A study on the ecosystem-based resource management system of self-regulatory community fisheries

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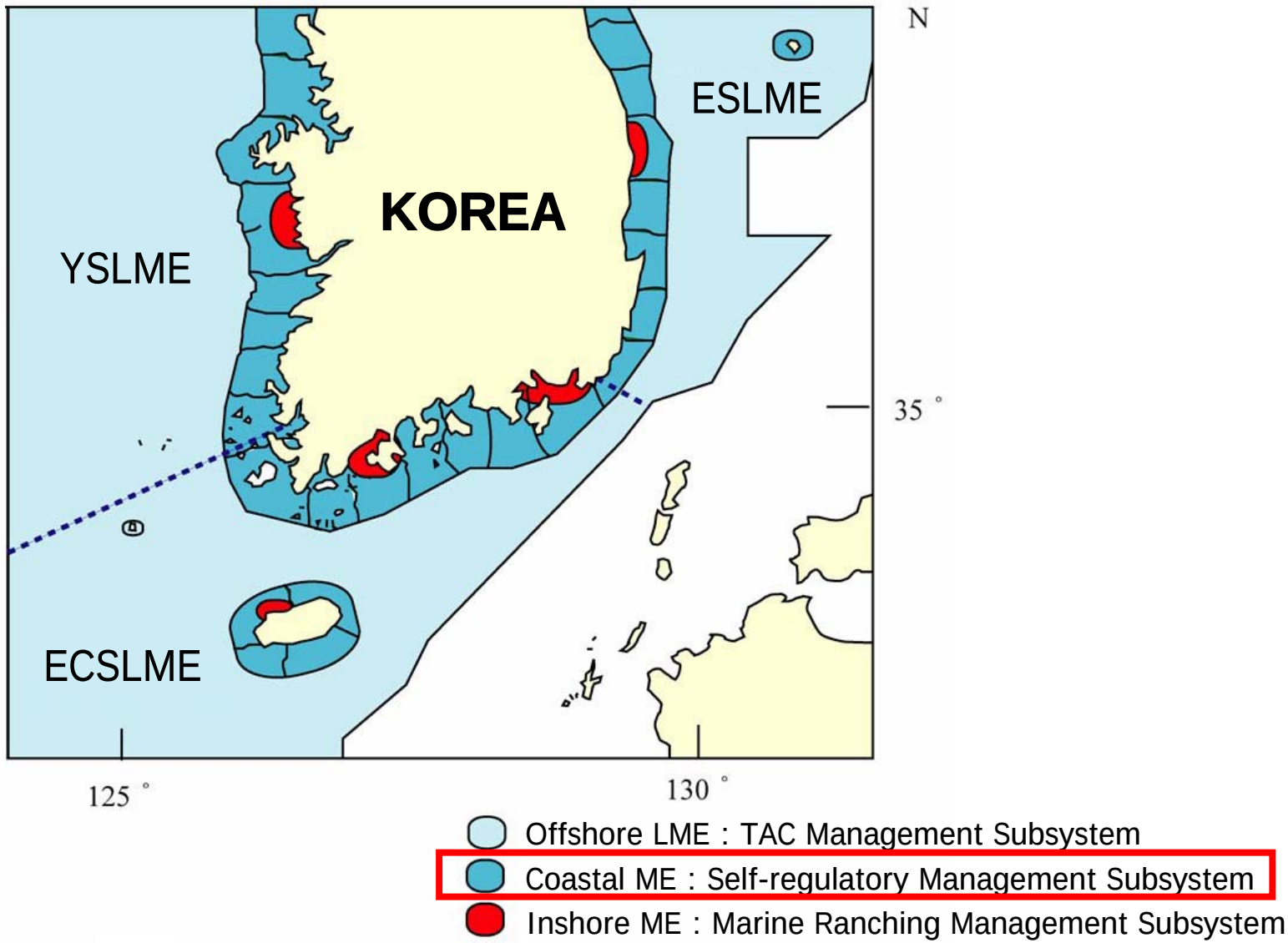
1 Introduction

Ecosystem-based integrated fisheries management system of Korea



What is Self-regulatory Fisheries Management?

- **Definition**

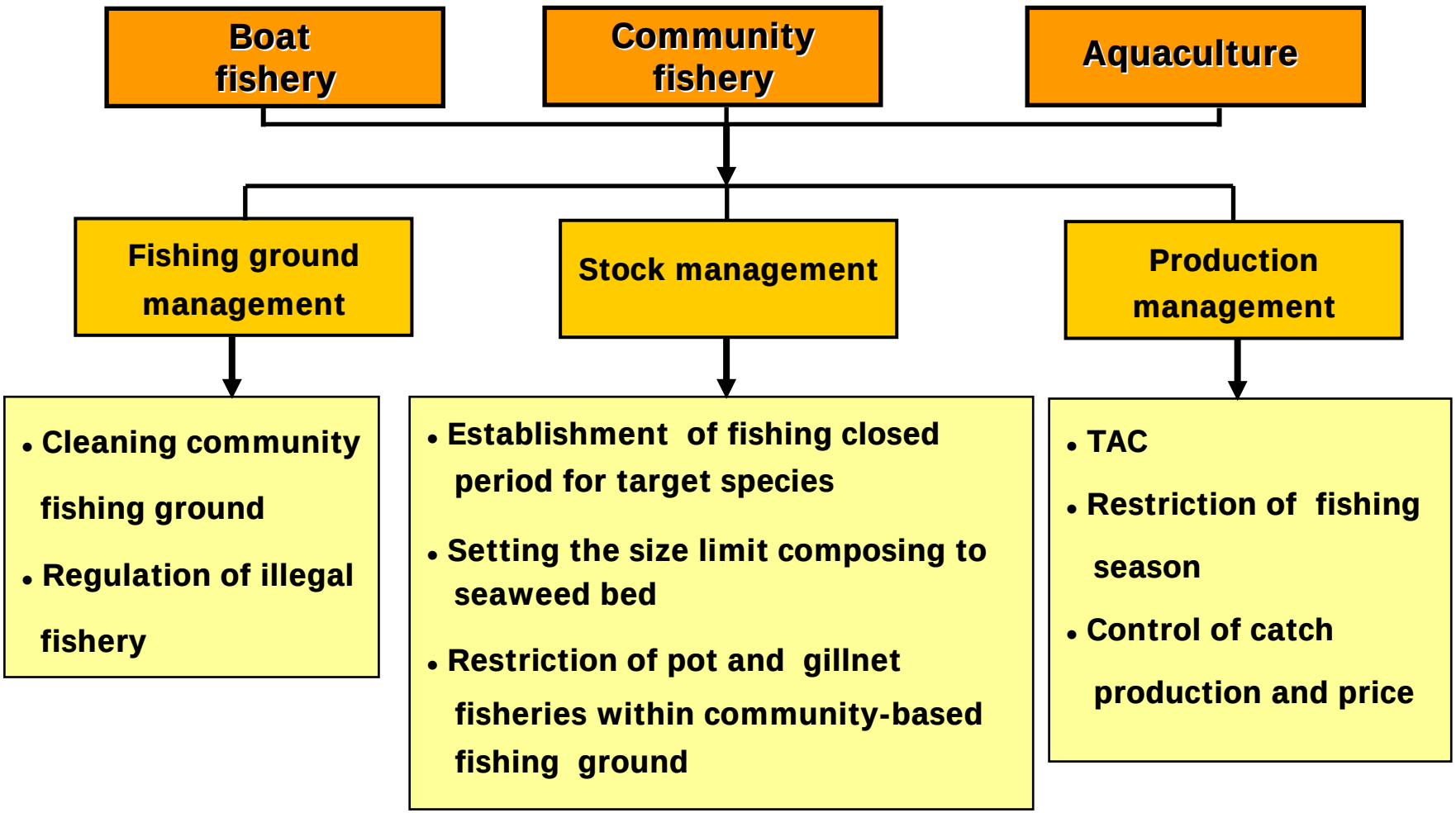
  - For coastal marine ecosystem

  : Fishermen conserve, manage and use fisheries resources themselves (442 communities participating in 2006)

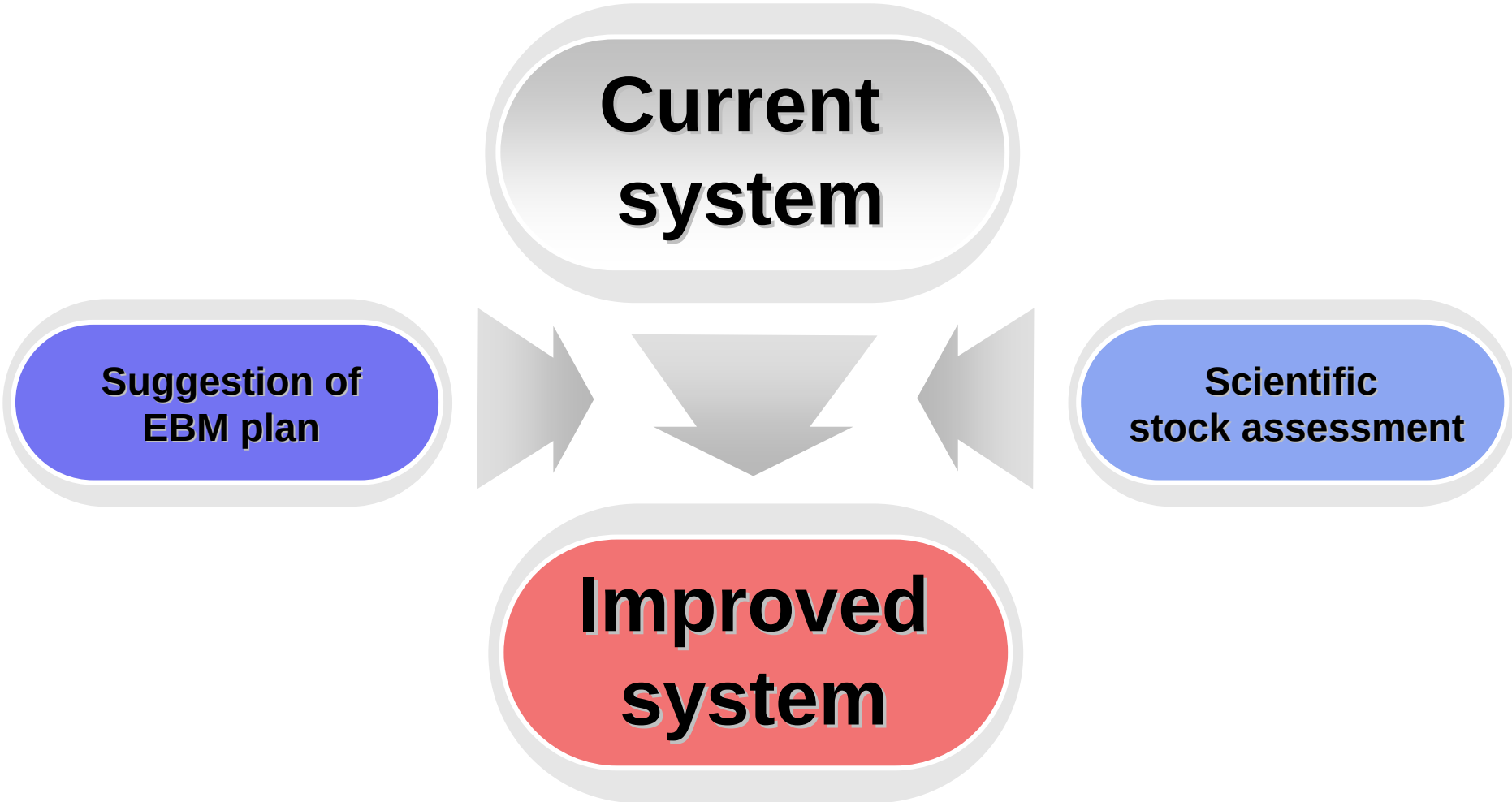
- **Management authority : self-regulating community**

- **Fisheries : boat fishery, community fishery, aquaculture, etc.**

Current system of Self-regulatory Fisheries Management of Korea

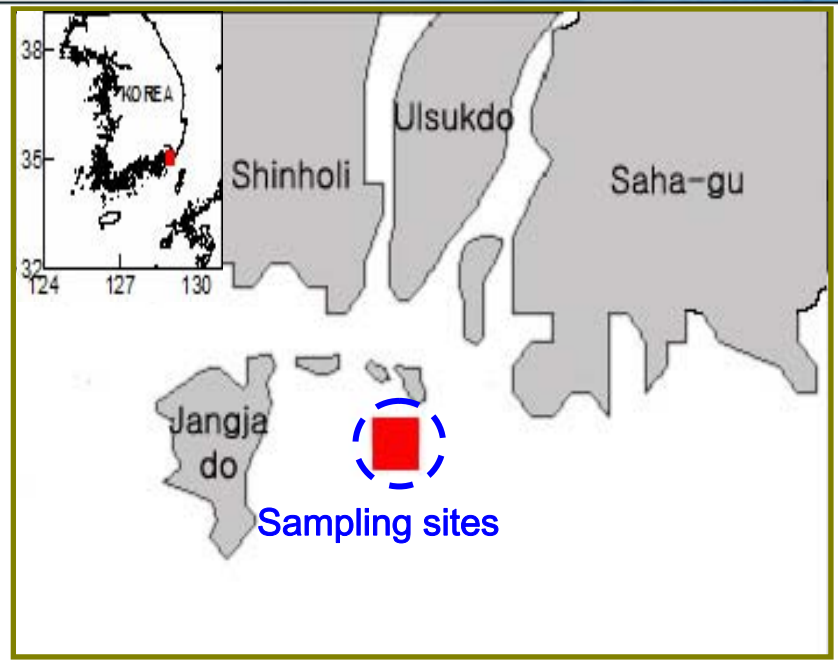


Purpose of this study



II Material & Method

Target Ecosystem



- **Target ecosystem**

  : Dong-Li self regulatory community located at Busan, Korea

- **Sampling periods**

  : Nov. 2004 – Aug. 2005 (seasonally 4 times)

Main fishing species

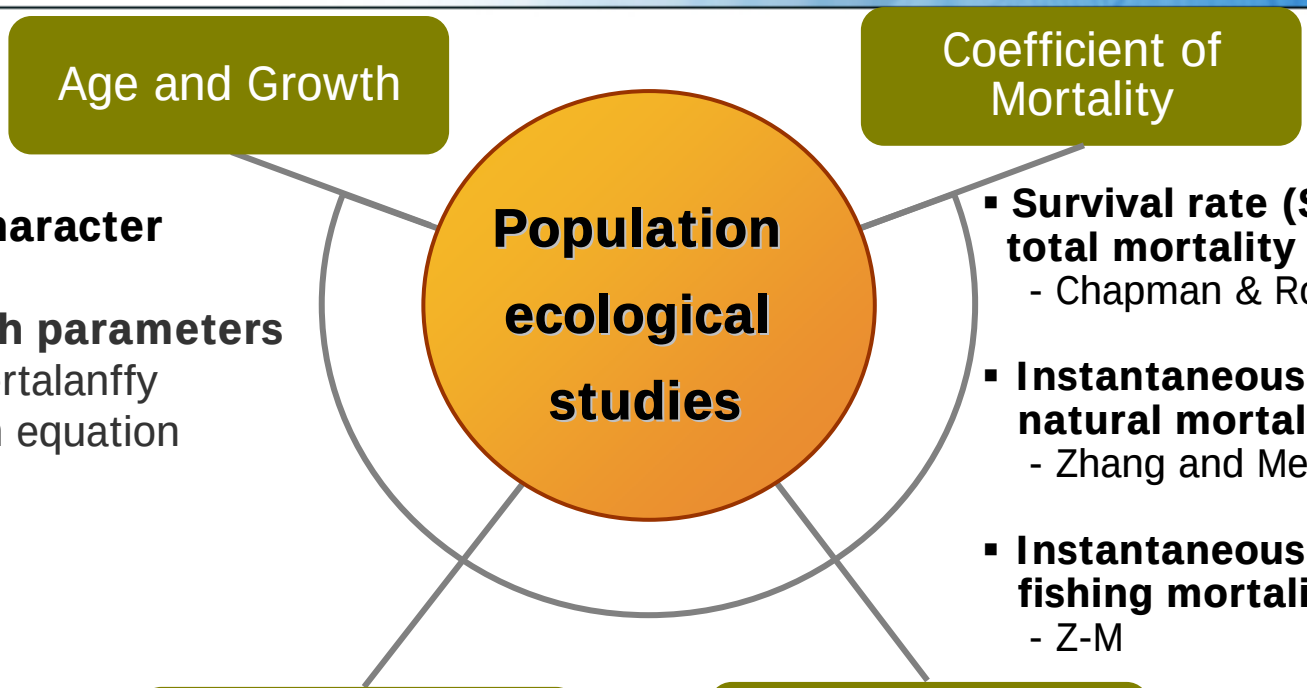
- **Main fishing species : *Mactra chinensis* (Hen clam)**

  - Order Veneroida, Family Mactridae

  - Distribution : Korea, Japan, Taiwan

  - Habitat : Sandy or Muddy bottom below 10m in depth

Population Ecological studies



- **Age character**
  : Shell
- **Growth parameters**
  : von Bertalanffy growth equation

- **Survival rate (S) & Instantaneous total mortality (Z)**
  - Chapman & Robson (1960)
- **Instantaneous coefficient of natural mortality (M)**
  - Zhang and Megrey (2006)
- **Instantaneous coefficient of fishing mortality (F)**
  - Z-M

$$t_c = \frac{t_a \times P_a + t_b \times P_b}{P_a + P_b}$$

where,
t_a : age of the youngest group
t_b : age of a dominant group
P_a : proportion of the youngest age group
P_b : proportion of a dominant age group

$$B = \frac{\overline{D} \times \overline{W} \times A}{q}$$

where,
$\overline{D}$: mean density (inds./m^2)
$\overline{W}$: mean weight (g)
A : area
q : catchability

Biological Reference Points & ABC

- **Biological reference points (BRPs)**
- **F_{opt} : Using Beverton and Holt (1957) model**

  $F_{0.1}$: Yield per recruit model

  $F_{40\%}$: Spawning biomass per recruit model

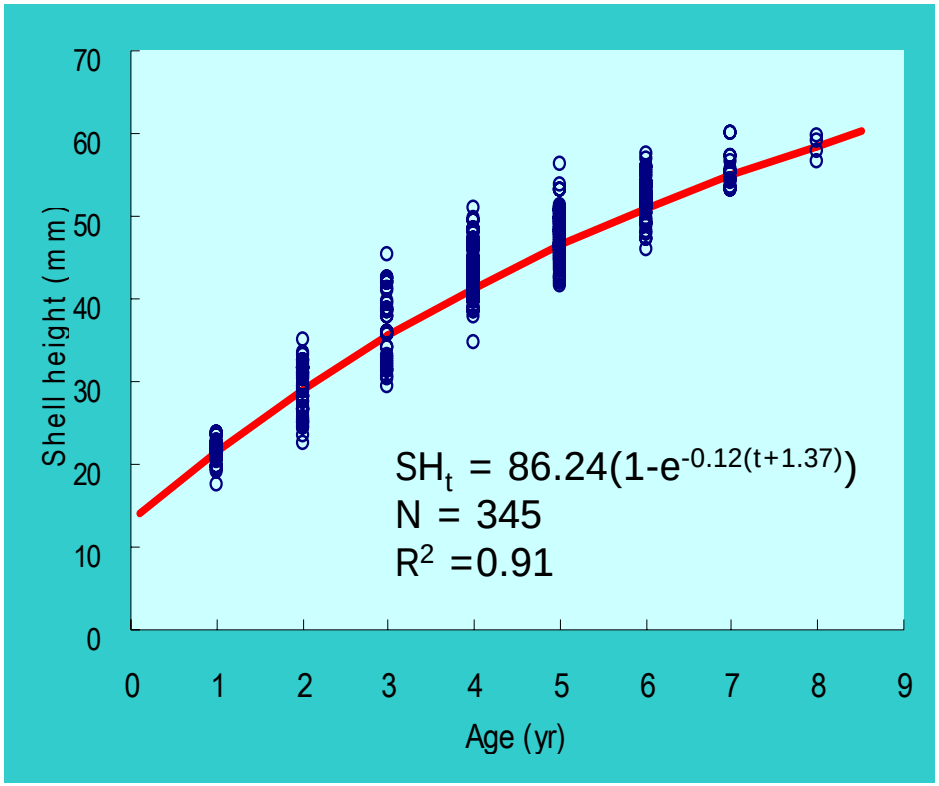
- **ABC (Acceptable biological catch)**

$$ABC = F_{opt} B \frac{1}{M + F_{opt}} (1 - \exp^{-(M + F_{opt})})$$

Where, B : Biomass (mt)
F_{opt} : Optimum fishing mortality
M : Natural mortality

III Results

Estimates of growth parameters of *Mactra Chinesis*, Hen clam



The von Bertalanffy growth curve by the non-linear regression method of *Mactra Chinensis* in the Dong-li self-regulatory community of Busan, Korea

Growth parameter

L_∞	86.24 mm
K	0.12 /yr
t_o	-1.37 yrs

Estimates of Survival rate (S) & Instantaneous coefficient of Mortalities (Z,M &F) of *Mactra Chinesis*, Hen clam

Survival rate & Instantaneous coefficient of total mortality			
	S	Var(s)	Z
Heinke	0.641	0.001	0.445
Catch curve	0.514	NA	0.666
Jackson	0.652	NA	0.428
Chapman & Robson	0.515	0.0005	0.664

Methods	Instantaneous coefficient of natural mortality	Instantaneous coefficient of fishing mortality
Alverson & Carney	0.365	0.299
Zhang & Megrey	0.232	0.432

Age at first capture (t_c)

Age composition of *Mactra chinensis* in the Dong-li self-regulatory community of Busan, Korea

Age(year)	1	2	3	4	5	6	7	8	Total
Number	27	54	33	83	76	52	16	4	345
Percent (%)	7.8	15.7	9.6	24.1	22.0	15.1	4.6	1.2	100.0

$$t_c \doteq \frac{t_a \times P_a + t_b \times P_b}{P_a + P_b} = 3.26 \; l \; yr$$

Biomass

Biomass

Number of operation	Density (inds./㎡)	Mean weight (g)	Total area (km^2)	Catchablity (q)
1	15.85	51.10	0.52	0.52
2	13.82	48.83	0.52	0.52
3	13.51	49.97	0.52	0.52
Mean	14.39	49.97	0.52	0.52

Biomass (mt)	Var (B) by Delta method	95% confidence interval (mt)
713	1.14×10^{15}	645.19~780.43

Biological Reference Points & ABC

BRP

Age at first capture	F_c	$F_{0.1}$	$F_{40\%}$	Y/R(g)		SB/R(g)	
				F_c	$F_{0.1}$	F_c	$F_{40\%}$
3.26	0.432	0.250	0.418	10.71	19.55	24.86	25.45

ABC

$F_{0.1}$	$F_{40\%}$	ABC (mt)
0.250	0.418	260~369

Current self-regulatory community fisheries management system in Dong-li community of Busan, Korea

	Current management system	
Size Limit length	Empirical decision	7 cm (shell length)
Fishing operation season		Nov. ~ Apr.
Amount of released seed		17,216,501 inds.
Catch limit	Self-regulation by experience	530 mt

Summary

Improved self-regulatory community fisheries management system in Dong-li self-regulatory community of Busan, Korea

Objectives	Reference points	Management scheme in Dong-li
1. Maintaining sustainable fisheries production	Catch limit (ABC)	369 mt
2. Maintaining spawning biomass	Limit size Season enclosed	6.25cm (SL) Apr. - Nov.
3. Maintaining optimum fishing intensity	$F_{0.1}$, $F_{x\%}$	0.250/yr ($F_{0.1}$)
		0.418/yr ($F_{40\%}$)
4. Increasing/maintaining stock biomass	B_{MSY}, $B_{x\%}$	491 mt (B_{MSY})
		409 mt ($B_{40\%}$)
5. Maintaining optimal habitat environment	Annual yield for pirate species	500 kg
6. Optimum stock enhancement	Amount of released seed (considering carrying capacity)	14,333,096 inds.

IV Further study

Further study

- Three Ecosystem-based fisheries management plans to be established

Conservation of spawning ground and habitat	**Areas of disturbed spawning ground and habitat**	**% of each spawning ground and habitat that is undisturbed**
Maintaining biodiversity	**% of prey species in diet**	**Minimum % in diet**
Maintaining socio/economic benefit	**Maximum economic yield (MEY)**	**f_{MEY}**