CHAPTER III

RESULTS

Mud crab fishery in Klong Ngao mangrove forest

Mud crabs are one of the most important fishery resources harvested commercially from the Ranong mangroves. This crab fishery supports seventy full time crab fishermen in four fishing villages in this area of approximately 600 hectares. Apart from these commercial fishermen, quite a few casual crab fishermen also harvest crabs from this mangrove. Mud crab, *S. serrata* were mostly caught in crab net traps. Crab trapping was usually carried out two to three days before and after new and full moon. The number of traps operated by each fisherman depends on the fishing ability of each fisherman. Each fisherman operated between 25 - 45 crab traps from small rowing boats. The actual fishing time varied from four to six hours depending on the tide and location of the fishing village. Baited traps were set at low tide in the middle of the creeks or on the sides of larger channels. Traps were continually checked at intervals of fifteen minutes until high tide.

About 9.1 tons of *S. serrata* were caught monthly in the Klong Ngao mangrove area or a total of 109 tons annually. Almost all the crabs

caught by commercial fishermen were handled by crab dealers. In addition to the crabs sold to the dealers, a substantial quantity were also consumed by the fishermen themselves. They usually kept animals smaller than 10 cm for their own consumption because of their much lower market value. The total catch was usually sorted into three grades according to sizes, namely: crabs 10 cm. and smaller in carapace width; crabs larger than 10 cm. and females carrying eggs. Approximately 46 percent of the total catch of 109 tons annually were crabs smaller than 10 cms. Crabs larger than 10 cms and berried females comprised of 42 and 12 % respectively in the total catch. The fisherman received 10 Bahts per kg for crabs smaller than 10 cms and 30 Bahts per kg for those above 10 cms. The berried females got the highest price of 50 Bahts per kg. The crab dealers sold their crabs to wholesalers in Ranong. These crabs were either sent to Bangkok or abroad such as Malaysia and Singapore.

Length - weight Relationship

The total number of fisherman's catch data for the measurement of weight (gm.) and carapace width (cm.) amounted to 8,130 individuals. Of these, 4,455 male and 3,675 female mud crabs were measured. The percentage of catch according to different size groups in male and female mud crabs were shown in Table 2 and 3. The majority of males and females caught was in the size group of 8 - 10 of 60.03 and 51.51 % respectively.

Carapace width and weight in male *S. serrata* ranged from 4.74 - 13.25 cm., and 45 - 720 gm., respectively. Carapace width and weight in female *S. serrata* ranged from 5.26 - 16.00 cm., and 45 - 720 gm., respectively.

Table 2: Percentage of catch in different size groups in male *S. serrata* from Klong Ngao mangrove forest, Ranong.

CLASS INTERVAL (cm.)	4-6	6-8	8-10	10-12	>12	TOTAL
APRIL	1	138	239	68	0	536
MAY	1	190	414	80	0	685
JUN	0	169	402	81	4	656
JULY	0	52	192	57	4	305
AUGUST	1	72	289	64	0	426
SEPTEMBER	0	53	181	84	4	322
OCTOBER	0	21	149	81	9	260
NOVEMBER	2	56	132	77	7	274
DECEMBER	0	78	291	104	12	485
JANUARY	0	43	105	46	2	196
FEBRUARY	2	37	93	23	0	155
MARCH	0	53	113	13	2	181
TOTAL	7	962	2690	778	44	4481
PER CENT	0.16	21.47	60.03	17.36	0.98	100

Table 3: Percentage of catch in different size groups in female *S.serrata* from Klong Ngao mangrove forest, Ranong

CLASS INTERVAL (cm.)	6-8	8-10	10-12	>12	TOTAL
APRIL	107	245	85	0	437
MAY	198	333	98	4	633
JUNE	215	395	142	9	761
JULY	32	104	169	5	310
AUGUST	57	169	119	3	348
SEPTEMBER	267	69	64	0	159
OCTOBER	7	63	25	1	96
NOVEMBER	22	81	45	0	148
DECEMBER	43	174	73	5	295
JANUARY	40	75	34	3	155
FEBRUARY	20	70	61	4	155
MARCH	35	137	51	1	224
TOTAL	802	1915	966	35	3718
PERCENT	21.57	51.51	25.98	0.94	100

The relationship between carapace width and weight of *S. serrata* from Klong Ngao mangrove forest, Ranong province, yielded the result as follows:

1. Male *S. serrata* Forskäl

The relationship between carapace width and weight of male *S. serrata* can be expressed as ;

$$W = 0.097131(CW)^{3.369941}$$

The linearized from can be expressed as;

$$\log(W) = 3.369941 \log(CW) - 1.012642$$

with $r^2 = 0.90521$ n = 4,455 (Figure 3;a,b)

2. Female *S. serrata* Forskäl

The relationship between carapace width and weight of female *S. serrata* can also be expressed as;

$$W = 0.559879(CW)^{2.559879}$$

and the linearized form;

$$\log(W) = 2.559879\log(CW) - 0.318198$$

with $r^2 = 0.9184$ n = 3,675 (Figure 4;a,b)

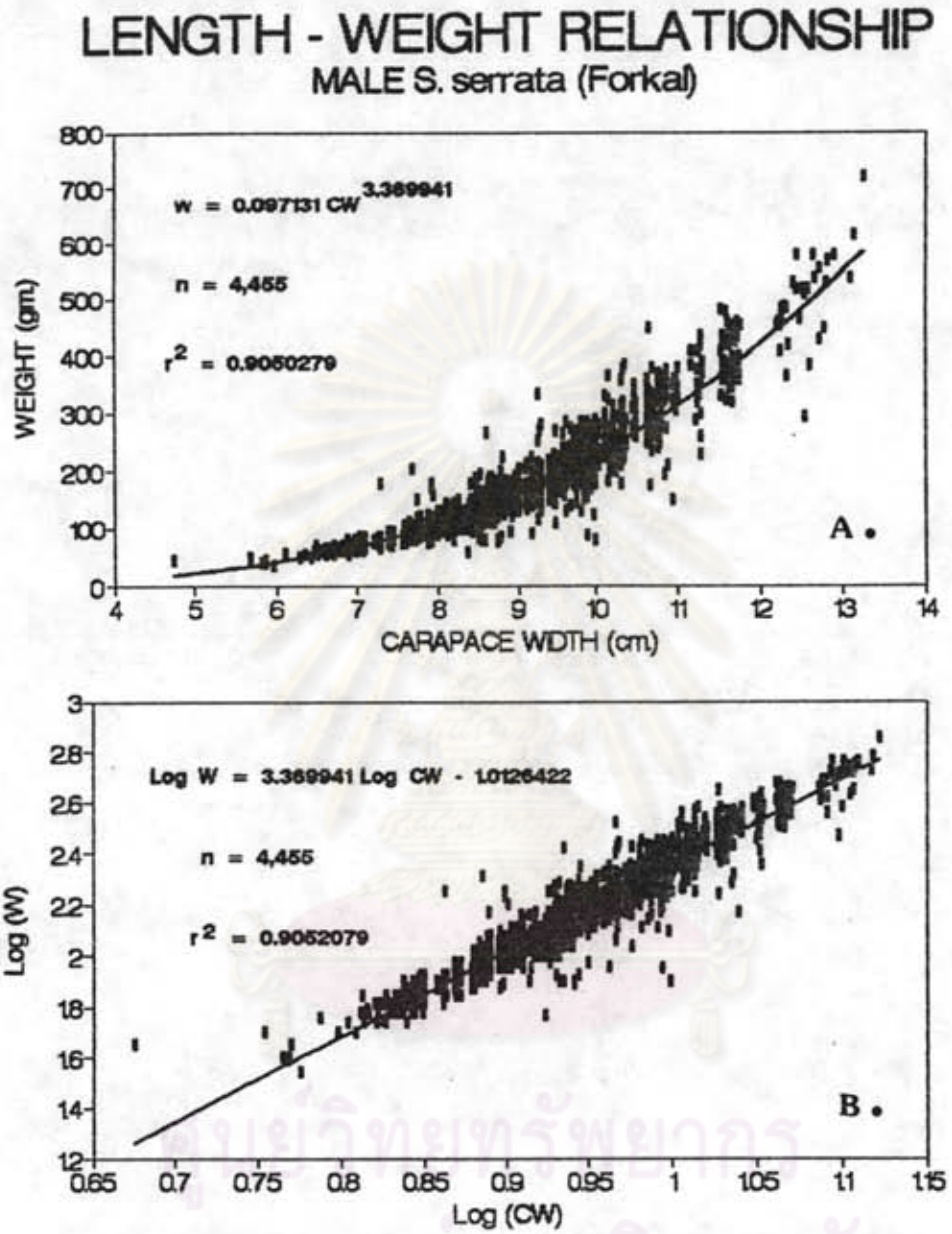


Figure 3 : Carapace width (CW) - weight (W) relationship of male *Scylla serrata* from Klong Ngao mangrove forest.

A. Allometric relationship

B. Linearized relationship

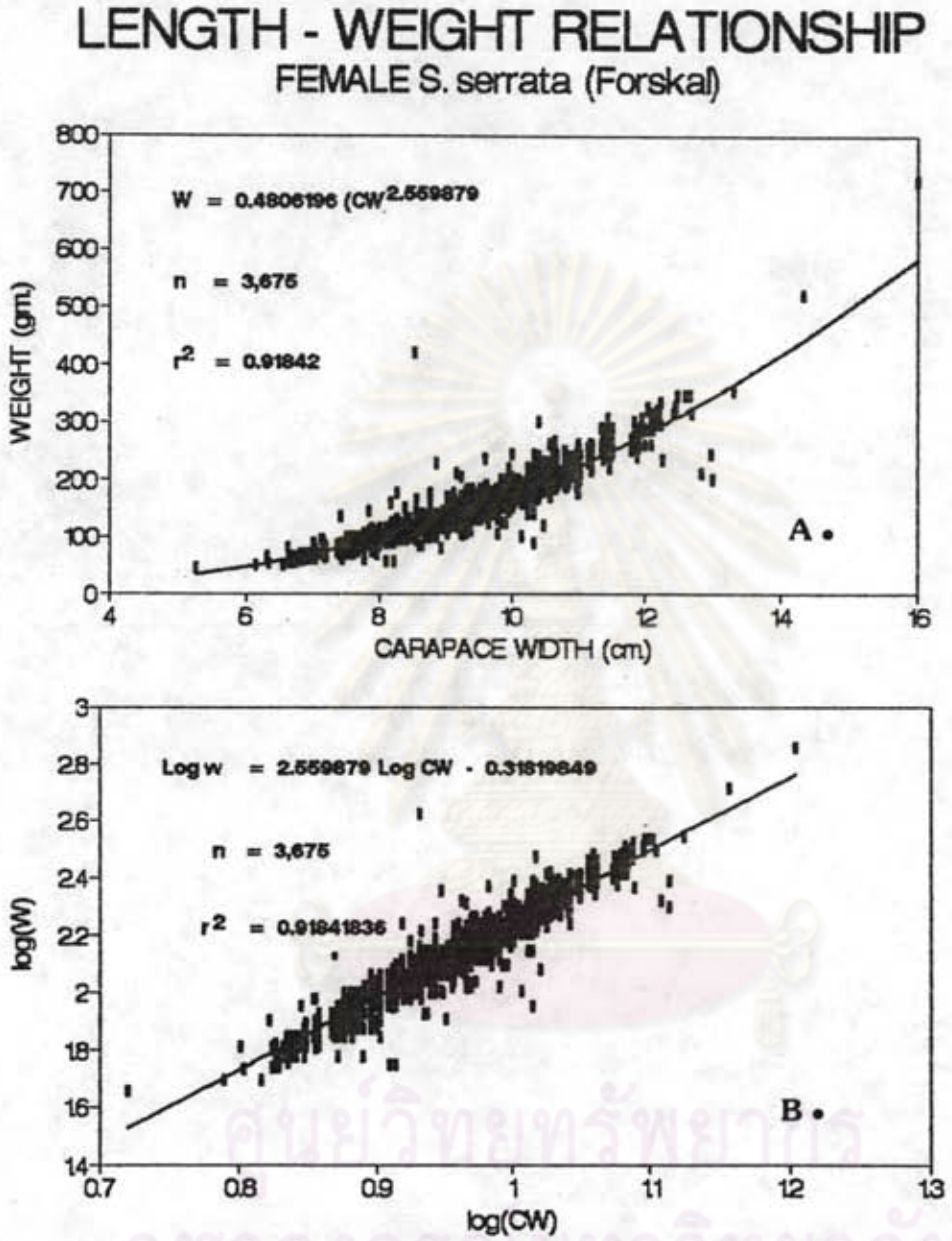


Figure 4 : Carapace width (CW) - weight (W) relationship of female *Scylla serrata* from Klong Ngao mangrove forest.

A. Allometric relationship.

B. Linearized relationship.

The result of the relationship between carapace width and weight of two sexes performed by regression analysis were summarized in Table 4, with corresponding to t^* value.

Table 4 : The relationship between carapace width and weight in male and female, *S. serrata* in Klong Ngao mangrove forest.

CW - W RELATIONSHIP (cm.)	$W = a(CW)^b$						
	a	b	S_b	S_W	r^2	n	t^*
MALE	0.0971	3.3699	0.0164	0.0610	0.9050	4455	22.6127
FEMALE	0.4806	2.5599	0.0126	0.0446	0.9184	3675	34.9613

Note: S_b = standard error of the regression coefficient; b.

S_W = *standard error of W estimates.*

The statistical t - test revealed that the coefficient *b*, for length - weight relationship of male and female *S. serrata*, were significantly different from 3. Since the calculation of t^* values gave all the result larger than the tabulated value of the student - t distribution, which was equal to 2.236 at the degree of freedom; df > 120 and 1 % of error level (p = 0.01). The range of possible value of *b* lied between 2.5 and 3.5 (Carlander, 1966; as cited by Pauly, 1982), usually close to 3. When *b* = 3, weight growth is called isometric; this means that it proceeds in the same dimension as the cube of length. When *b* is not equal to 3, weight

growth is called allometric; this means that it proceeds in a different dimension or differing from $(CW)^3$ and can be either positive (b>3) or negative (b<3). The result from the calculation of t* valued show that both male and female *S. serrata* growth were allometric.

In comparing the carapace width - weight relationship of both sexes ,the weight in males increased more rapidly than females as the carapace width increased (Figure 5).

Abdominal Width - Carapace Width Relationship

1. Male *S. serrata* Forskal

The relationship between abdominal width (AW) and carapace width (CW) of male *S. serrata* was expressed as;

$$CW = 1.3127 + 3.4183\ AW$$

with $r^2 = 0.7800$,

n = 4,455

(Figure 6A.)

2. Female *S. serrata* Forskal

The relationship between carapace width (CW) and abdominal width (AW) of female *S. serrata* was expressed as;

$$CW = 4.9306 + 1.1865\ AW$$

with $r^2 = 0.8779$,

n = 3,675 .

(Figure 6B.)

Growth Parameter

The length - frequency data of male mud crab, *S. serrata*, from Klong Ngao mangrove forest with the class interval of 0.5 cm., were shown in Table 5. Length - frequency data of female *S. serrata* with the class interval of 0.5 cm, were shown in Table 6.

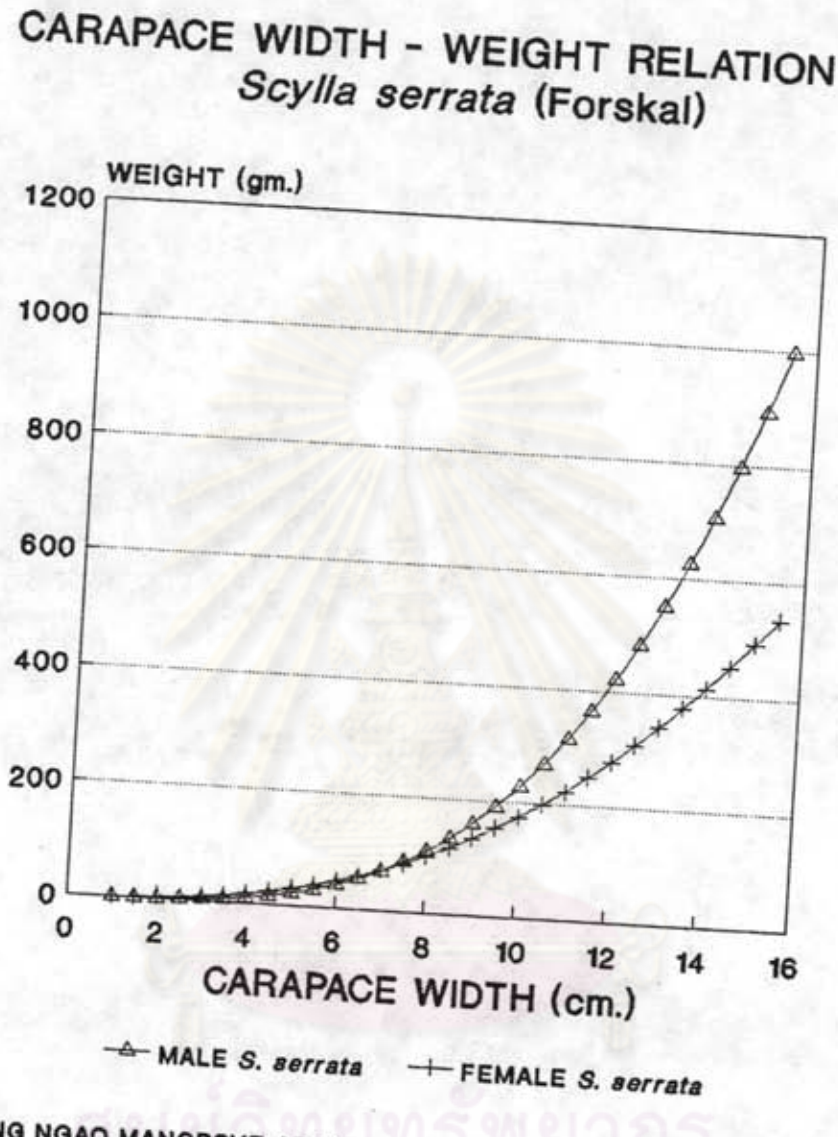


Figure 5: The comparison of carapace width - weight between male and female *S. serrata* from Klong Ngao mangrove forest, Ranong.

AW - CW RELATIONSHIP

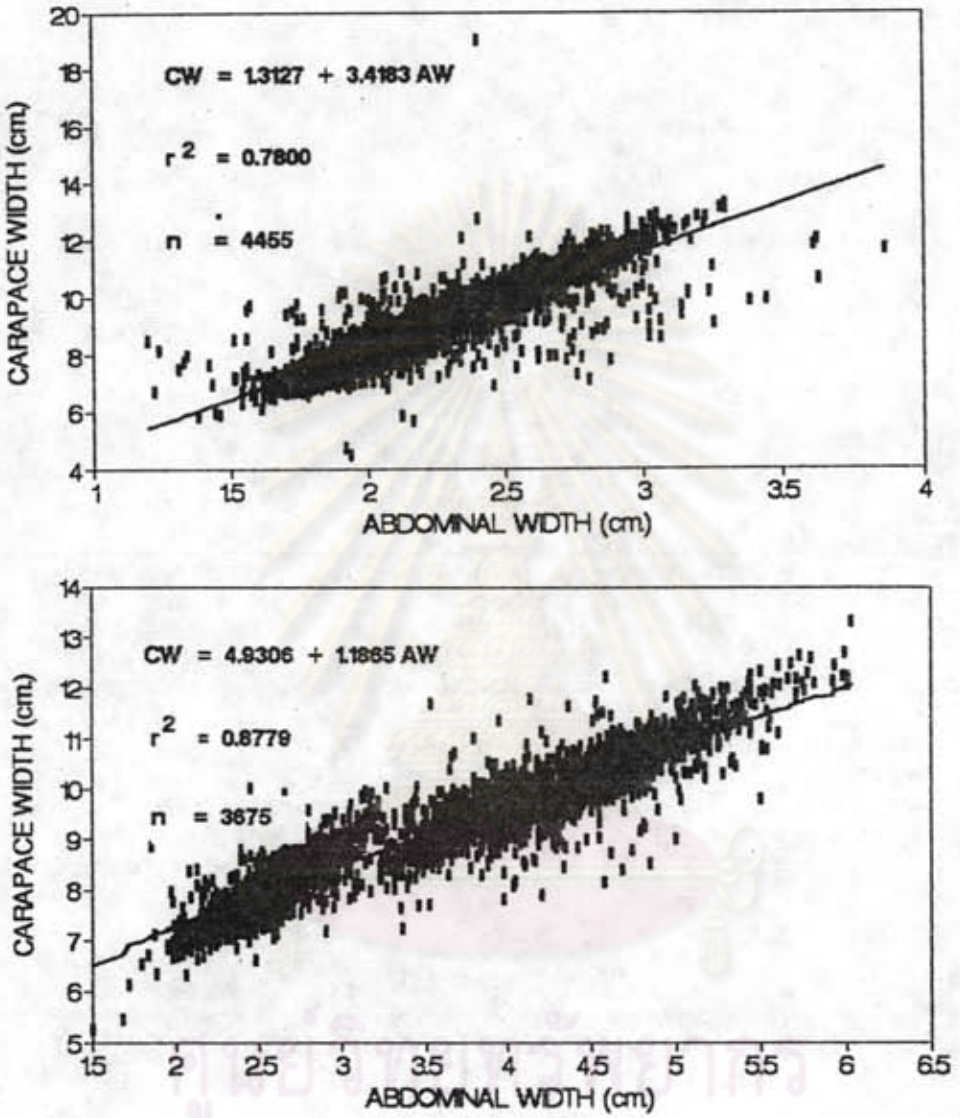


Figure 6: Carapace width - abdominal width relationship of mud crab ***Scylla serrata*** from Klong Ngao mangrove forest, Ranong.

A. Male ***Scylla serrata***

B. Female ***Scylla serrata***

The comparison between the distribution of carapace width in male and female *S. serrata* throughout the year showed that length - frequency histogram in male *S. serrata* was unimodal distribution; and female *S. serrata* was bimodal distribution (Figure 7). Size of female crabs which decreased in a number between two mode of the carapace width ranged from 8 - 10 cm.

Determination of growth parameter, asymtotic length (L_∞),and growth coefficient (K) of mud crab populations using length - frequency data with adjusted class interval from 0.5 cm.to 1.0 cm., yield the estimation of L_∞ = 17.50 cm., K = 0.9 with Rn = 0.273, and t_0 = 0.010 in male crab populations; and L_∞ = 17.7 cm., K = 0.6 with Rn = 0.314, and t_0 = -0.50 in female crab populations.

Longevity estimation of mud crab, ***S. serrata***, computed from 95 % sizes of L_∞ of crab yield 3.3 year in male ***S. serrata*** and 5 year in female ***S. serrata***

The growth curve of *S. serrata* which estimated from ELEFAN I are built up as shown in Figure 8 and 9.

Table 5 : Frequency data of carapace width in male *Scylla serrata* at Klong Ngao mangrove forest; April 1988 - March 1989, with 0.5 cm. class interval.

MIDLENGTHS (cm.)	MONTH												
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
4.5					1	1							2
5.0	1					2							3
5.5						6							6
6.0		1				12		2			2		17
6.5		2	1			15		2				1	21
7.0	9	15	13	5	6	19	4	7	9	7	6	5	105
7.5	44	57	68	20	19	33	8	20	23	16	10	21	339
8.0	85	116	87	27	47	33	9	27	46	20	21	26	544
8.5	71	133	122	36	77	44	18	25	74	30	26	24	680
9.0	113	110	110	42	67	30	32	22	92	33	23	37	711
9.5	105	86	99	48	75	43	42	55	70	24	22	33	702
10.0	40	85	71	66	70	29	57	30	55	18	22	19	562
10.5	39	57	44	34	34	23	34	31	36	10	11	8	361
11.0	22	16	22	14	17	14	18	25	28	14	7	1	198
11.5	5	3	13	7	9	9	20	9	28	15	2	1	121
12.0	2	4	2	2	4	7	9	12	12	7	3	3	67
12.5			3	3		2	6	4	4			2	24
13.0			1				3	2	6	1			13
13.5				1					1	1			3
14.0								1	1				2
TOTAL	536	685	656	305	426	322	260	274	485	196	155	181	4481

Table 6 : Frequency data of carapace width in female *Scylla serrata* at Klong Ngao mangrove forest, April 1988 - March 1989; with 0.5 cm. class interval.

MIDLENGTHS (cm.)	MONTH											
	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
6.0							1			1	1		3
6.5	1		1			1			1				4
7.0	7	10	9		5	1		3	2	2		2	41
7.5	35	65	63	9	18	10	1	7	15	8	5	13	249
8.0	64	123	142	23	34	14	5	12	25	29	14	20	505
8.5	72	110	110	16	49	22	9	20	52	30	25	26	541
9.0	63	62	76	11	38	12	16	17	53	21	19	21	409
9.5	57	81	99	17	24	19	19	28	40	10	17	42	453
10.0	53	80	110	60	58	16	19	16	29	14	9	48	512
10.5	40	53	64	81	64	30	14	21	23	13	22	29	454
11.0	27	33	36	60	33	23	7	12	22	12	23	8	296
11.5	13	7	27	23	17	7	4	9	20	8	12	10	157
12.0	5	4	15	5	5	4		3	8	1	4	4	58
12.5			9	3	2		1		2	1	2	1	21
13.0				1	1				3	1	1		7
13.5				1									1
14.0										1			1
14.5											1		1
TOTAL	437	628	761	310	348	159	96	148	295	152	155	224	3713

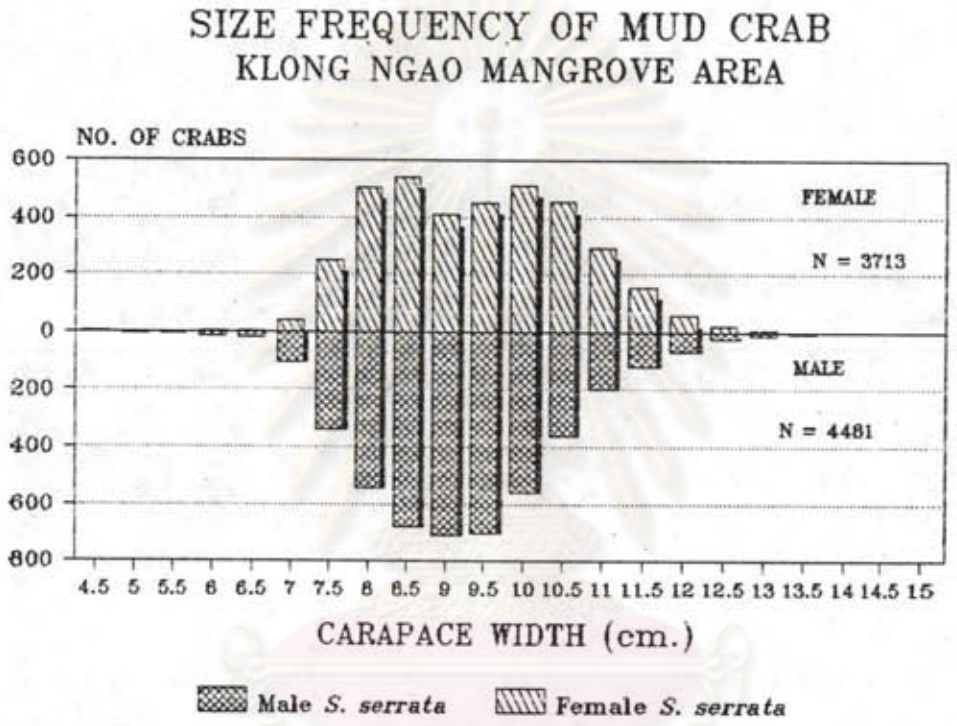


Figure 7: The distribution of carapace width (CW) in ***S. serrata*** throughout the year from Klong Ngao mangrove forest, Ranong.

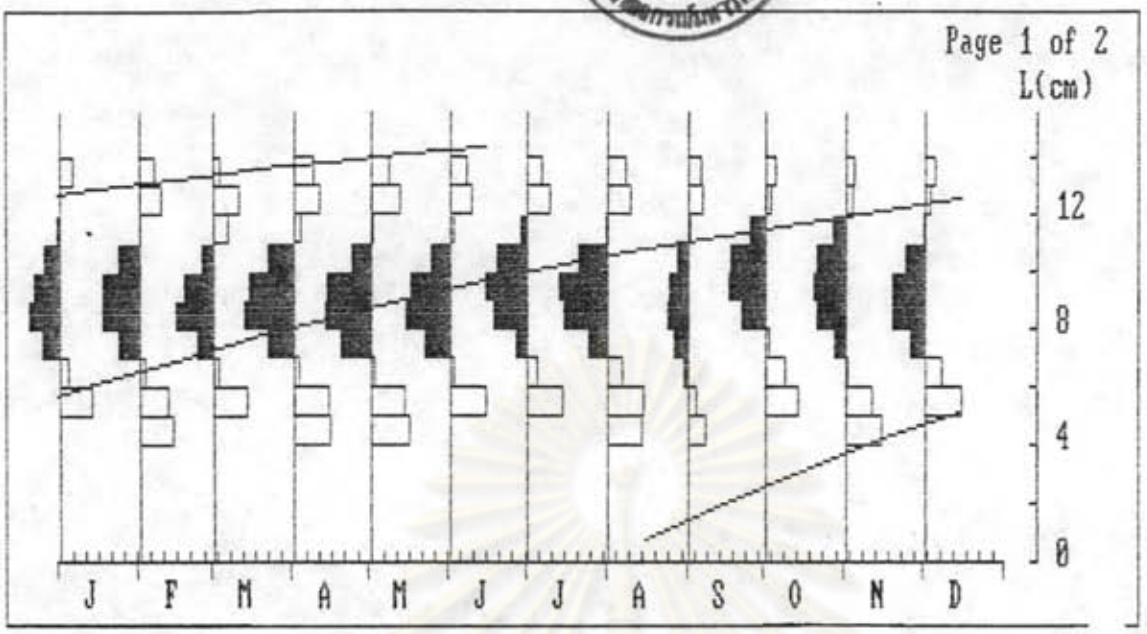


Figure 8: Growth curve of male *S. serrata* population from Klong Ngao mangrove forest, output form ELEFAN I.

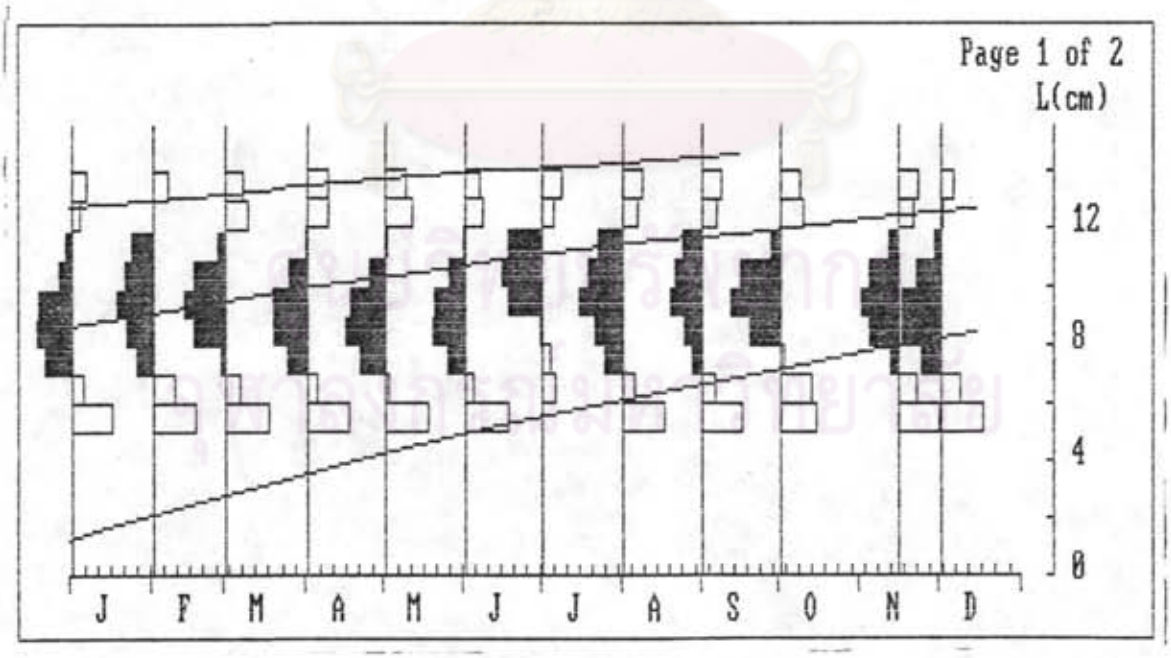


Figure 9: Growth curve of female S. serrata population from Klong Ngao mangrove forest, output from ELEFAN I.

Recruitment

1.Male *S. serrata*

The recruitment pattern of male ***S. serrata*** population around Klong Ngao mangrove forest revealed that there are recruitment occurred throughout the year with the percentage of 96.45 % in one peak. The main pulse of recruitment pattern covered about six months from May to October. The highest peak of recruitment recorded in August with 17.96 % (Figure 10).The percentage of annual recruitment computed by ELEFAN II was presented in Table 7 and Figure 11.

Table 7: Percentage of annual recruitment of male ***Scylla serrata*** population around Klong Ngao mangrove forest.

Months	% Recruitment
Mar	4.40
Apr	3.54
May	7.70
Jun	11.03
Jul	16.20
Aug	17.92
Sep	15.92
Oct	12.40
Nov	5.99
Dec	3.00
Jan	1.85
Feb	0.00

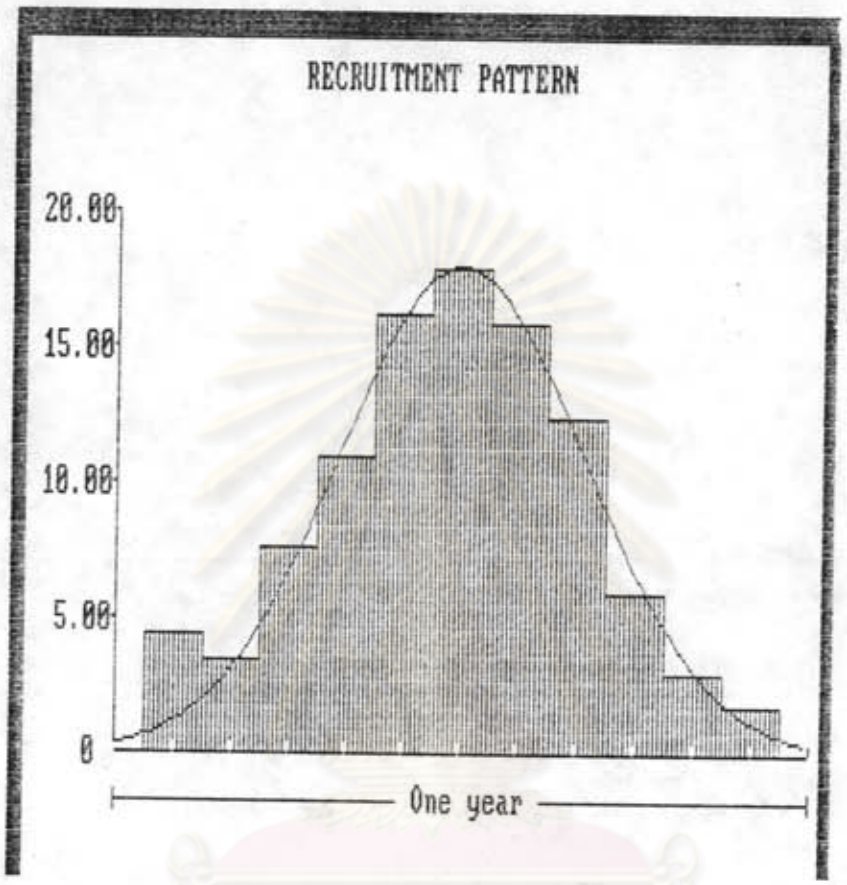


Figure 10: Recruitment pattern of male ***Scylla serrata*** population from Klong Ngao mangrove forest, output from ELEFAN II program.

2. Female *S. serrata*

The recruitment pattern of female *S. serrata* from Klong Ngao mangrove forest as obtained from ELEFAN II in Table 7 and Figure 11 showed that recruitment occurred throughout the year, but with two distinct peaks. The maximal component of distributions extended 5 month from February to June. The peak of recruitment was in February. The recruitment pulse covered about 4 months with the percentage of 25.72%. The latter other peak of recruitment was in May with pulse covering the rest of the year with the percentage of 67.98 %.

Table 8: Percentage of annual recruitment of female *Scylla serrata* population around Klong Ngao mangrove forest.

Absolute Time (Month)	% Recruitment
Nov	0.08
Dec	2.98
Jan	9.82
Feb	10.03
Mar	16.88
Apr	13.70
May	19.05
Jun	12.21
Jul	8.79
Aug	5.37
Sep	1.10
Oct	0.00

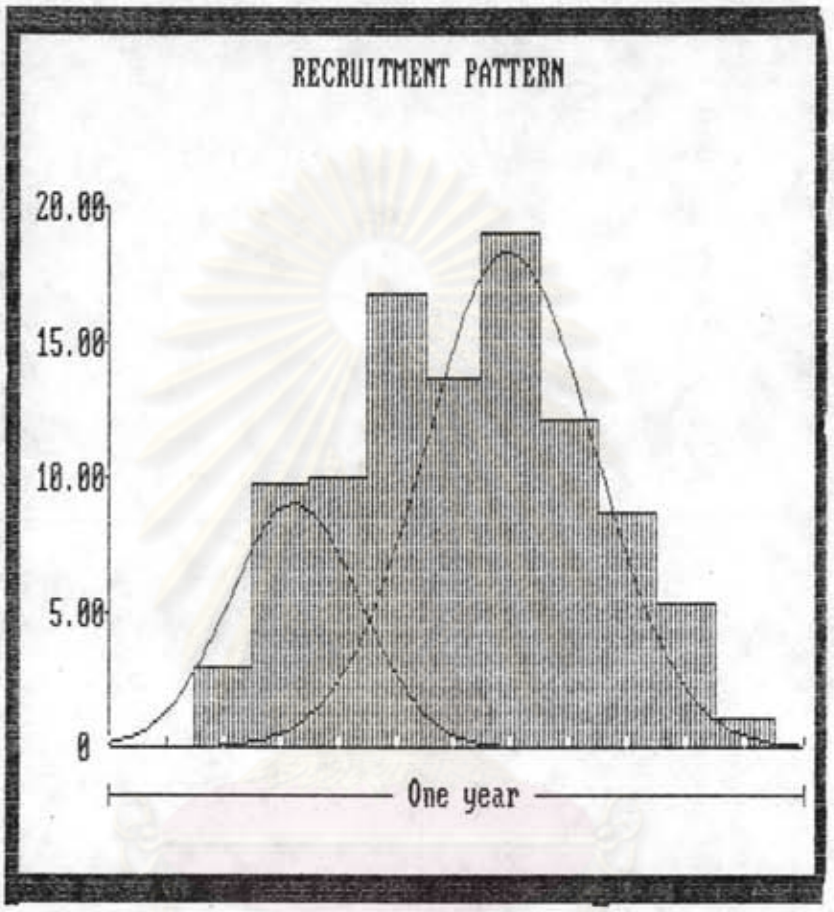


Figure 11: Recruitment pattern of female ***Scylla serrata*** population at Klong Ngao mangrove forest, generated from ELEFAN II program.

Mortality

The catch curve of both male and female *S. serrata* and female *S.serrata* were shown in Figures 12 and 13. Estimation of total mortality (Z) = 6.374 in male and 5.120 in female. Natural mortality (M) in male and female were estimated 1.938 and 1.481 respectively. While the fishing mortality in male and female were 4.436 and 3.639 respectively.

The ELEFAN II is also provided the probability of capture, the chance of animal to be caught of each class sizes. The size of male *S. serrata* with high chances of capture of 50 % and 75 % were 8.653 and 9.272 cm., respectively. In females, the sizes most likely caught at 50 % and 75 % probability were 9.574 and 10.216 cms respectively. These results corresponded well with the catch data that the majority of males and females caught was in the size group of males and females caught was in the size group of 8 - 10 cms. Apparently the females were usually larger than males. The result of probability of capture was computed as shown in Table 9 and 10 and the resultant curves are shown in Figure 14 and 15.

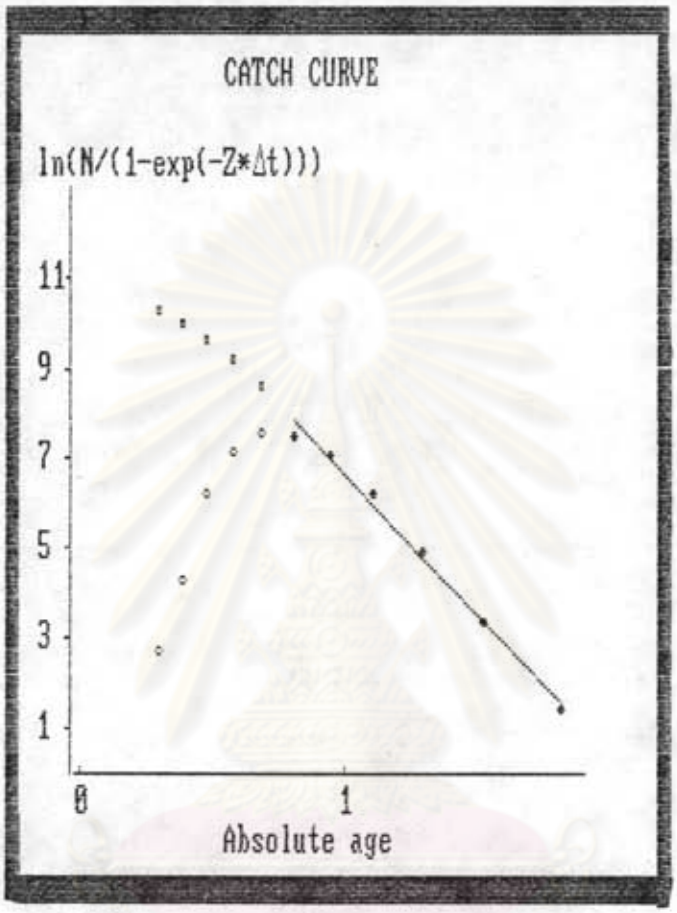


Figure12: Catch curve of male mud crab, ***S. serrata***, from Klong Ngao mangrove forest, Ranong; generated from ELEFAN II.

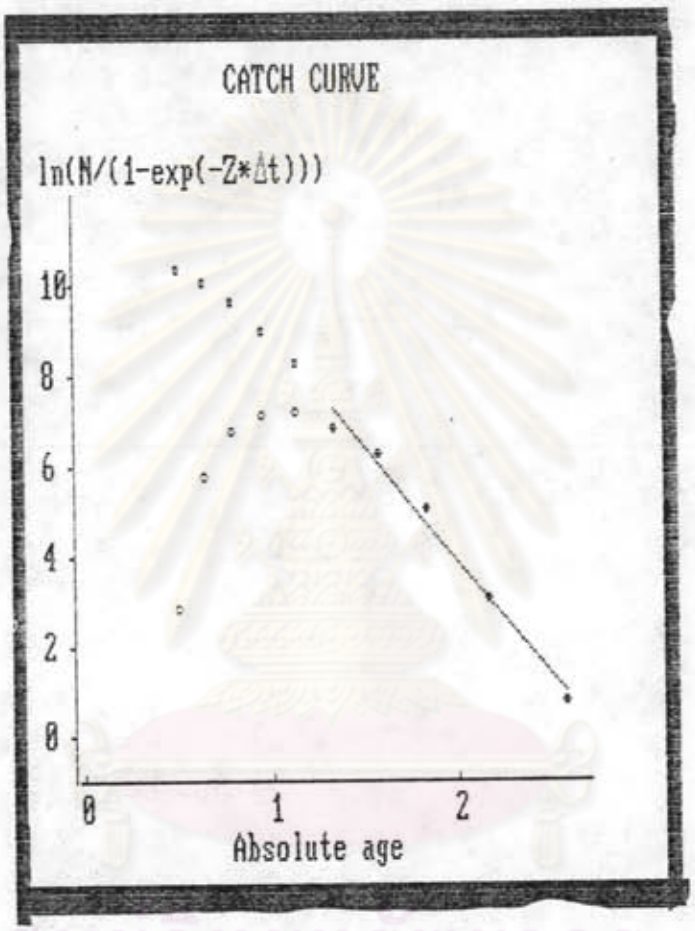


Figure13: Catch curve of female mud crab, ***S. serrata***, from Klong Ngao mangrove forest, Ranong; generated from ELEFAN II.

Table 9 : Result on probability of capture of male mud crab, *S. serrata*, around Klong Ngao mangrove forest, computed by ELEFAN II program.

Mid-lengths (cm.)	Prb. Selection	Smooth Prob.
4.5	0.001	0.00100
5.5	0.003	0.00400
6.5	0.033	0.02100
7.5	0.132	0.11400
8.5	0.356	0.43300
9.5	1.000	0.81800
10.5	1.000	0.96400
11.5	1.000	0.99400
12.5	1.000	0.99892
13.5	1.000	0.99982
14.5	1.000	0.99997

L - 25 = 8.034 L_∞ = 17.500

L - 50 = 8.653 K = 0.90

L - 75 = 9.272 t_0 = 0.01

Slope = 1.776

Table 10: Result on probability of capture of female *Scylla serrata* from Klong Ngao mangrove forest, output of result computed by ELEFAN II.

Mid-lengths (cm.)	Prob. Selection	Smooth prob.
5.5	0.001	0.00100
6.5	0.014	0.00700
7.5	0.059	0.03400
8.5	0.157	0.15200
9.5	0.357	0.48100
10.5	1.000	0.82700
11.5	1.000	0.96100
12.5	1.000	0.99200
13.5	1.000	0.99848
14.5	1.000	0.99971

L - 25 = 8.878 L_∞ = 17.7

L - 50 = 9.574 K = 0.60

L - 75 = 10.216 t_0 = -0.50

Slope = 1.641

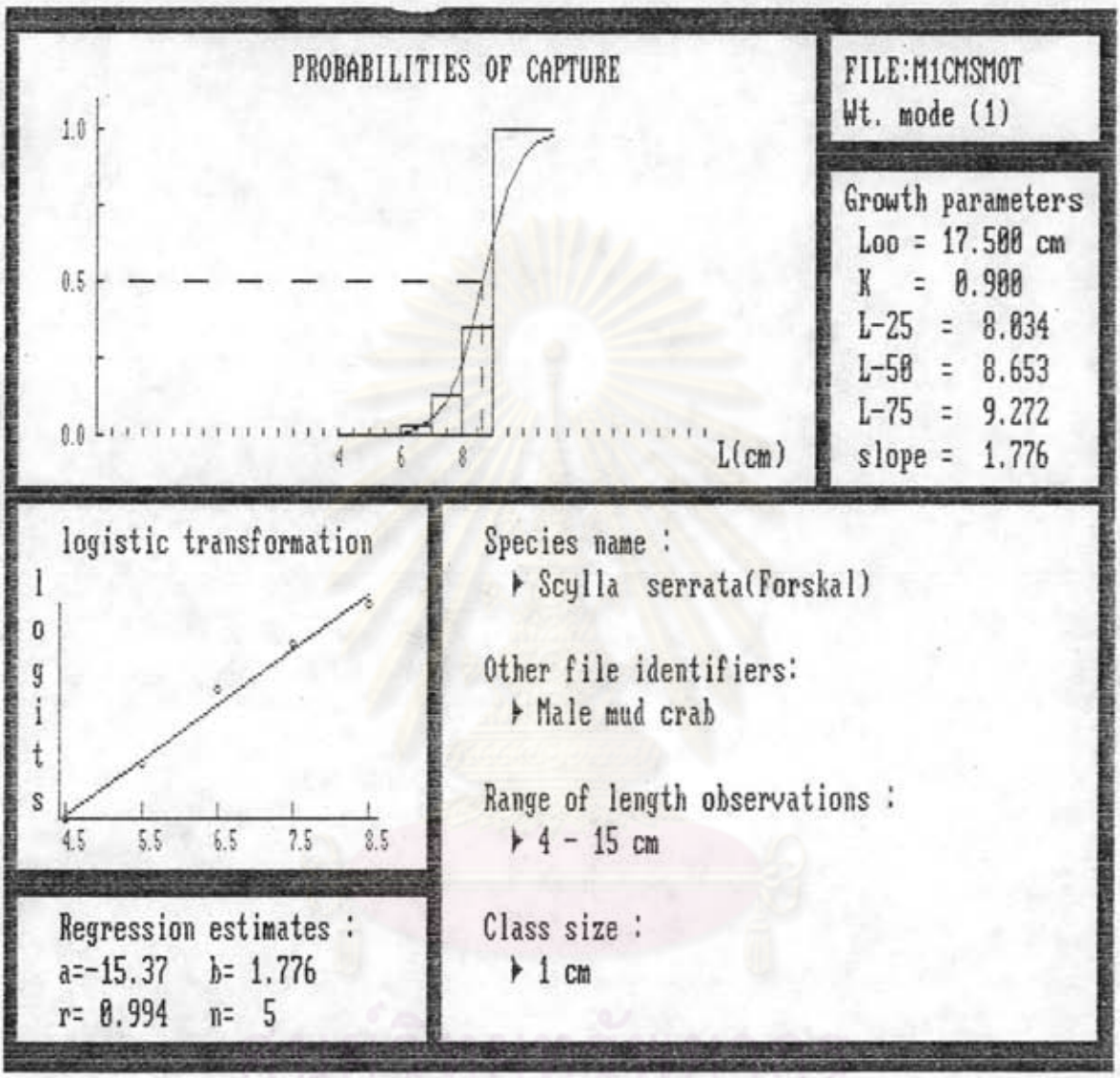


Figure14: Resultant curve on probability of capture of male ***Scylla serrata*** population around Klong Ngao mangrove forest, output from ELEFAN II.

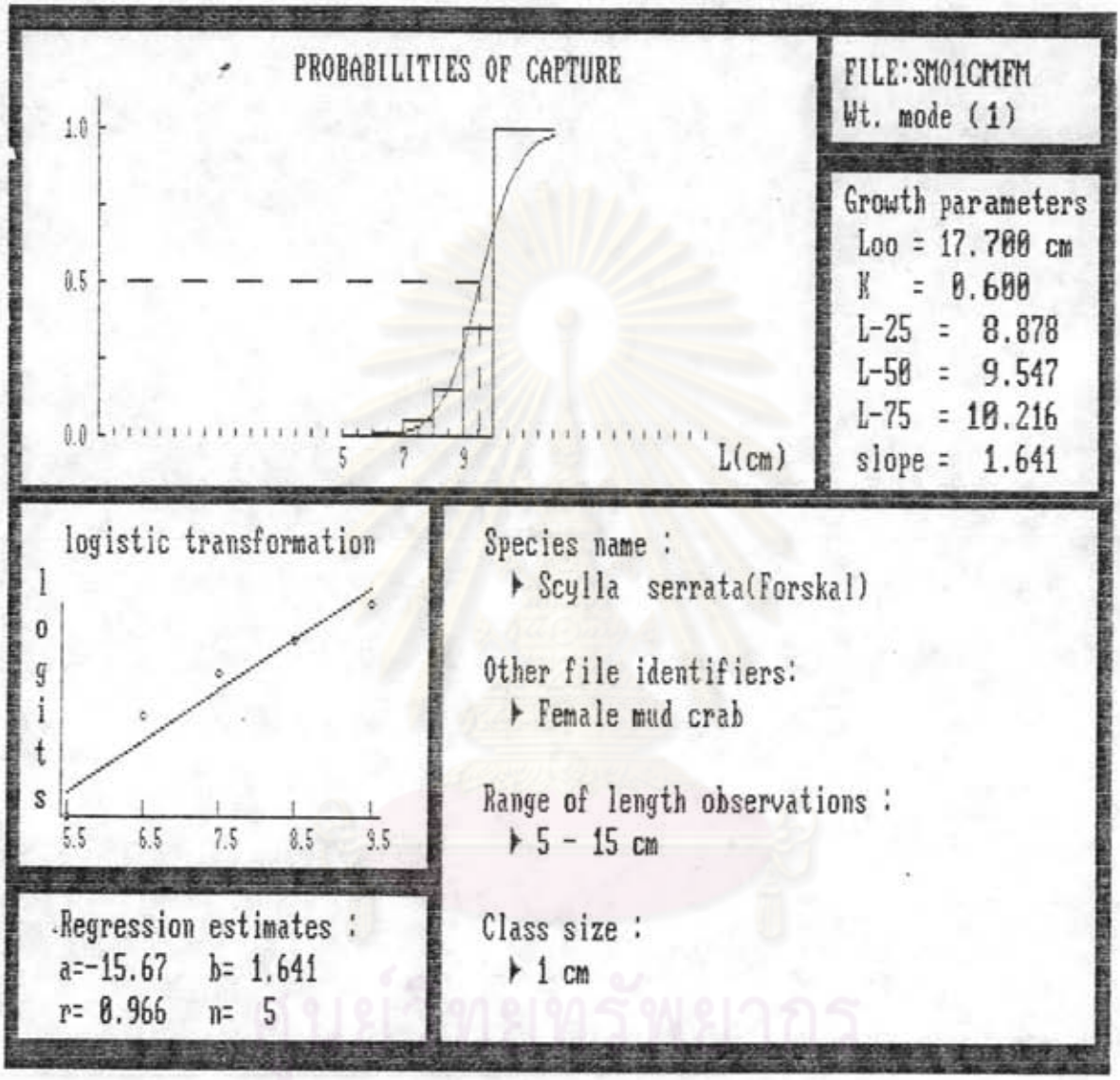


Figure 15: Resultant on probability of capture of female *Scylla serrata* around Klong Ngao mangrove forest, computed from ELEFAN II.

Reproduction

1. Sex - Ratio

Sex - ratio between male and female mud crabs throughout the year is 1:0.82 with 45.20 % of female ratio. There were two interval of declination in female ratios. The first interval appeared in April and the second interval showed declining trend from September to January. From January, on the female ratio increased equaled to the male ratio in February (Table 11, Figure 16). The spawning migration in female mud crabs was evidenced from the sex - ratio data.

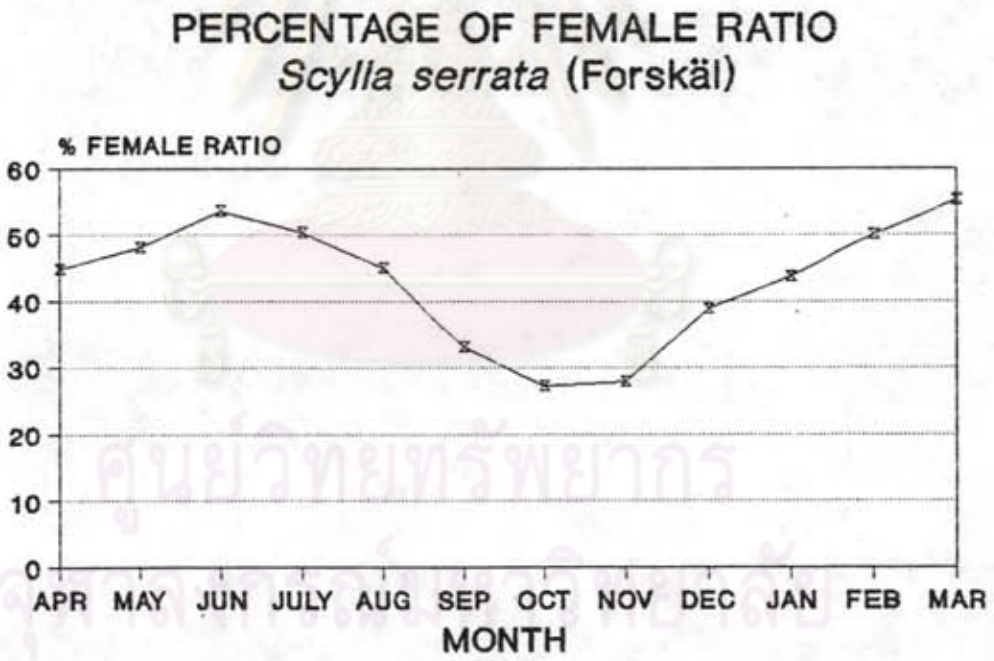


Figure 16: A percentage of female ratio of ***Scylla serrata***, Klong Ngao mangrove forest, Ranong.

Table 11: Chi - square test of monthly sex - ratio between male : female, *Scylla serrata*, in the Klong Ngao mangrove forest.

MONTH	f_o (M♂)	f_o (F♀)	M+F	f_e	χ^2	M:F	% RATIO OF FEMALE
APR	534	436	970	485	4.95*	1:0.82	44.95
MAY	684	633	1317	659	0.99	1:0.93	48.06
JUN	657	759	1416	708	3.67	1:1.16	53.60
JUL	305	310	615	308	0.02	1:1.02	50.41
AUG	426	350	776	388	3.72	1:0.82	45.10
SEP	322	159	481	241	27.62*	1:0.49	33.06
OCT	260	97	357	179	37.21*	1:0.37	27.17
NOV	274	106	380	190	37.14*	1:0.39	27.89
DEC	462	295	757	379	18.42*	1:0.64	38.97
JAN	195	152	347	174	2.66	1:0.78	43.80
FEB	155	155	310	155	0.00	1:1.00	50.00
MAR	181	223	404	202	2.18	1:1.23	55.20
Total	4455	3675	8130	4065	37.42	1:0.82	45.20

2. Gonad - Somatic Index (GSI.)

The data on Gonad - Somatic Index revealed that females *S. serrata* in the catches throughout the year had the monthly mean values within the range of 0.61 - 12.97 % (Table 12 - 13, Figure 17). The female crabs with the gonad development in the 2nd stage were approximately 41.15 %, while those in the 3rd and 4th stages were 13.80 and 26.30 % respectively. The immature female crabs with gonads being in the 1st stage were approximately 18.75 %.

The high values of GSI were recorded in May and September. The maximum value of GSI was recorded in September GSI showed the declining trend after the month of September with the lowest being in December and January. It was apparent that the mature female *S. serrata* disappeared from the mangrove forests during October to January reflected by the low GSI values. From the field observations, revealed that from October to January the ratio of females caught in the total catch within the mangrove were low as compared to other months. The declination of GSI values were coincided with a decreased in sex - ratio of female *S. serrata* population. GSI value and the female ratios decreased in September (Figure 18). Whereas the ratio of berried females caught by offshore trawling increased during November and October. This clearly indicated that the mature females moved out from the mangrove forest to spawn offshore. The major spawning season was between the months of September to January.

Table 12: Number of female *S. serrata* at each gonadal development stage in the Klong Ngao mangrove forest.

MONTH	1st Stage	2nd Stage	3rd Stage	4th Stage	Total
APR	7	13	7	8	35
MAY	4	15	3	10	32
JUN	11	20	7	2	40
JUL	9	13	12	14	48
AUG	4	11	2	13	30
SEP	1	1	4	39	45
OCT	6	17	5	0	28
NOV	7	9	2	0	2
DEC	9	10	0	0	19
JAN	7	15	2	0	24
FEB	6	20	4	3	33
MAR	1	14	5	12	32
TOTAL	72	158	53	101	384
PERCENTAGE OF EACH STAGE	18.75	41.15	13.80	26.30	100

Table 13: Gonad - somatic Index in female *Scylla serrata* from Klong Ngao mangrove forest.

MONTH	1st Stage	2nd Stage	3rd Stage	4th Stage	MEAN GSI. (2^{nd}-4^{th} Stages)
APR	0.17	0.78	1.45	6.15	2.48
MAY	0.20	1.53	3.17	8.37	4.36
JUN	0.12	0.65	1.23	2.63	0.88
JUL	0.13	0.57	1.42	6.38	2.93
AUG	0.12	0.56	2.70	6.97	3.93
SEP	0.67	0.75	1.65	14.44	12.97
OCT	0.18	0.84	1.18	2.93	1.00
NOV	0.14	0.66	0.96	0.00	0.72
DEC	0.10	0.61	0.00	0.00	0.61
JAN	0.08	0.54	1.12	0.00	0.61
FEB	0.14	0.71	1.83	2.79	1.11
MAR	0.18	1.03	1.60	4.14	2.33
MAXIMUM	0.67	1.53	3.17	14.44	12.97
MINIMUM	0.08	0.54	0.00	0.00	0.61

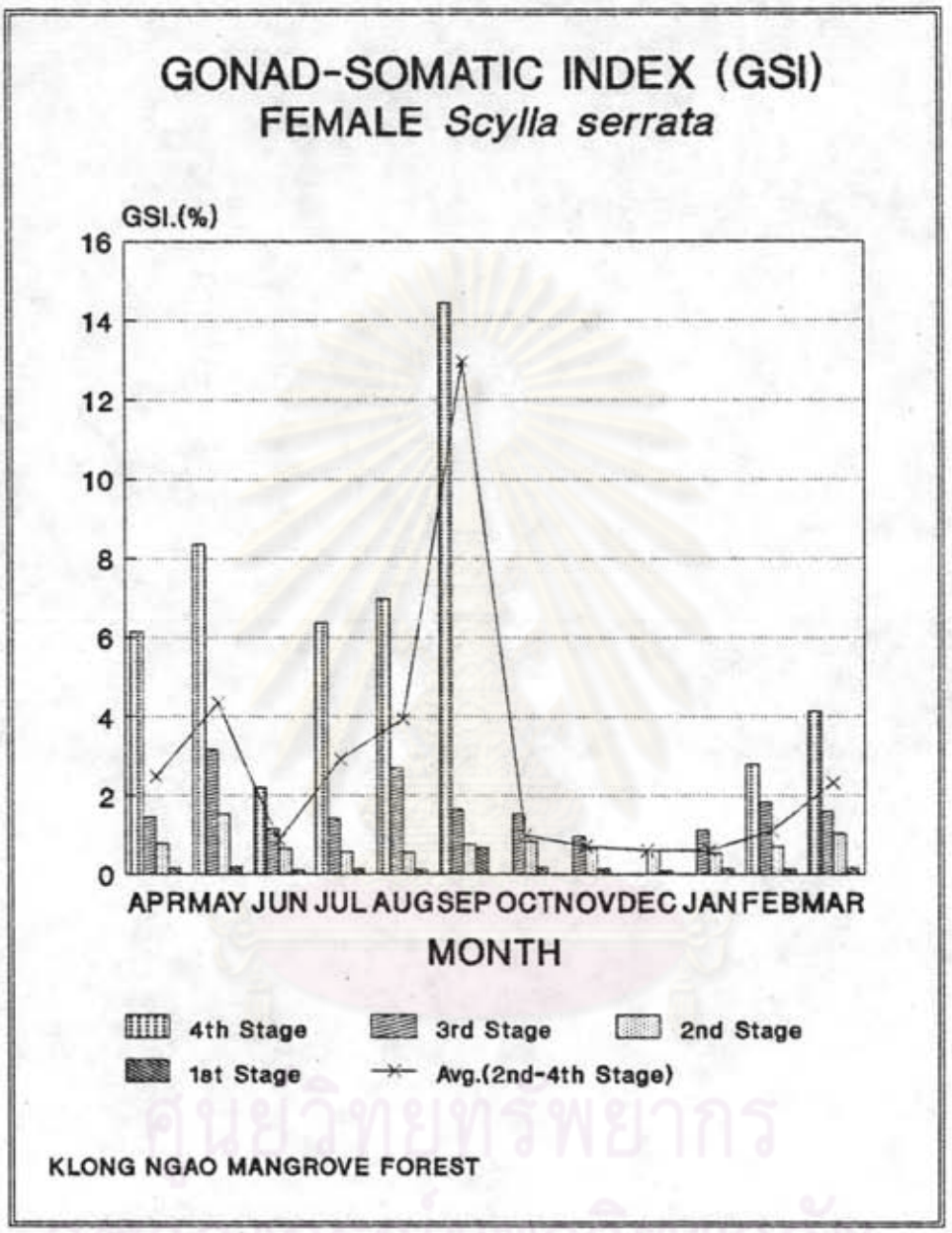


Figure 17: Monthly gonad - somatic index in female *S. serrata* from Klong Ngao mangrove forest, Ranong.

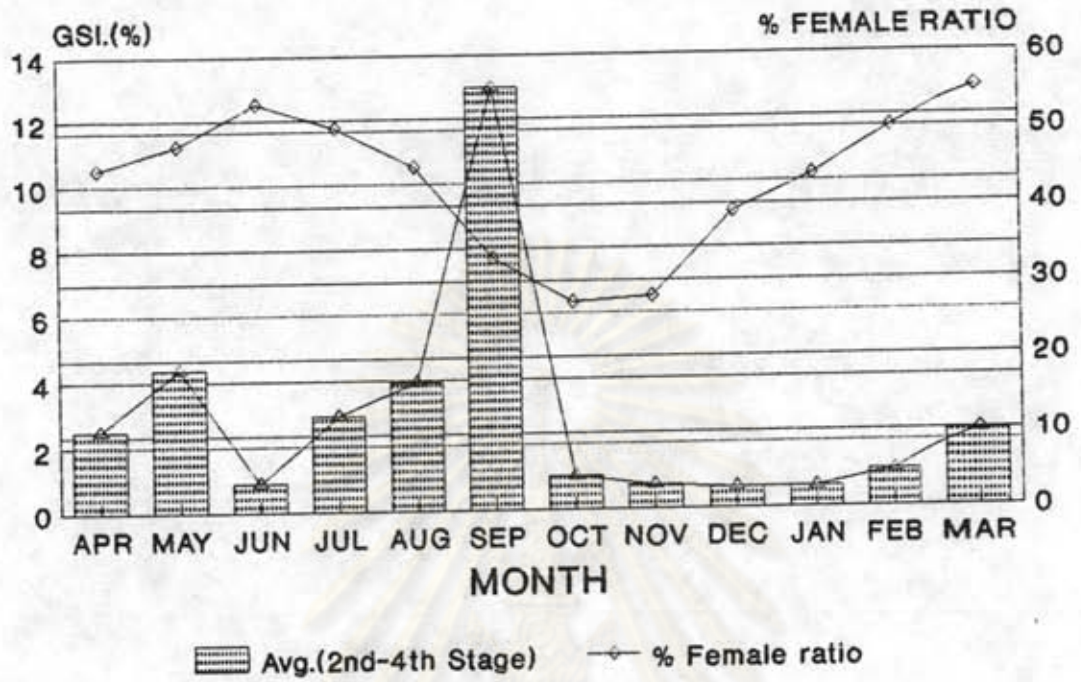


Figure 18: The comparison between Gonad - Somatic Index and a percentage of female ratios in *S.serrata* from Klong Ngao mangrove forest, Ranong.

3. Gonadal Development

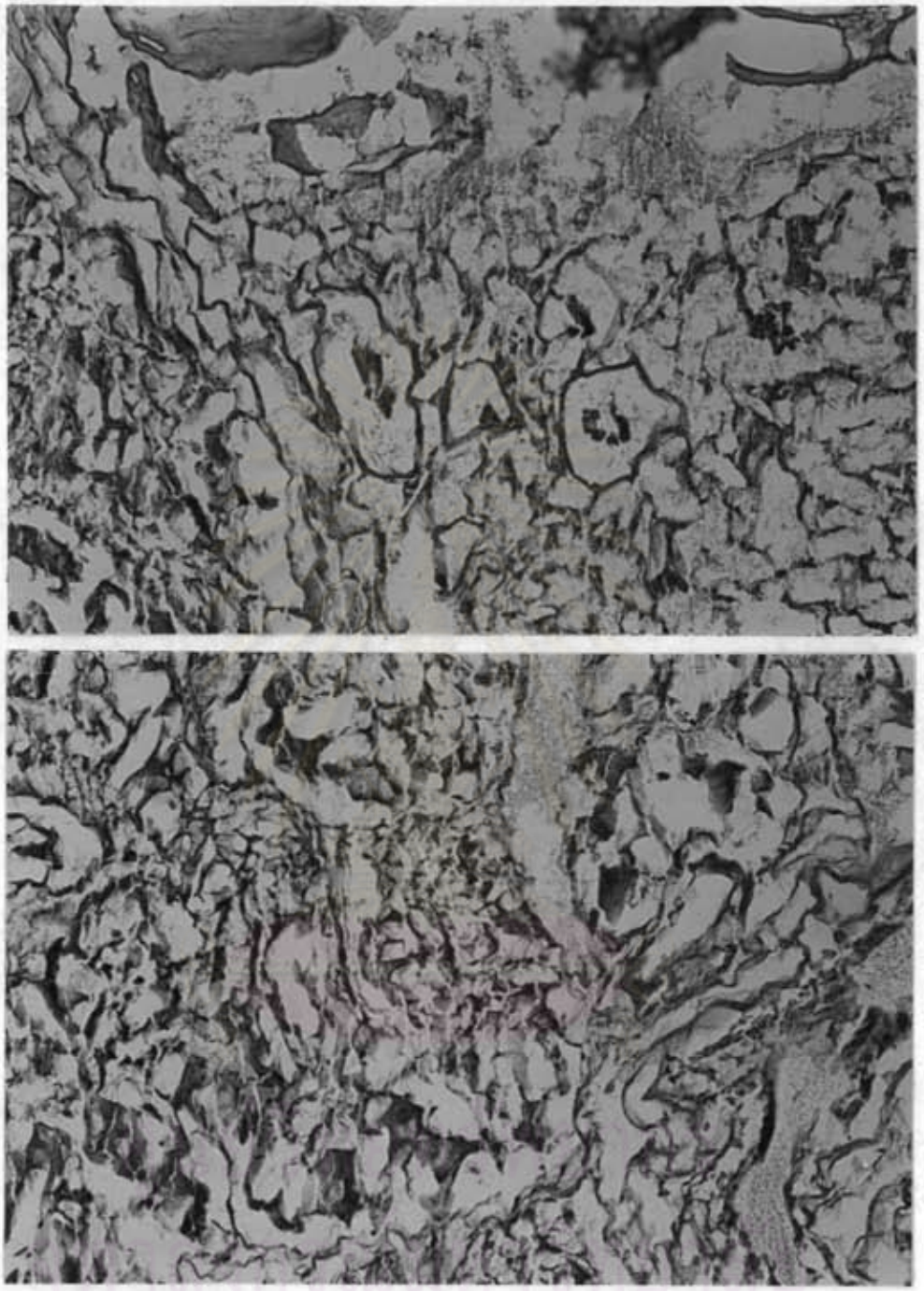
The gonad condition of female *S. serrata* was classified into 4 stages based on the change of color as translucent, creamy or pale yellow, yellow, and orange or reddish orange. The microscopic examination in *S. serrata* ovary conditions were as followed;

1. stage I : A long narrow translucent strip was above the digestive gland of *S. serrata.* From the histological study indicates the initiation of follicles (Figure 19 A,B). The stage was defined as an immature ovary.

2. stage II: Ovary initially changed color to creamy or pale yellow. Microscopic examination showed that some yolk globule were form into oocyte (Figure 20C).

3. stage III: Ovary becomed enlarge and changed color to yellow, covering 1/3 - 3/4 part of the digestive gland. Microscopic examination showed that most of oocyte, were filled with yolk globule (Figure 20D).

4. stage IV : The stage was defined as mature ovary. The ovary covered most part of the digestive gland, and become orange or reddish orange. With microscopic examination showed that each of oocyte was large and fully packed with mature genital product (Figure 21 E, F).

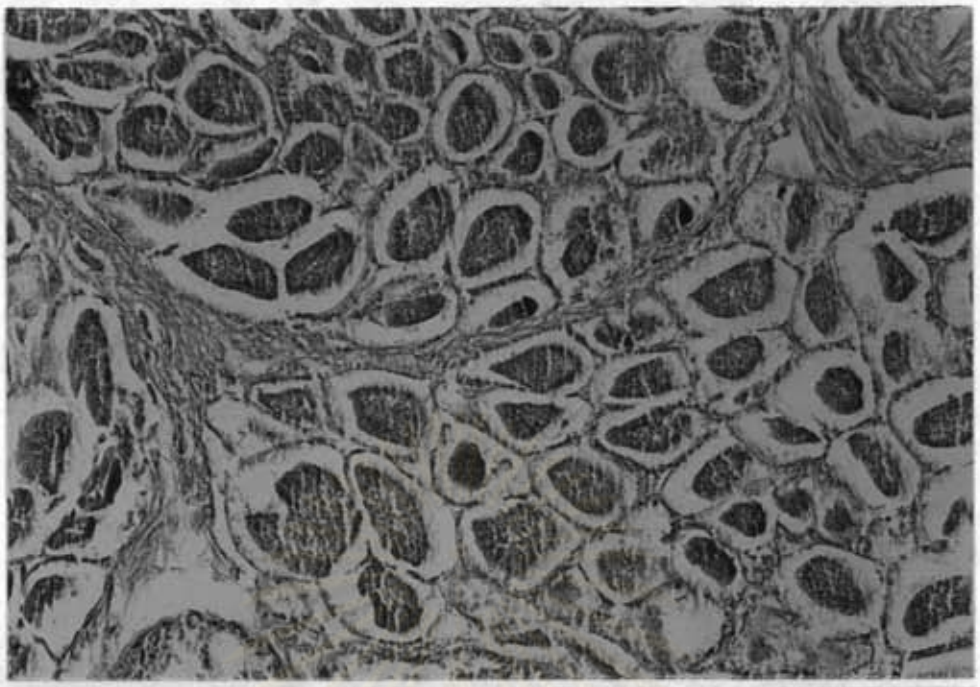


A.

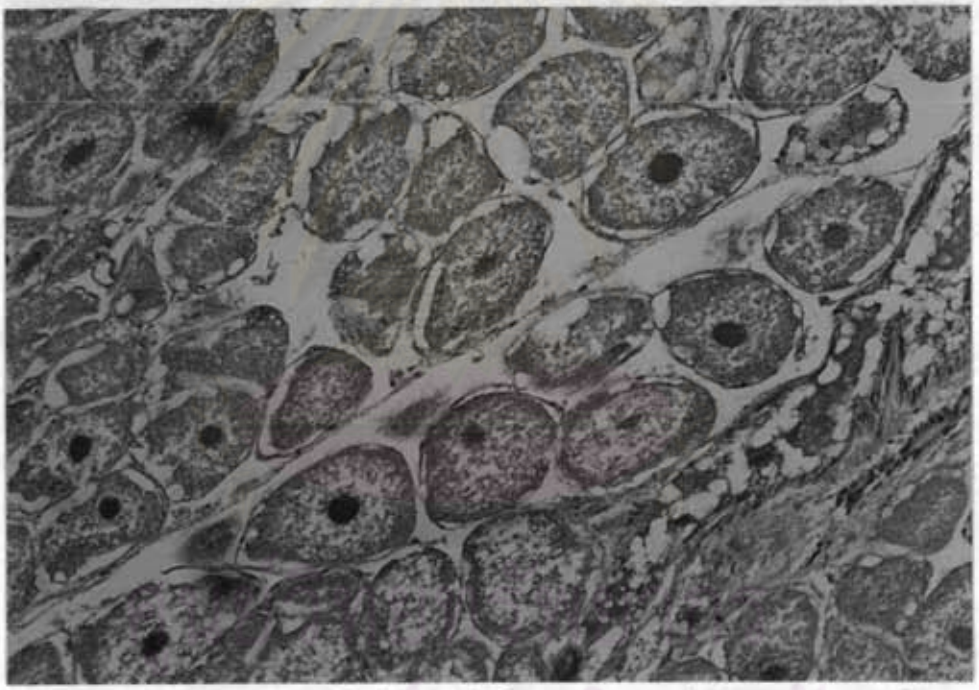
B.

Figure 19: Histological identification of gonad stages of female Scylla *serrata*.

A. and B. = Immature stage of and ovary.



C.

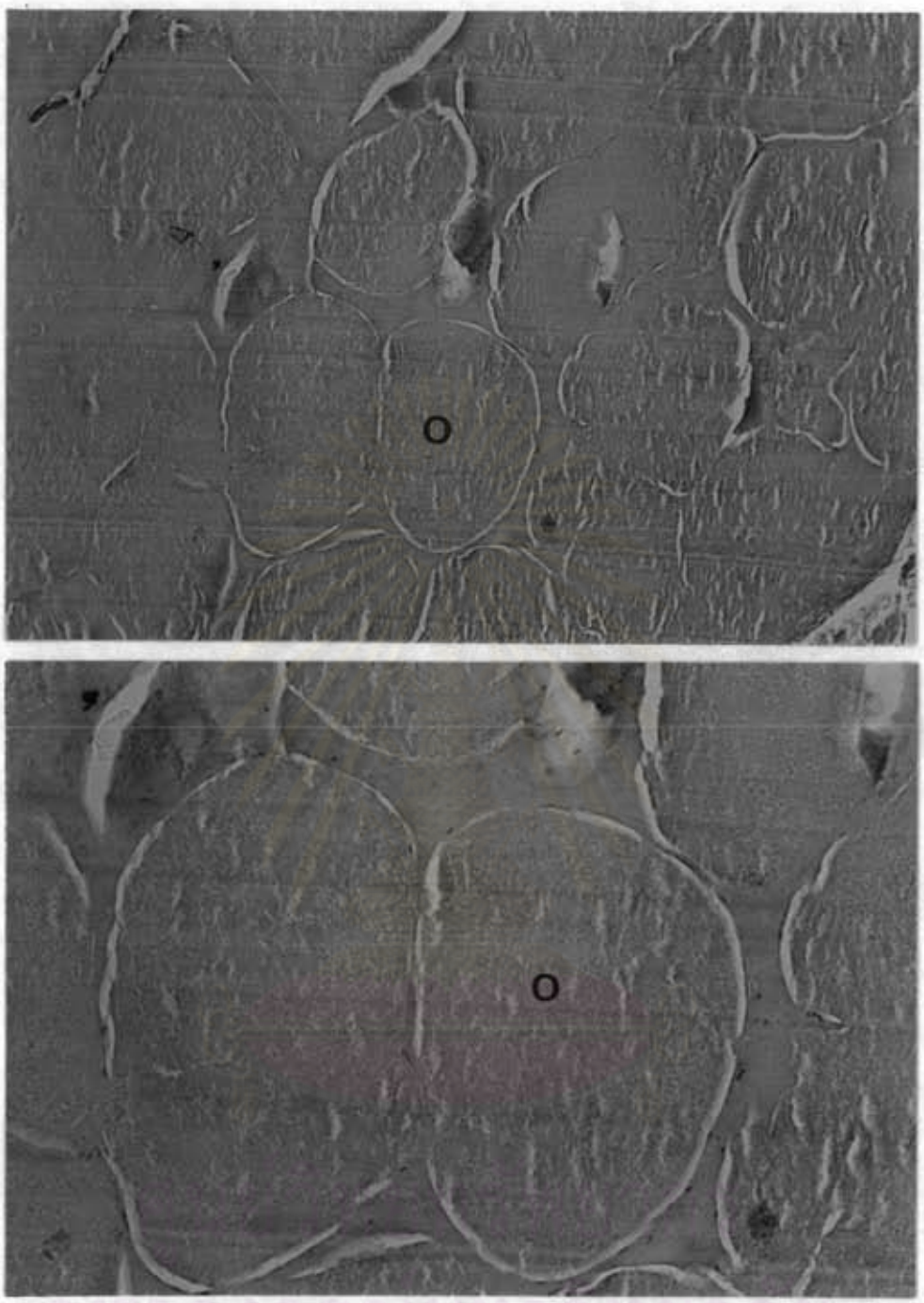


D.

Figure 20: Histological identification of gonad stages of female *Scylla serrata*

C = 2nd stage(Y=yolk, O=oocyte).

D = 3rd stage(Y=yolk, O=oocyte, Nu=nucleus).



E.

F.

Figure 21: Histological identification of gonad stages of female *Scylla serrata*

E = 4th stage; mature stage (O = oocyte).

F = mature stage(O= oocyte).

3. Size at First Sexual Maturity

The fourth stage of gonad development in *S. serrata* when the ovary become orange or red color, was considered as fully developed and commonly used to determine size at first sexual maturity. Carapace width of female crab whose ovaries at 4th stage ovary ranged from 8.35 - 11.51 cm., with mean carapace width of 9.94 cm.(n = 102). The minimal size in female*S. serrata* with mature ovary was 8.35 cm.. This indicated that female *S. serrata* reach the sexual maturity at about this size.(Figure 22).

When sizes frequency data of gravid female *S. serrata* compared with female sizes distribution throughout the year found that modal sizes of gravid female were ranged from 9 - 10 cm. were coincided with the decrease in number between two mode of female sizes frequency throughout the year(Figure 23 and 24). This could be due to the spawning migration of mature female crabs.

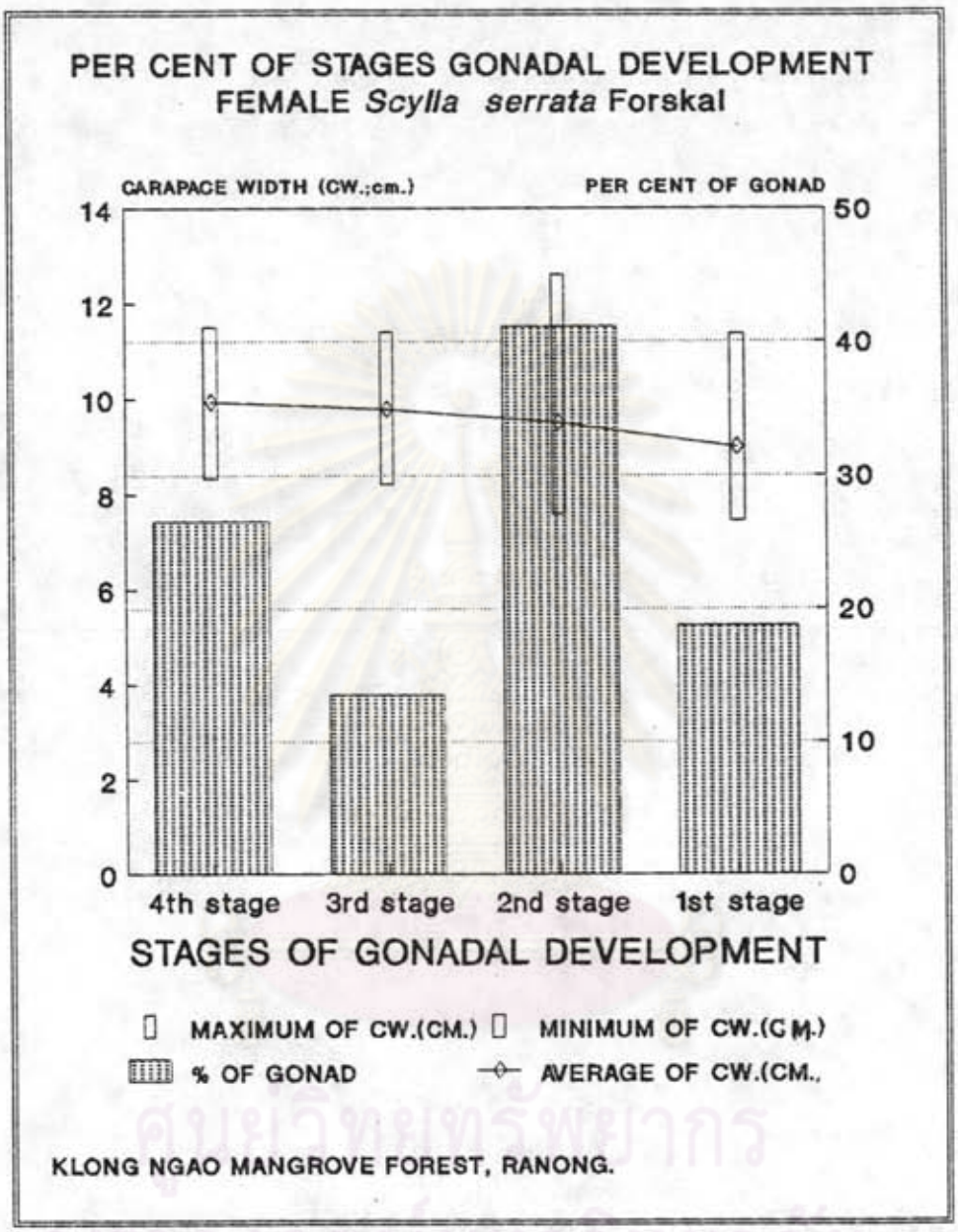


Figure 22: A per cent of ovary stages of female *Scylla serrata* from Klong Ngao mangrove forest

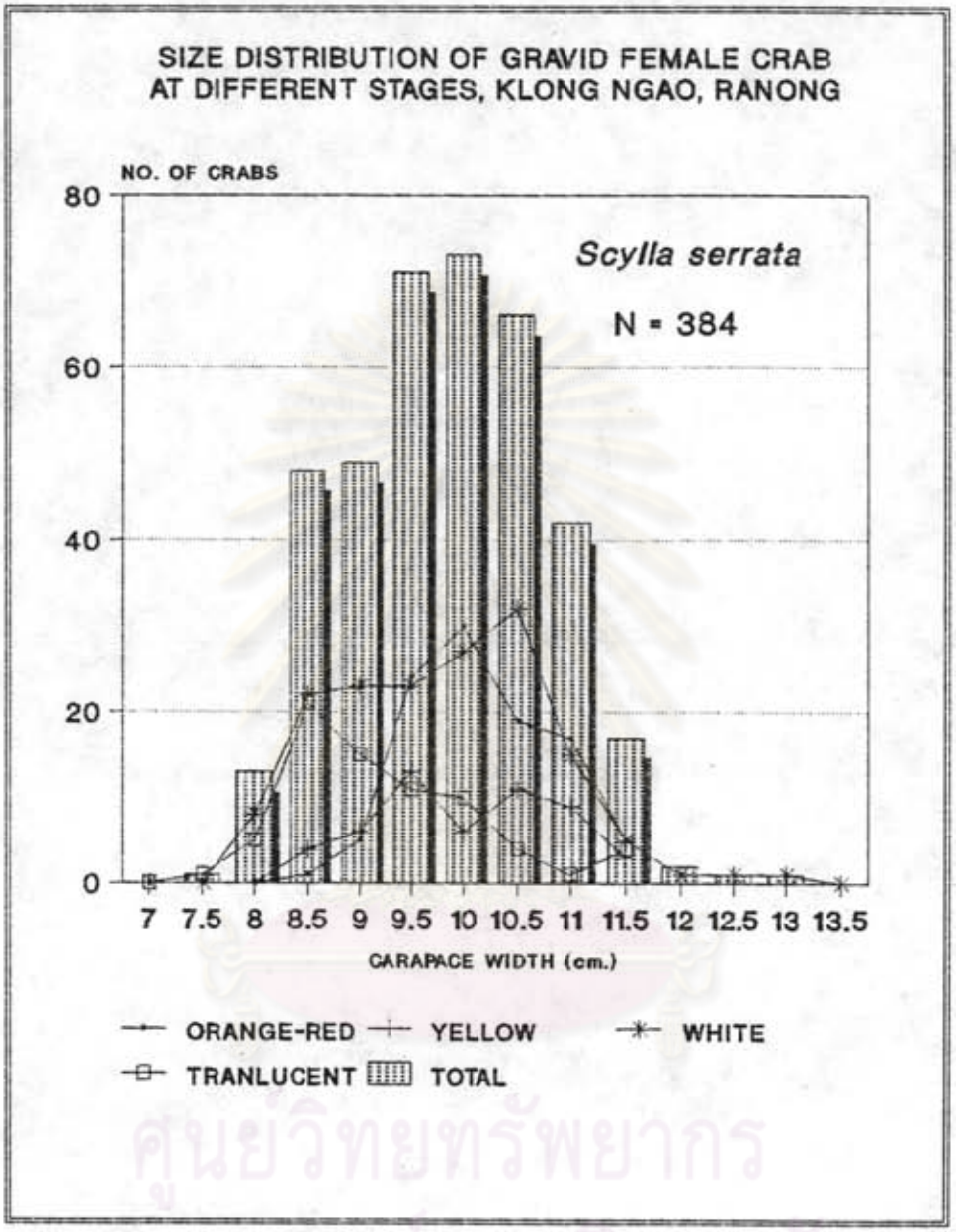


Figure 23: Size distribution of gravid female *Scylla serrata* from Klong Ngao mangrove forest, Ranong.

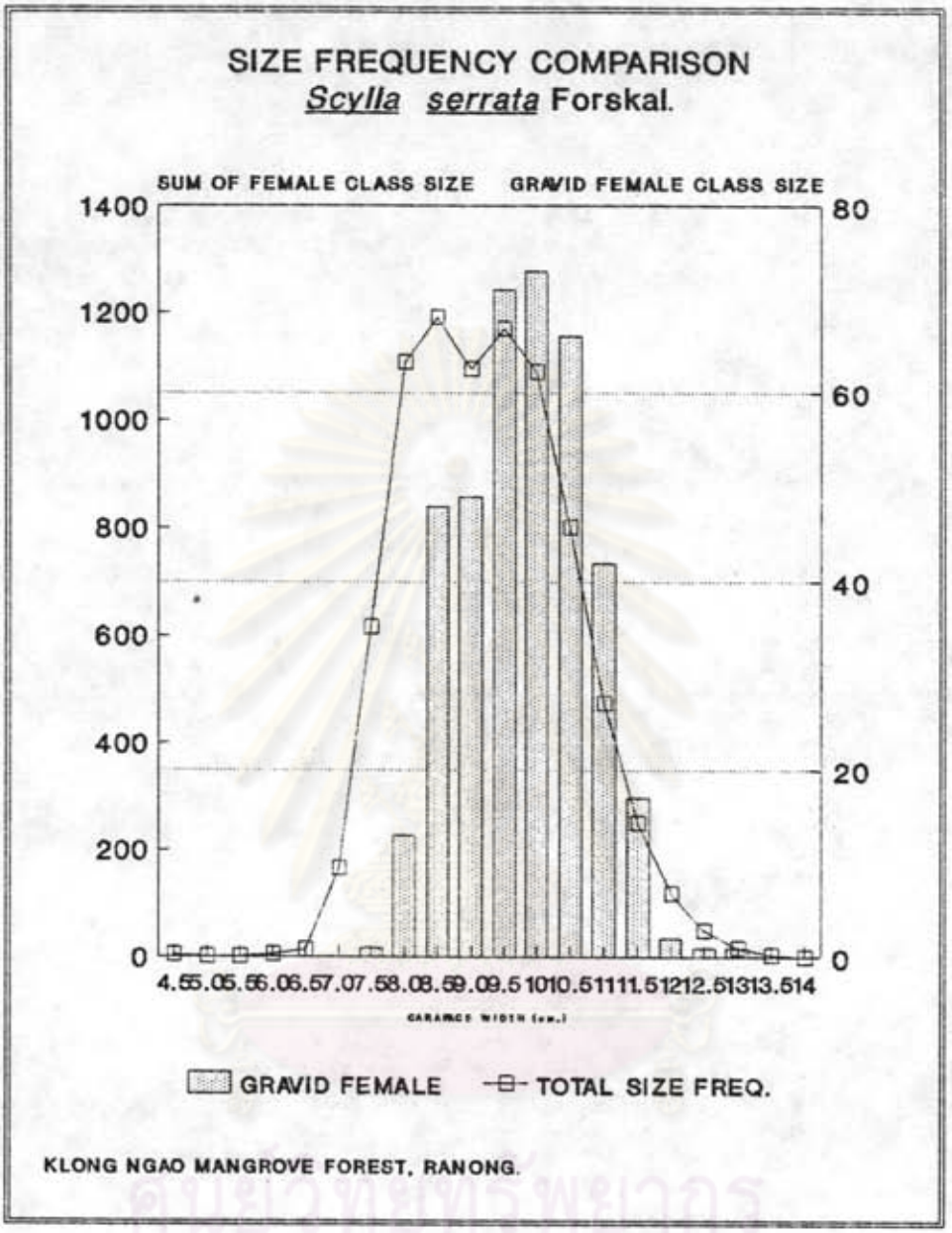


Figure 24: The comparison of size distribution between gravid female & female *Scylla serrata* from Klong Ngao mangrove forest, Ranong.