to high nutrient concentrations, slight variations in salinity and temperature enhancing the chance for survivals in crab larvae and the less harsh wind condition during the Northeast Monsoon period facilitating the offshore spawning migration of female crabs.

Based on the environmental factors in the Klong Ngao mangrove forests (Rakkhiew, in press; Itthipatachai, in press), it can easily support Poovachiranon's postulation for the major spawning season in mud crabs occurring at the end of the rainy season. The nutrient concentrations were high during October. The fluctuations in chlorophyll concentrations also followed closely to the nutrient concentrations with the increasing trend in October and the maximum peak reached in November (Figure 26). The chlorophyll concentrations in the Klong Ngao mangrove forest were relatively high. This productive condition in the Klong Ngao mangrove especially in the rainy season also reflected by phytoplankton communities (UNDP/UNESCO Technical Report, in press). During the wet season conditions, phytoplankton in Klong Ngao were rich in terms of abundance and diversity with 124 species being recorded. Thus these phytoplankton provided and important food source for molluscan and crustacean larvae as well as for herbivorous copepods.

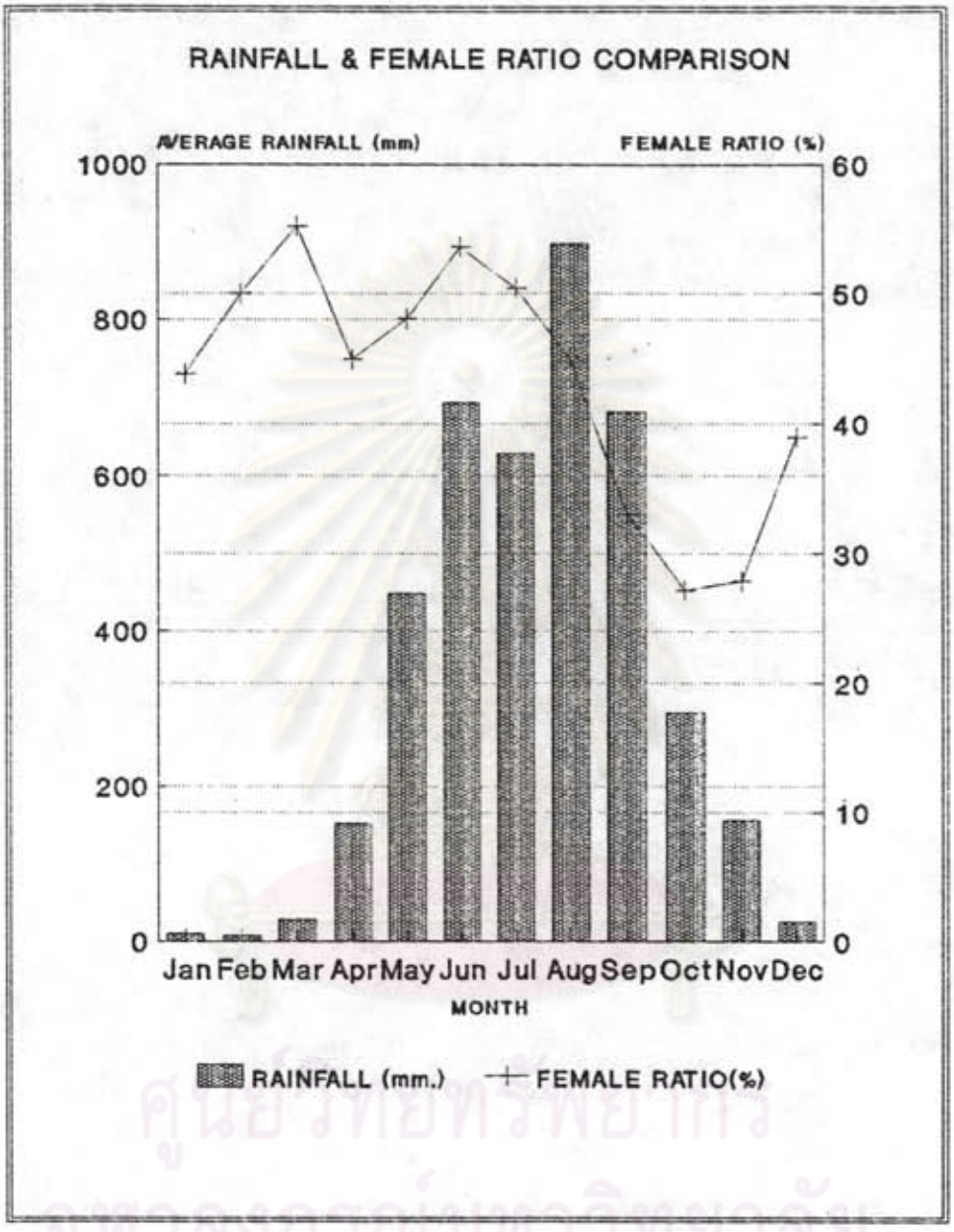

Figure 25: The comparison between the amount of rainfall & percentage of female ratio in Klong Ngao mangrove forest, Ranong.

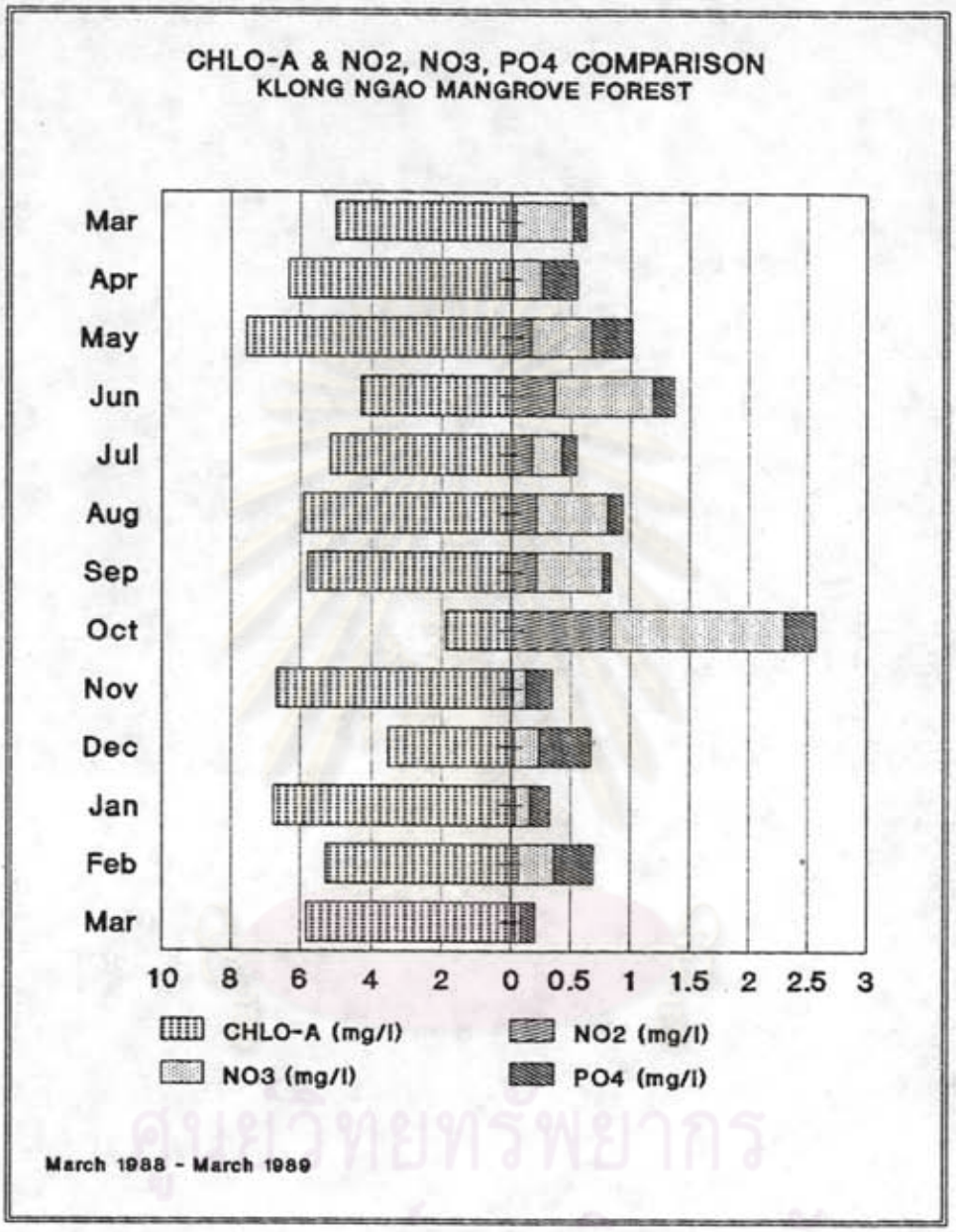

Figure 26: Chlorophyll-a & NO_2, NO_3, PO_4 comparison in Klong Ngao mangrove forest, Ranong, during March 1988 - March 1989.
(Adapted from: Itthipatachai, in press; Rakkeao, in press)