Report of LB-SPR analysis
(Six month result)

Areas: Surat Thani and Nakhon Si Thammarat provinces
Data Collection: BSC length data will be collected between February and December 2024: Samples will be collected from the fields every two months)

Background: The length-based spawning potential ratio (LB-SPR, Hordyk et al. 2016) will be conducted to assess the stock status of the blue swimming crab (BSC) in Surat Thani and Nakhon Si Thammarat fishing ground.

Sources of data: The BSC samples will be collected from the fisherman landing sites in Surat Thani and Nakhon Si Thammarat provinces and conducted between February and June 2024. The details of BSC samples from Surat Thani province and Nakhon Si Thammarat province were showed in Table 1

Table 1 Updated numbers and size of BSC samples collected from Surat Thani province and Nakhon Si Thammarat province

Areas	Number (individuals)	Min-length (cm.)	Max-length (cm.)	Average (cm.)
Surat Thani province	1,264	6.00	17.00	11.03
Nakhon Si Thammarat	1,434	4.50	17.40	11.28
Total	2,698	4.50	17.40	11.16

Data analyses: The asymptotic length was estimated by $Lmax$/0.95 and the curvature parameters was adjusted by using growth performance index (ϕ', Munro and Paly, 1983). The total, Z, mortality coefficient was

estimated by the length converted catch curve (Pauly, 1984). Meanwhile, the natural, M, mortality coefficient was estimated by Rikhter and Efanov's Formula (Rikhter and Efanov, 1976) using size at 50% maturity from last year as input parameter as we strongly believed that there is no significantly change of biological parameter during a year. The fishing, F, mortality coefficient was estimated as Z-M. Size at selectivity was estimated through probability of capture curve (Pauly, 1984). The mentioned input parameters were estimated by using the FiSAT II package (FAO-ICLARM Stock Assessment Tool, Gayanilo et al., 2005). Meanwhile, the LB-SPR was estimated by using Package "LBSPR" for Program R (Hordyk, 2019).

The variation and error of samplings were minimized by collecting the BSC sample from the same fishermen and same landing sizes. The sample were collected based on covering all size class, smallest to biggest, to make sure we prepared high quality of LFD set for assessing biological and fishery parameters.

Results: (Six month investigation)
The maximum- and asymptotic- OCW of the samples collected from Surat Thani and Nakhon Si Thammarat were 17.0, 17.89 cm and 17.4, 18.3 respectively (Table 3). The curvature parameter (K) was 1.6 $year^{-1}$ (Fig. 1). The Z- and M- mortality coefficients for Surat Thani fisheries were estimated at 6.28 and 2.93 $year^{-1}$, respectively. While Z and M for Nakhon Si Thammarat were estimated at 5.30 and 2.89 $year^{-1}$ and then F-mortality coefficients for Surat Thani and Nakhon Si Thammarat were 3.35 and 2.41 $year^{-1}$ respectively (Fig2). The probability of capture curve (Fig. 3) revealed that size at 50% and 75% selectivity for Surat Thani and Nakhon Si Thammarat were 9.86, 10.45 cm and 10.59, 11.33 cm respectively. Length at 50% maturity was 9.96 cm (OCW) (Fig 3), which took about 0.5 year to reach this size. From these obtained parameters, the estimated spawning potential ratio (SPR) of the BSC stock in Surat Thani and Nakhon Si Thammarat were at 0.47 and 0.57, respectively (Fig. 5 and 6).

Table 3 Input parameters and LBSPR results separately in each area.

Areas	Max-length (cm.)	Asymptotic length (cm.)	K	Z	M	F	Lc 50	Lc 75	Lm	SPR	SPR -5% Fishing mortality	SPR +5% Fishing mortality
Surat Thani	17.0	17.89	1.60	6.28	2.93	3.35	9.90	10.69	9.96	0.41	0.42	0.40
Nakhon Si Thammarat	17.4	18.3	1.60	5.30	2.89	2.41	10.13	10.78	9.96	0.49	0.50	0.48

References

Gayanilo, F.C.Jr., Sparre, P., Pauly, D. 2005. FAO-ICLARM Stock Assessment Tools II (FiSAT II). Revised version. User's guide. FAO Computerized Information Series (Fisheries). No. 8, Revised version. Rome, FAO. 168 p.

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Hordyk A.R. 2019. LBSPR: Length-Based Spawning Potential Ratio. R package version 0.1.4. https://CRAN.R-project.org/package=LBSPR

Hordyk A.R., Ono K., Prince J.D. and Walter C.J. 2016. A simple length-structured model based on life history ratios and incorporating size-dependent selectivity: application to spawning potential ratios for data-poor stocks. Can. J. Fish. Aquat. Sci. 73: 1787–1799 (2016) dx.doi.org/10.1139/cjfas-2015-0422

Munro, J. L. and D. Pauly. 1983. A simple method for comparing the growth of fishes and invertebrates. Fishbyte 1 (1): 5-6

Pauly, D. 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud.Rev. (8):325p

Rikhter, V. A., and V. N. Efanov. 1976. On one of the approaches to estimation of natural mortality of fish populations. ICNAF Res. Doc., 76/VI/8: 12 p.

Appendix

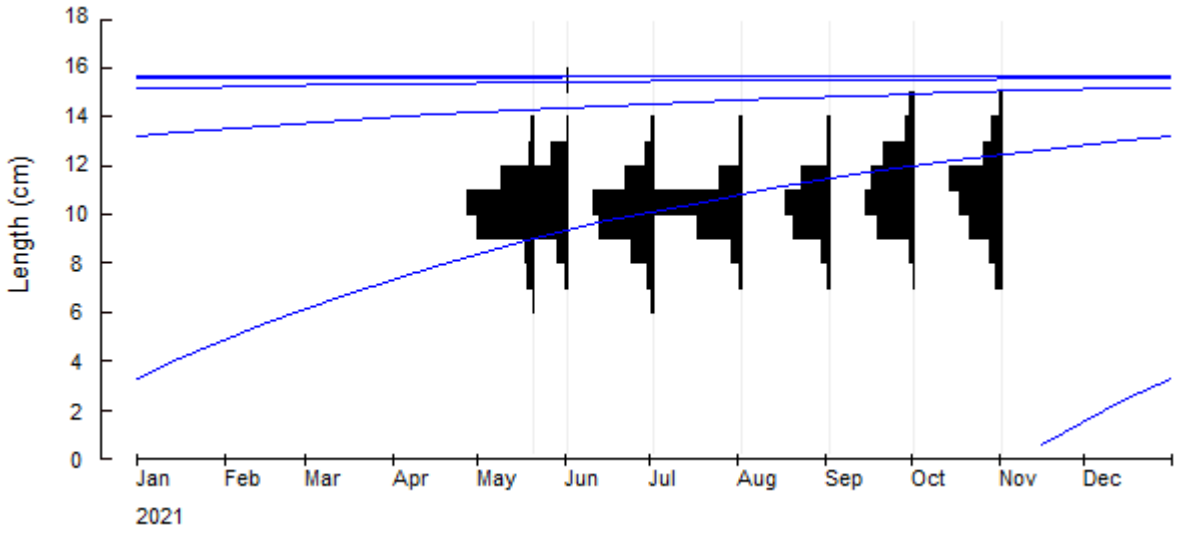
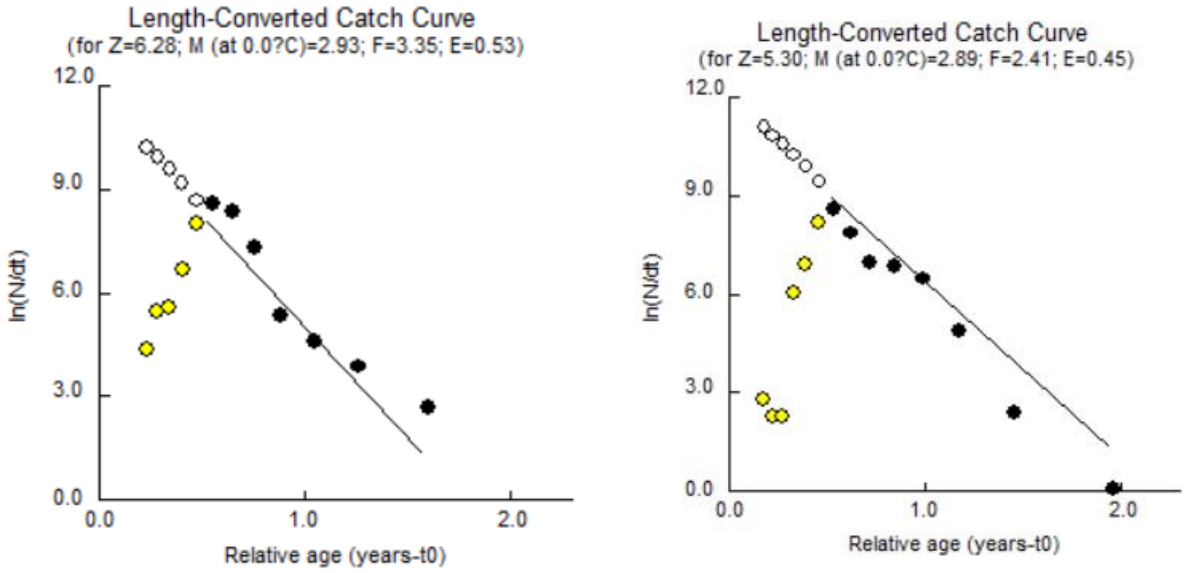
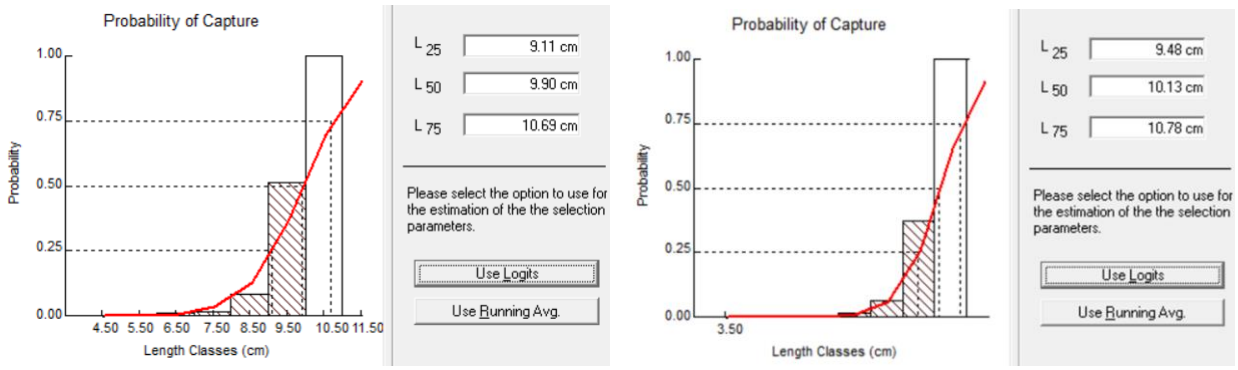


Fig. 1 Size distribution and growth curves of blue swimming crab, incorporated with the von Bertalanffy's growth curve.



(A) (B)

Fig. 2 Total mortality estimation from length converted catch curve in FiSAT from 6 months length frequency data used in this study (A) Surat Thani province (B) Nakhon Si Thammarat province



(A) **(B)**

Fig. 3 Probability of capture of blue swimming crab calculated from 6 months length frequency data (A) Surat Thani province (B) Nakhon Si Thammarat province

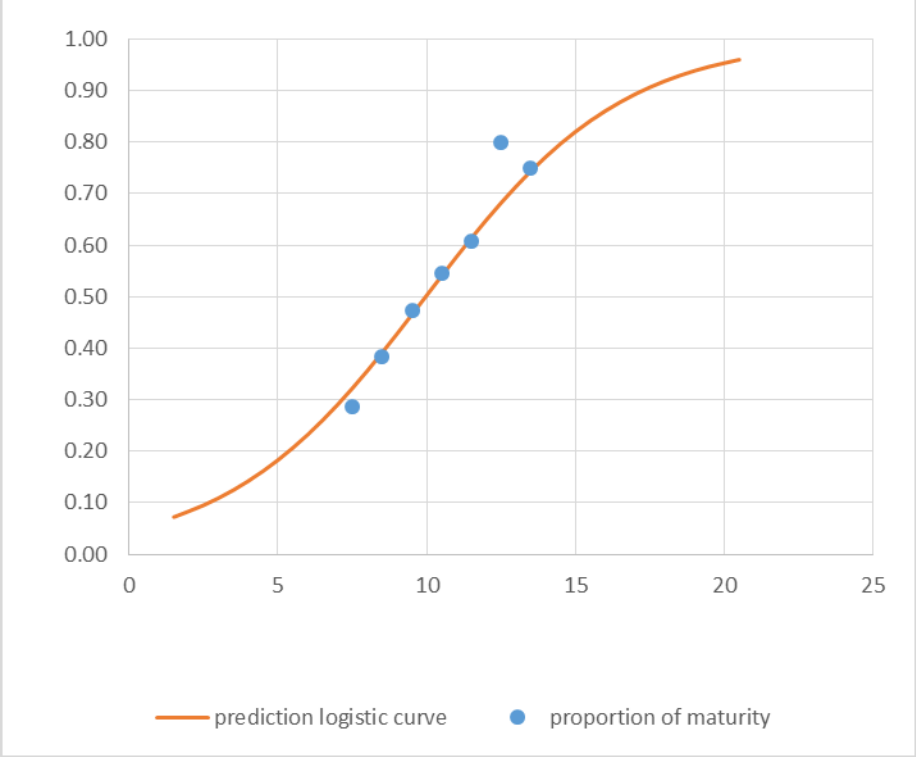


Fig. 4 Proportion of maturity of blue swimming crab calculated by logistic equation

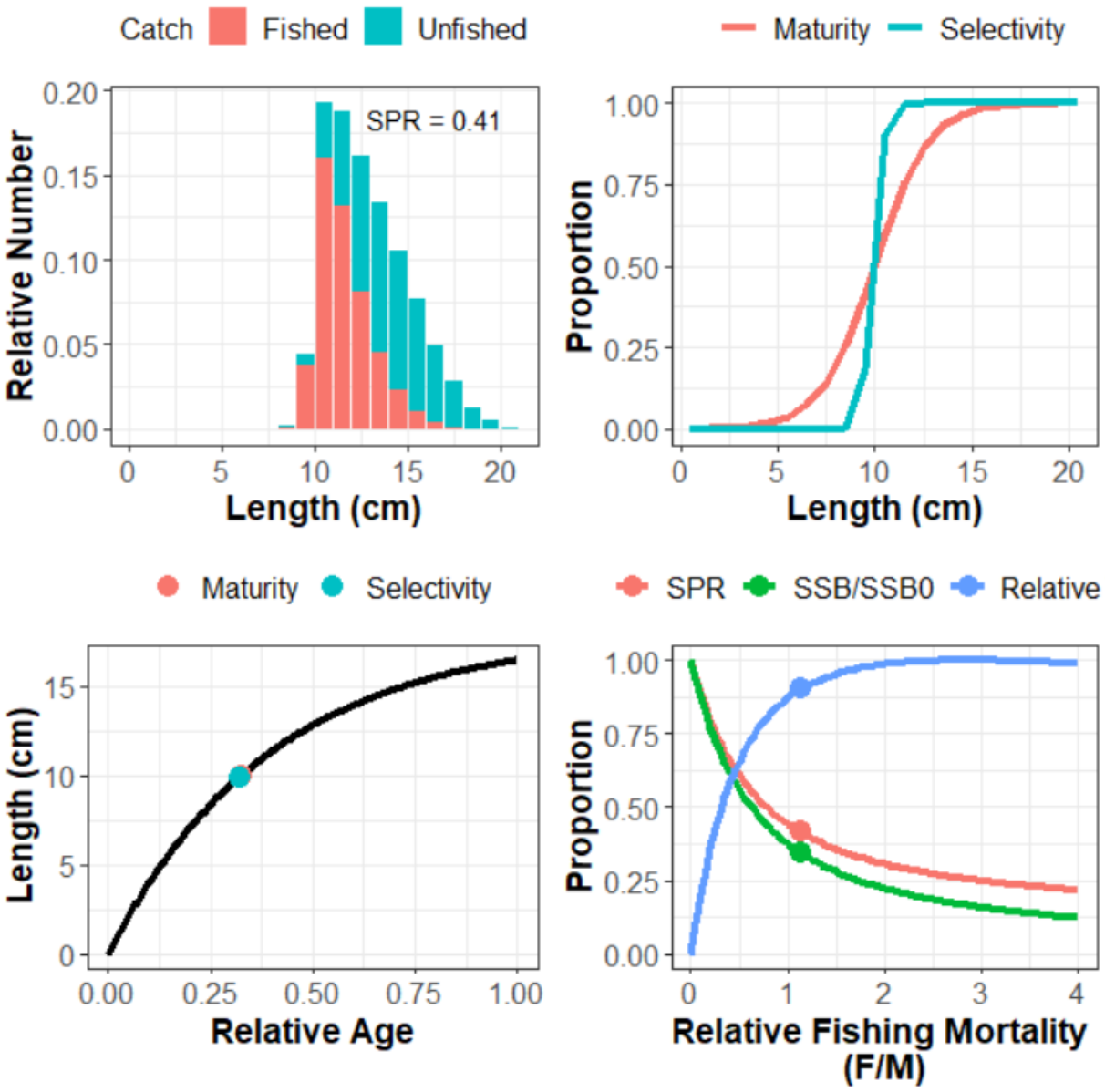


Fig. 5 Output from the LB-SPR analysis of blue swimming crab in Surat Thani.

(a) the expected (equilibrium) size structure of the catch and the expected unfished size structure of the vulnerable population, (b) the maturity and selectivity-at-length curves, (c) the growth curve with relative age, and (d) the SPR and relative yield curves as a function of relative fishing mortality.

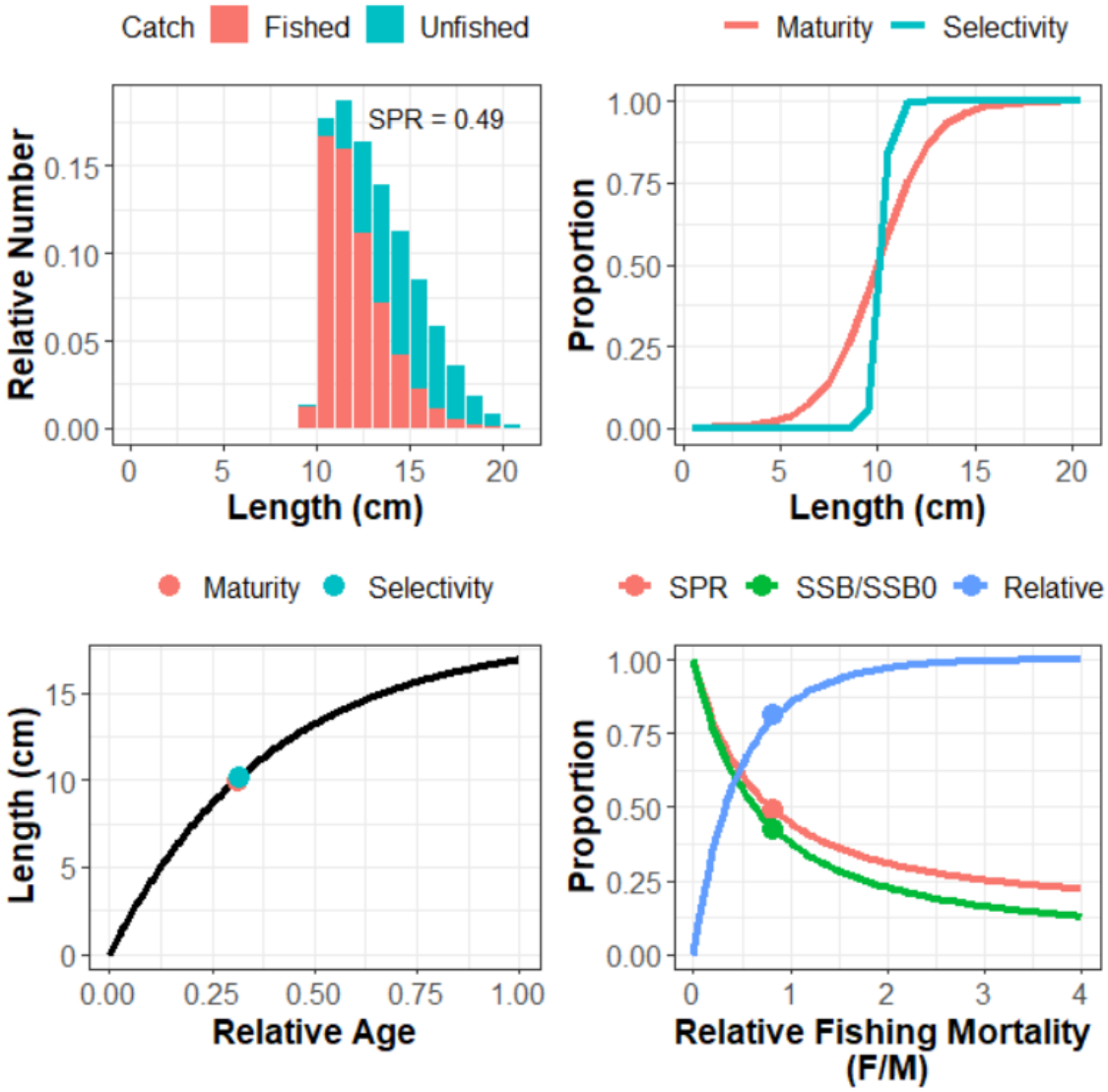


Fig. 6 Output from the LB-SPR analysis of blue swimming crab in Nakhon Si Thammarat.

(a) the expected (equilibrium) size structure of the catch and the expected unfished size structure of the vulnerable population, (b) the maturity and selectivity-at-length curves, (c) the growth curve with relative age, and (d) the SPR and relative yield curves as a function of relative fishing mortality.

Supplement Table 1 Length frequency data collected from Surat Thani province during February to June 2024

Count of ML	Month			
ML	Feb	Apr	Jun	Grand Total
5.5		4		4
6.5		13		13
7.5	4	7	5	16
8.5	15	7	33	55
9.5	62	34	128	224
10.5	149	140	179	468
11.5	152	156	104	412
12.5	85	61	27	173
13.5	17	13		30
14.5	4	14	1	19
15.5	1	12		13
16.5		7		7
Grand Total	489	468	477	1434

Supplement Table 2 Length frequency data collected from Nakhon Si Thammarat province during February to June 2024

Count of ML	Month			
ML	Feb	Apr	Jun	Grand Total
4.5	1			1
6.5		1		1
7.5	2	10	13	25
8.5	7	34	23	64
9.5	16	97	144	257
10.5	31	171	234	436
11.5	25	74	143	242
12.5	72	23	24	119
13.5	120	7	1	128
14.5	105	4		109
15.5	31			31
16.5	4			4
17.5	1			1
Grand Total	415	421	582	1418

Supplement 3 Script for LBSPR analysis for Surat Thani province

```
library(LBSPR)
### Make scenrio ###
MyBSC <- new("LB_pars")
MyBSC@L_units <- "cm"
MyBSC@BinWidth <- 1
MyBSC@BinMax <- 21
MyBSC@BinMin <- 0
### Biology parameters
MyBSC@Linf <- 17.89
MyBSC@L50 <- 9.96 ##Length at 50% maturity
MyBSC@L95 <- 14 ##Length at 95% maturity
MyBSC@MK <- 1.83 ##M/K ratio M=2.93, K = 1.6
### Exploitation
MyBSC@SL50 <- 9.90 # Probability of capture
MyBSC@SL95 <- 10.69 # Probability of capture
MyBSC@FM <- 1.14
### Run the LBSPR simulation model.
BSCSim <- LBSPRsim(MyBSC)
BSCSim@FM
plotSim(BSCSim)
```

Supplement 4 Script for LBSPR analysis for Nakhon Si Thammarat province

```
library(LBSPR)
### Make scenrio ###
MyBSC <- new("LB_pars")
MyBSC@L_units <- "cm"
MyBSC@BinWidth <- 1
MyBSC@BinMax <- 21
MyBSC@BinMin <- 0
### Biology parameters
MyBSC@Linf <- 18.3
MyBSC@L50 <- 9.96 ##Length at 50% maturity
MyBSC@L95 <- 14 ##Length at 95% maturity
MyBSC@MK <- 1.806 ##M/K ratio M=2.89, K = 1.6
### Exploitation
MyBSC@SL50 <- 10.13 # Probability of capture
MyBSC@SL95 <- 10.78 # Probability of capture
MyBSC@FM <- 0.88
### Run the LBSPR simulation model.
BSCSim <- LBSPRsim(MyBSC)
BSCSim@FM
plotSim(BSCSim)
```

Sampling Locations

(A) Map showing blue swimming crab sampling point in Surat Thani province

(A) Map showing blue swimming crab sampling point in Nakhon Si Thammarat province

(B)