

Artificial Reef

Utility and Implementation in China

Presented by Prof. Li Jilong,
Director, Division of Academic Exchange and Cooperation
/Natural Resource and Ecology Environment Research Center
Chinese Academy of Fishery Sciences
No. 150, West Qingta Rd, Fengtai District
Beijing, 100141, P. R. China

Tel: 86-010-68671170/68690770

Fax: 86-010-68676685/68673940

Mobil: 13621210515

E-mail: lijilong@cafs.ac.n

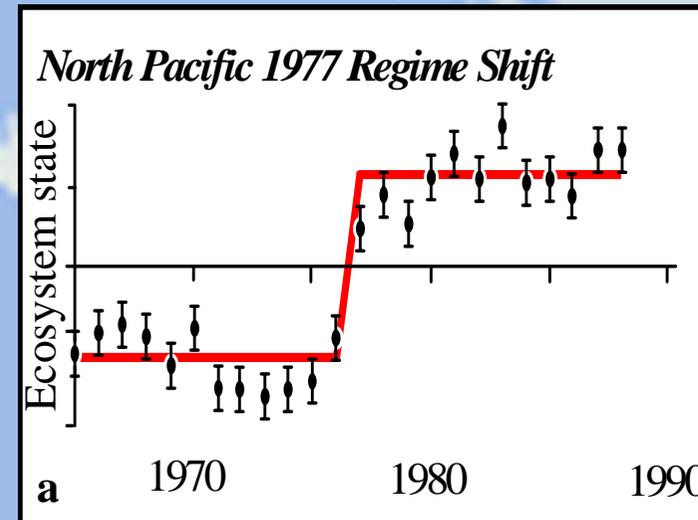
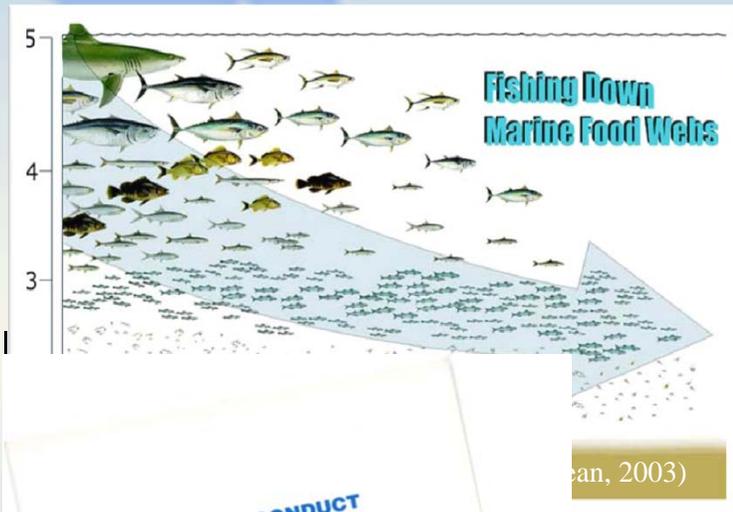
All the data and photos used in this presentation are from the project of “Evaluation of Artificial Reef Construction”, Supported by MOA, China

This project was conducted by prof. Jilong LI, prof. Qing Liu, Mr. Wenbo Yang, Dr. Bin Zhang, prof. Yong Chen, prof. Xiumei Zhang, prof. Shouyu Zhang and prof. Peimao Chen

Is sea food reproducible resources for human!?

Worldwide trend for marine living resources

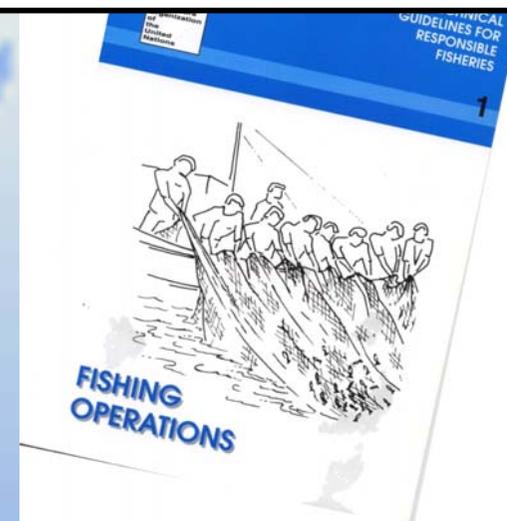
Fishing down: When the large fish at the top of the food web are fished out, fisheries go after smaller fish and invertebrates at lower levels while their trawling destroys marine benthic ecosystem.



1982: United Nations Convention on the Law of the Sea (1982, China)

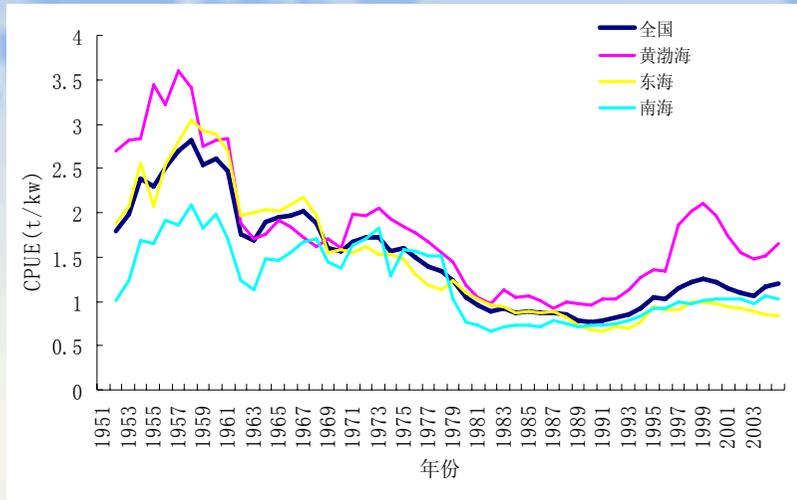
1995: Code of Conduct for Responsible Fisheries (FAO)

2006: Action Plan for Aquatic Resource Conservation, China

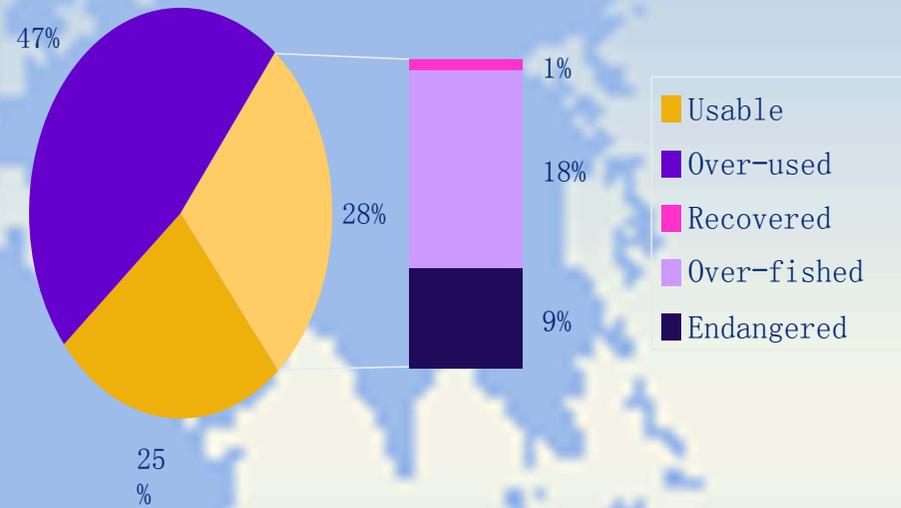


Is sea food reproducible resources for human!?

Trend for marine living resources in China



Changes of CPUE in China (motored and motor-free vessels)



Status of world marine living resources

National Aquatic Resource Conservation Action Plan

State Council of PRC
January, 2006

National Aquatic Resource Conservation Action Plan

- Action 1: Fishing regulation and resource rational exploration
- Action 2: Ecology and habitats conservation for natural waters
- Action 3: Biodiversity/endangered species conservation

- Among these actions, **ARTIFICIAL REEF** was proposed for :
- (1) Increase the quantity for stable and increasable species
 - (2) Increase the quantity of manageable species

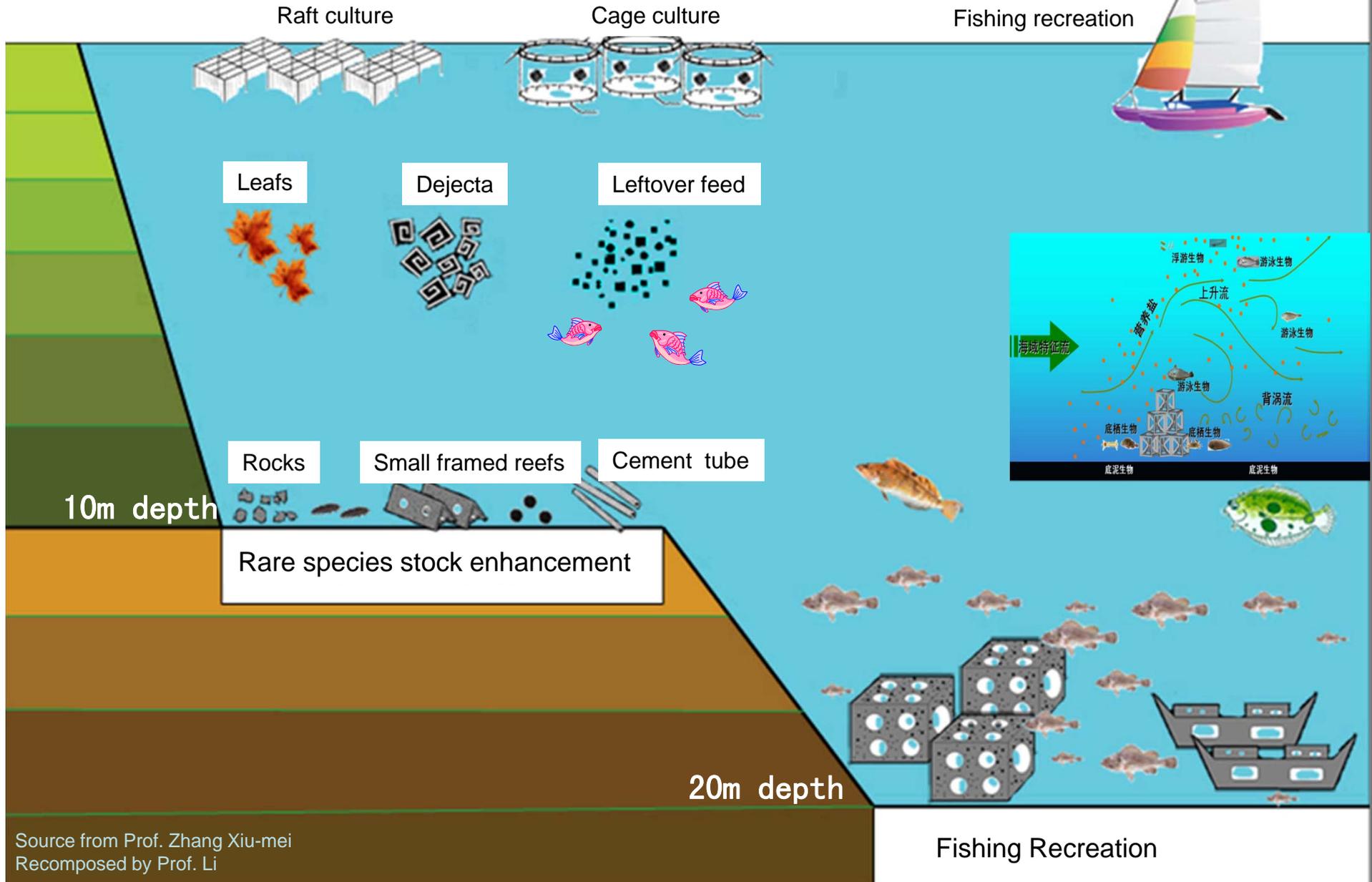
MAIN CONTENTS for

Artificial Reef Practices and Management in China

1. Introduction
2. Main practices of reefs construction
3. Major type of artificial reef with materials
4. Benefits from reefs
5. Management for the artificial reef
6. Key fields for future study

1. Introduction

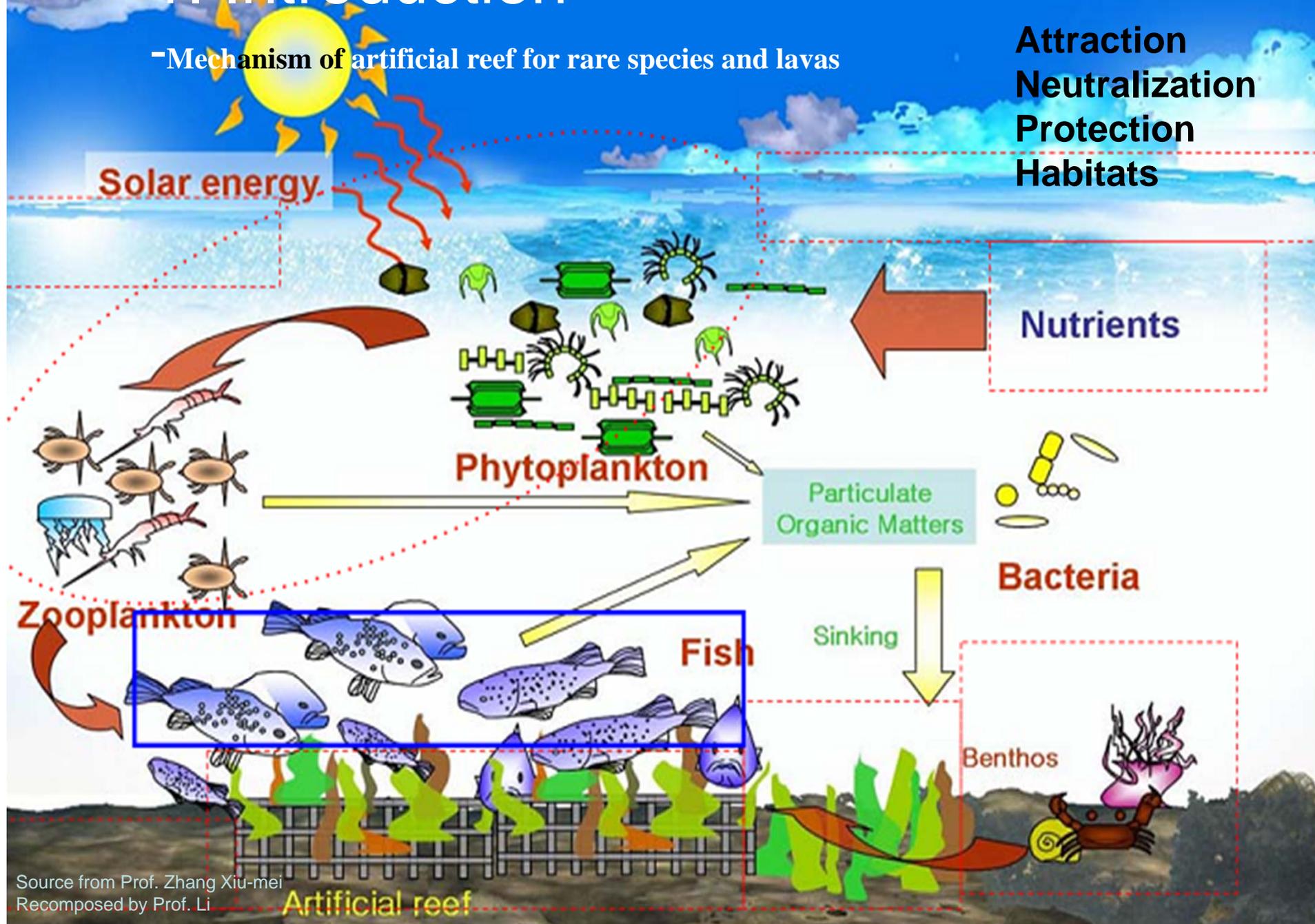
-Diagram of Artificial Reefs and Sea Ranching



1. Introduction

- Mechanism of artificial reef for rare species and lavas

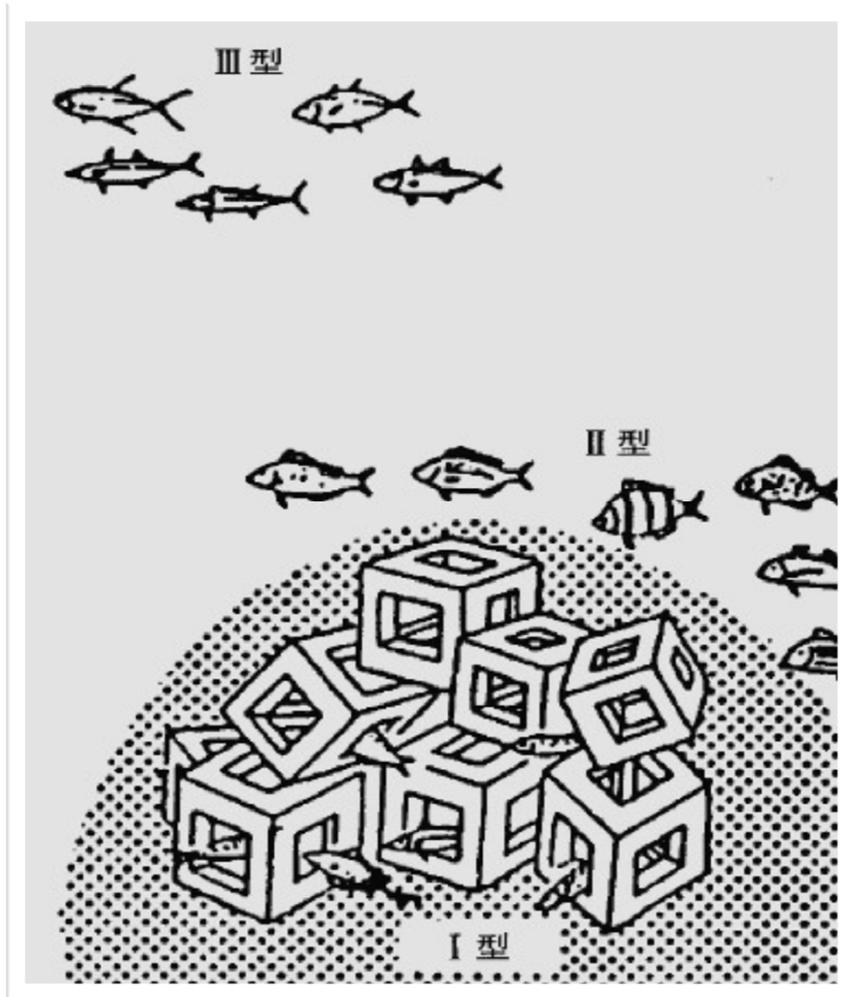
Attraction
Neutralization
Protection
Habitats



Source from Prof. Zhang Xiu-mei
Recomposed by Prof. Li

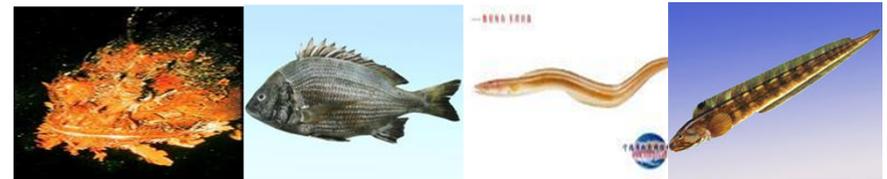
1. Introduction

-Reef Position for different type of fish
(yang et al; 2000)



Fish class I :

褐菖鲉 scorpion fish ,*Sebastiscus marmoratus*,
黑鲷 big-eye bream ,*Sparus macrocephalus*,
星康吉鳗 eel , *Conger myriaster*,
长绵鲷 blenny, *Enchelyopus elongatus*



Fish class II :

石鲽 Stone flounder ,*Kareius bicoloratus*
牙鲆 Flounder *Paralichthys olivaceus*
孔鲆 Common skate. Rav. *Raja norosa* etc



Fish class III :

蓝点马鲛 Spotted Mackerel, *Scomberomorus niphonius*,
鲐 Mackerel, *Pneumatophorus japonicus*,

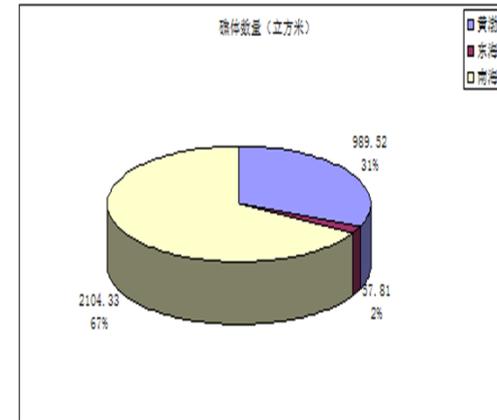


2. Main practices of reefs construction

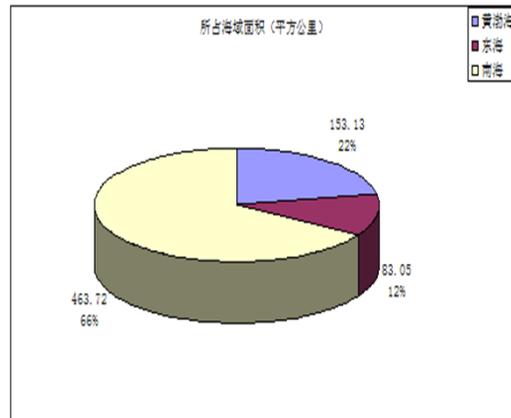
-Distribution Along the Coast



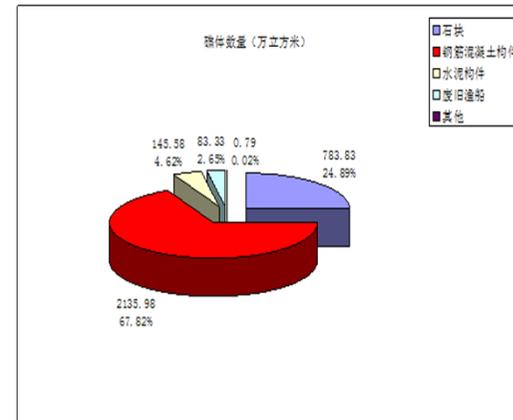
From 1985 to 2010, 31.5 m m³ reefs in volume were constructed, which covers 463.72km²



Among the reefs, 31% in Bohai Sea and Yellow Sea; 2% in East China Sea; 67% in South China Sea in volume.



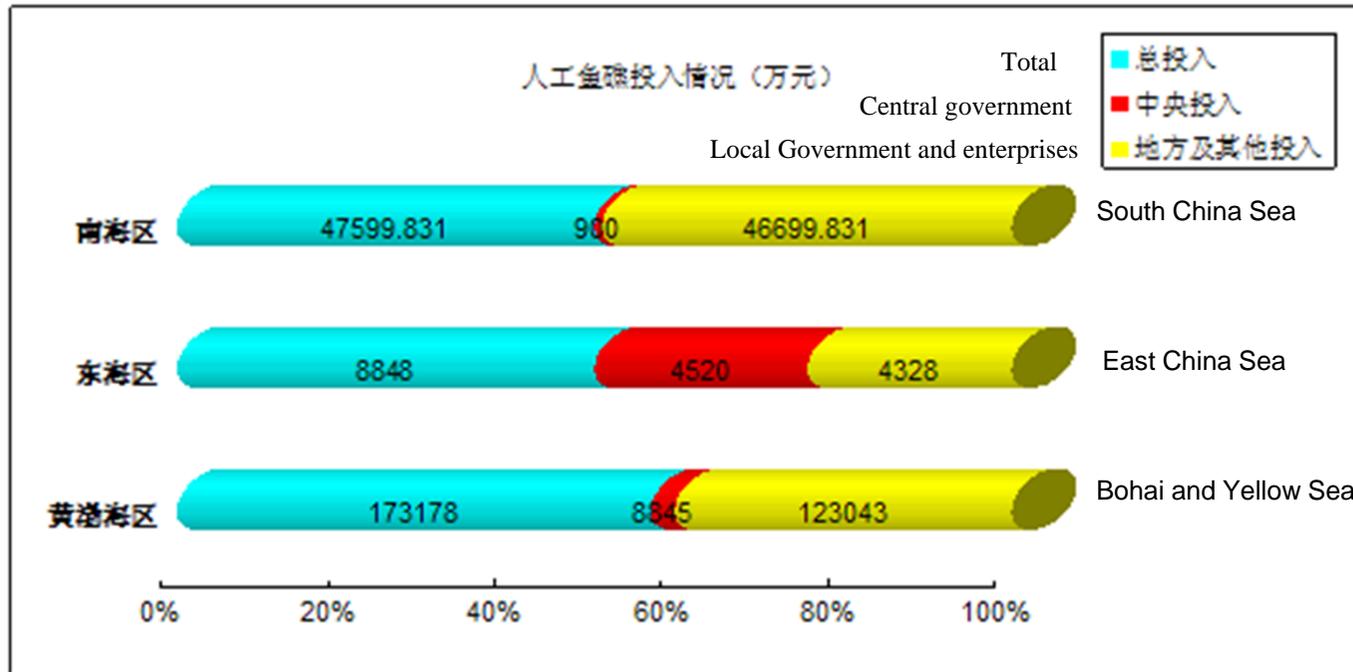
According to the covered area: 22% in Bohai Sea and Yellow Sea; 12% in East China Sea ; 66% in South China Sea.



As for materials used for reefs, Natural rocks mainly for Bohai Sea and Yellow Sea; Cement mainly for East and South China Sea.

2. Main practices of reefs construction

-Investment



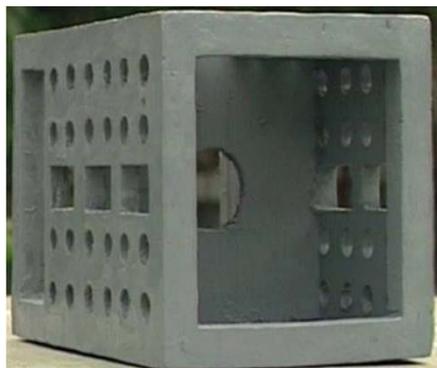
According to the statistics(may not cover all),
From 1985 to 2010, total investment in China is 2.29 billion(RMB), among this,
Central government 0.25 billion(RMB)
Local Government and enterprises 2.04 billion(RMB)

3. Major types of artificial reef

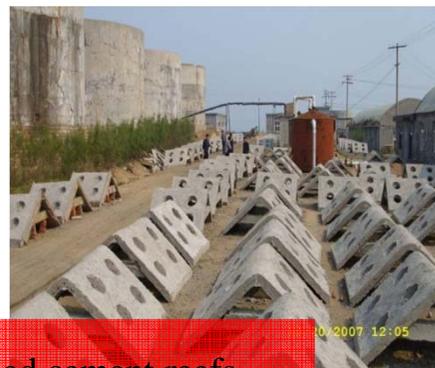
-With Materials



Rock reefs



Different framed cement reefs



3. Major types of artificial reef

-With Function

According to the function of the reefs constructed, they can be classified:

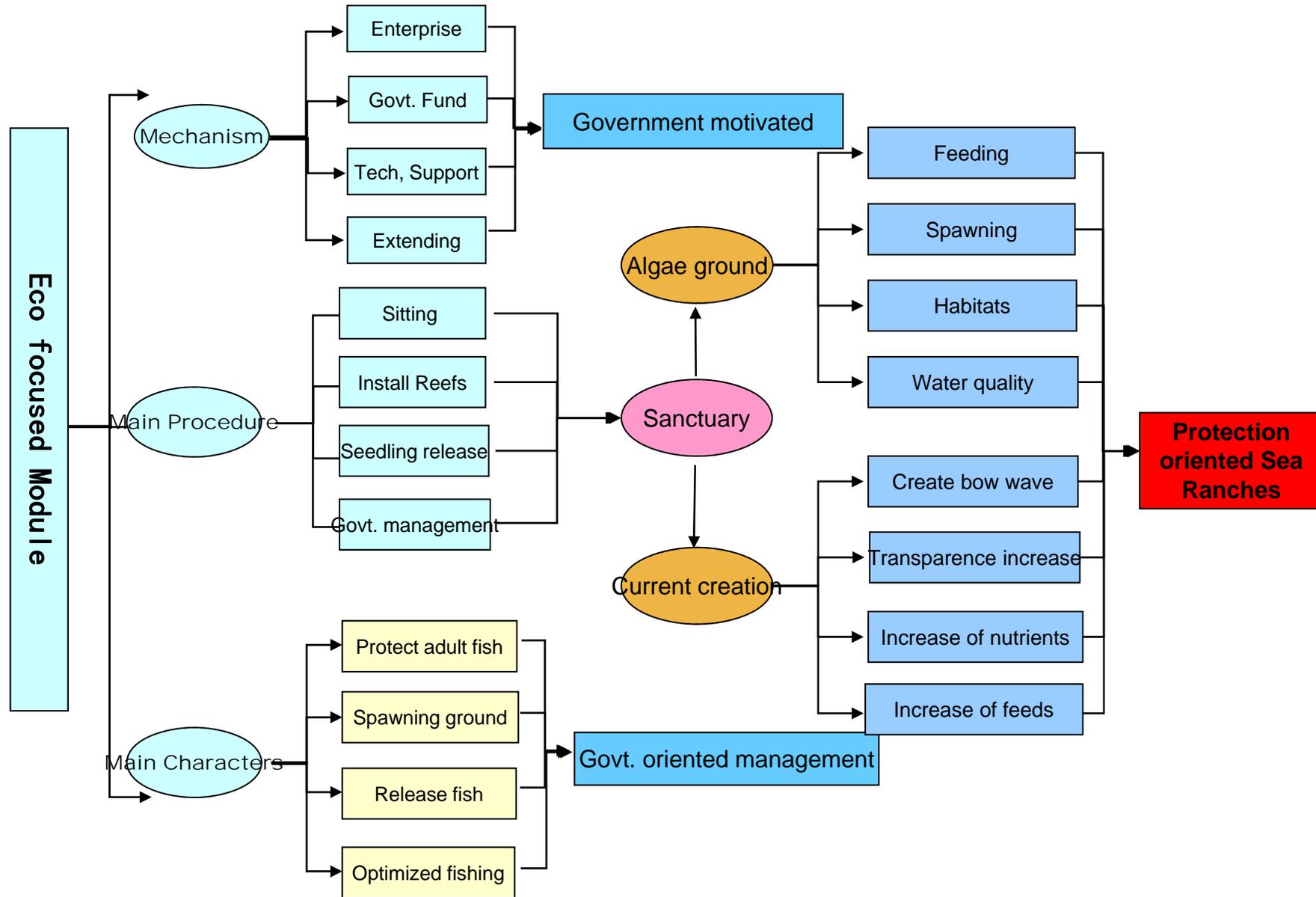
1. Rare species stock enhancement (seed/fingerling releasing and feeding)
2. Reef fish restoration (attracting fish)
3. Coastal ecological environment (habitats) conservation (with algae/grass transplanting)

Distributions of major types of the reefs:

1. Rare species stock enhancement (seed/fingerling releasing and feeding)
 - Liaoning and Shandong provinces,
 - for sea cucumber, abalone and sea hedgehog(海胆)
2. Reef fish restoration (attracting fish)
 - Zhejiang province,
 - for porgy(鲷科鱼类)
3. Coastal ecological environment (habitats) conservation (with algae/grass transplanting)
 - Guangdong, Guangxi, Haina and Jiangsu, Zhejiang, Fujian provinces,
 - for ecology environment (habitats) conservation

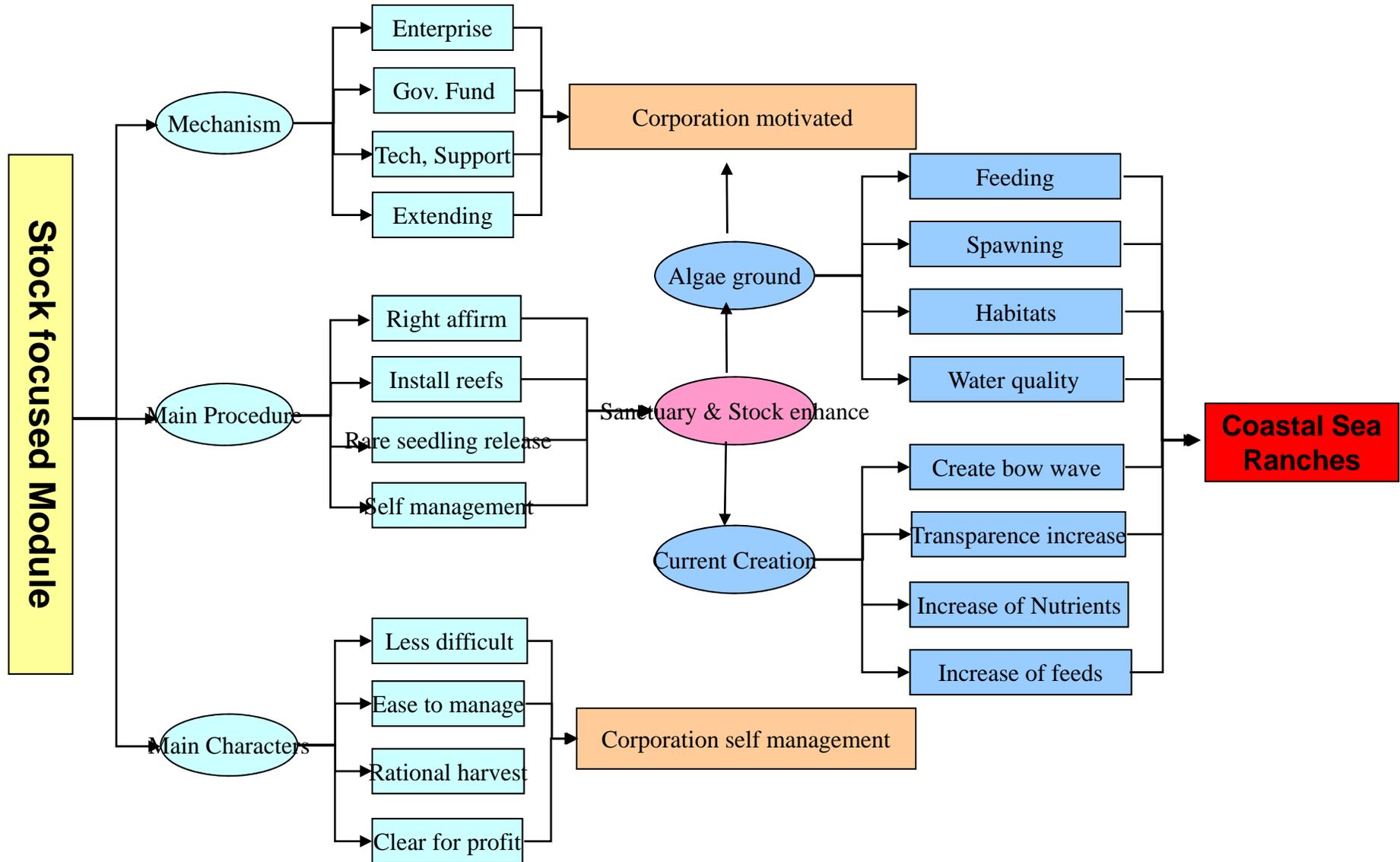
3. Major types of artificial reef

-With Functions



3. Major types of artificial reef

-With Functions



3. Major types of artificial reef

-With Management Module

1. Government initiated

For this module, the government plays a key role for the artificial reef planning, fund collection and management.

2. Enterprise initiated

For this module, the enterprise plays a key role for the artificial reef investment and construction activities under the supervision and guidance of government, and the enterprise manage the course and obtain the benefits from the reefs.

- ◆ Nowadays, enterprise initiated artificial reefs are mainly practiced in the provinces along coast of Bohai and Yellow Sea;
- ◆ However, enterprise initiated artificial reefs are a little more (55 %) than those of government initiated (45 %) in the provinces along coast of East China Sea;
- ◆ Government initiated artificial reefs are mainly practiced in the provinces along coast of South China Sea.

4. Benefits from the Reefs

(1) Ecological benefits

- ◆ Improving water quality, optimizing habitats
- ◆ Protection of fish
- ◆ Improving eutrophic level and primary productivity around the reefs
- ◆ Improving the abundance of food around the reefs
- ◆ Improving the biodiversity level and increase the fishery resource

(2) Economic Benefits

- ◆ Enrich fish species
- ◆ Increase fish catches
- ◆ Enhance the value of catches

(3) Social Benefits

- ◆ Supply high quality sea food to satisfy human's material and culture need and guarantee their health.
- ◆ Promote fishery redevelopment and increase job opportunity, including reef design, construction, transportation and hatchery, recreation, restaurant.
- ◆ Help readjustment of fisheries, shift fishermen from fishing to resource management and conservation.



4. Benefits from the Reefs

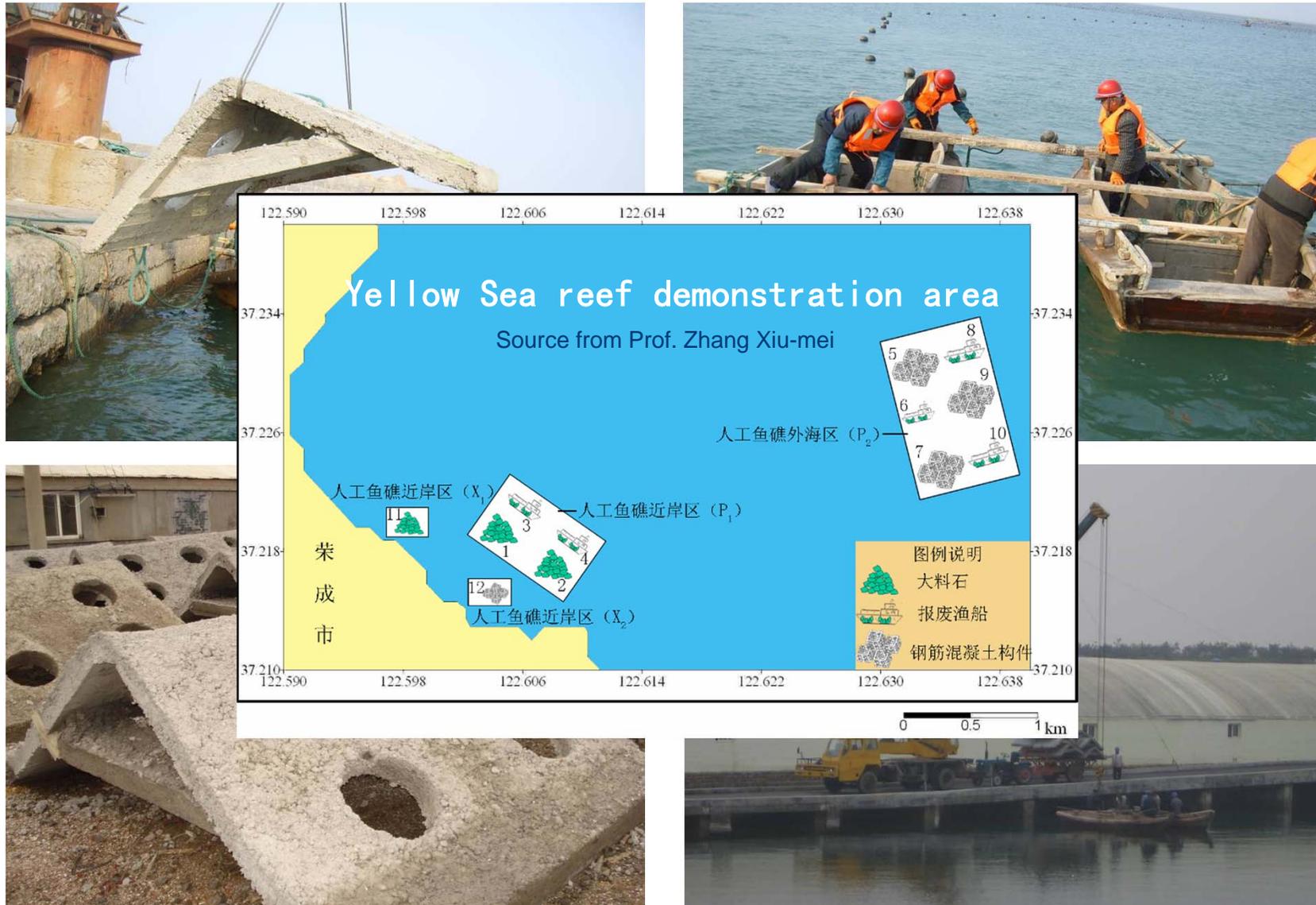
(3) Example for special case

- ◆ Shandong: from 2006, 16 demonstration artificial reefs were constructed, with a total scale of 1195.2ha. To the year of 2009, rare sea species catches from the reef reached 958t, with an increase of fish catches of 600t, valuing 143.8m (RMB) with a net profit of 87.27m (RMB).
- ◆ Zhejiang: for the reefs of Shanhenshan in Chengsi county, after 2 years of reef construction, 50 vessels fishing around reefs accumulated 13.2 m (RMB) with a net profit of 8.9 m (RMB); moreover, reefs attracted more than 4000 people for fishing recreation and obtained 1.60 m (RMB) add value.
- ◆ Guangdong: in Dongsheng village, average annual income for fishermen were less than 5000(RMB), while it reached 6500(RMB) after reefs constructed.



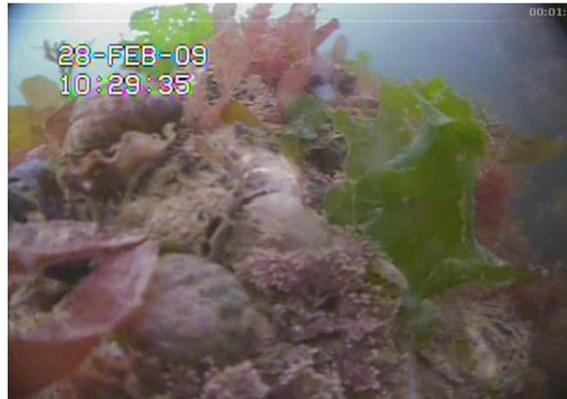
4. Benefits from the Reefs

(3) Example for special case-Lidao, Shandong



4. Benefits from the Reefs

(3) Example for special case -Lidao, Shandong



Source from Prof. Zhang and Chen

Organism affiliated to reefs

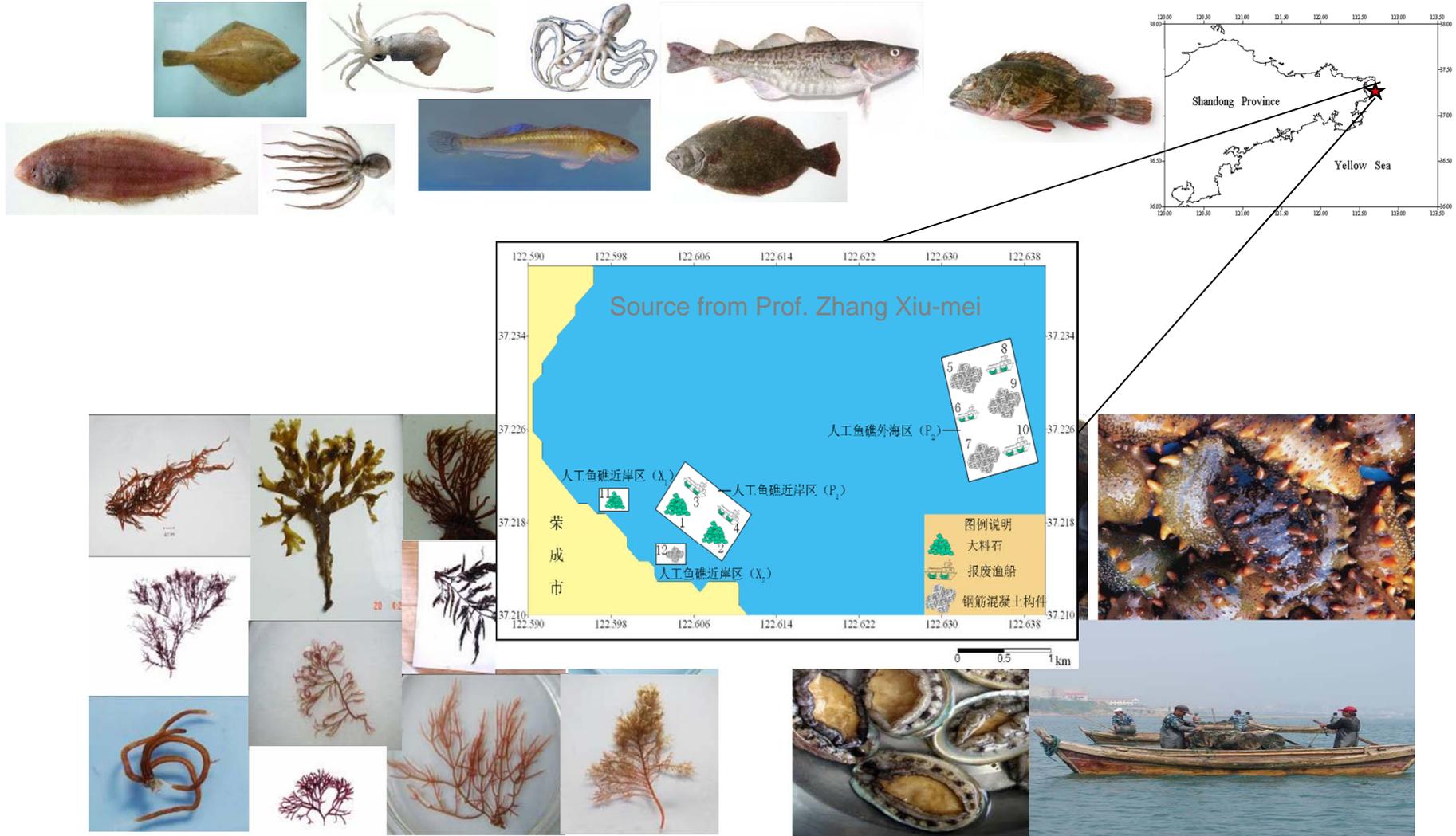
4. Benefits from the Reefs

(3) Example for special case -Lidao, Shandong



5. Management for the artificial reef

-Bearing capacity evaluation With ECOPATH, Lidao as an example



- With ECOPATH, Sea Cucumber stock capacity, **206 kg /mu/year, 31.72%**
- With ECOPATH, abalone stock capacity, **132.57 kg /mu/year. 52.80%**

5. Management for the artificial reef

-Bearing capacity evaluation With ECOPATH, Lidao as an example



	Group	Consumer	Producer	Detritus
1	I style fish	+		
2	II style fish	+		
3	III style fish	+		
4	Sebastes schlegelii	+		
5	Hexagrammos otakii	+		
6	Small Demersal fish	+		
7	Small Pelagic fishes	+		
8	Stichopus japonicus	+		
9	Haliotis discus hannai	+		
10	Crustacean	+		
11	Cephalopods	+		
12	Mollusca	+		
13	Echinoderm	+		
14	Other benthos	+		
15	Zooplankton	+		
16	Heterotrophic bacteria	+		
17	Bethic algle and seaweed		+	
18	Phytoplankton		+	
19	Detritus			+



Haliotis discus hannai



Stichopus japonicus



Hexagrammos otakii



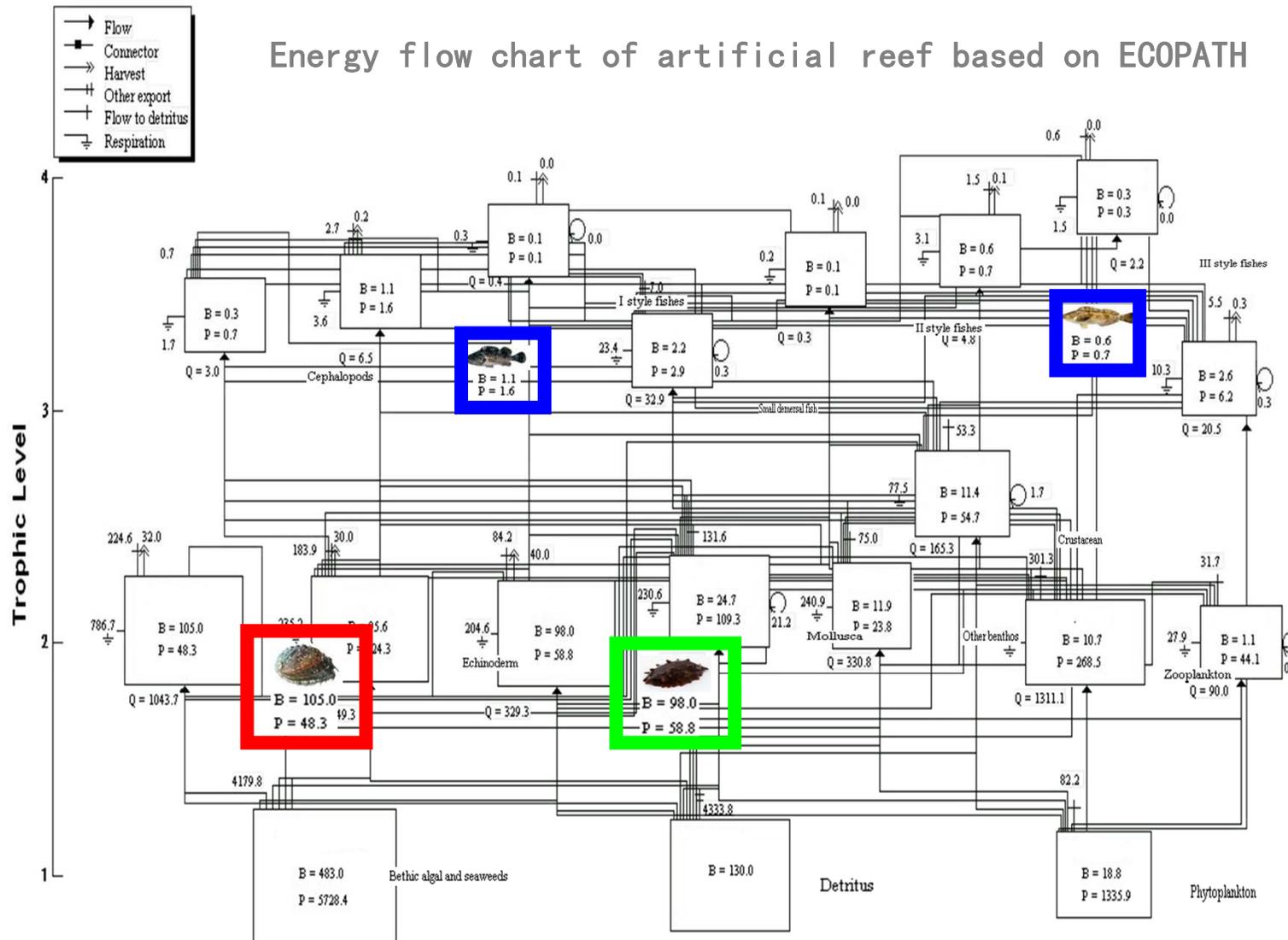
Sebastes schlegelii

With ECOPATH module
Character of reef Ecosystem and bearing capacity
of sea cucumber and abalone were calculated

5. Management for the artificial reef

-Bearing capacity evaluation With ECOPATH, Lidao as an example

Energy flow chart of artificial reef based on ECOPATH



5. Management for the artificial reef

-Reef Construction Procedure Comparison with US

Policy Statement of the National Marine Sanctuary Program: Artificial Reef Permitting Guidelines(2005)

National artificial reef plan: guideline for siting, construction, development, and assessment of artificial reefs (2007)

**POLICY STATEMENT OF THE
NATIONAL MARINE SANCTUARY PROGRAM:
ARTIFICIAL REEF PERMITTING GUIDELINES**

PURPOSE

The purpose of this policy is to address how the National Marine Sanctuaries Program will consider proposals to establish artificial reefs in sanctuaries. This policy will build upon, not replace, the National Artificial Reef Plan developed in accordance with the Fishing Enhancement Act. Nothing in this policy is meant to conflict with other laws and this policy only applies to activities within designated national marine sanctuaries.

BACKGROUND

Artificial reef development is generally prohibited in national marine sanctuaries and may only be undertaken in these areas for educational, research, and historic purposes. Because the impacts of artificial reefs are not entirely understood, the program will proceed cautiously in considering permits for artificial reef development. The program will use information obtained from monitoring artificial reefs currently in place to determine the extent and type of future artificial reef development.

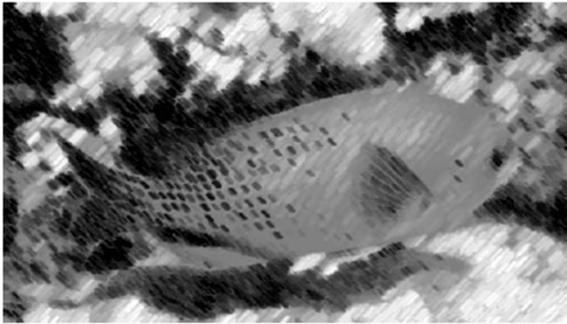
DEFINITION

For the purposes of this policy, artificial reef development is defined as placing any material or matter in an area of the marine environment which does not exist under natural circumstances for the purpose of protecting, regenerating, or increasing populations of living marine resources, or for enhanced recreational purposes. The replacement of vertical relief using artificial or natural structures where relief has been removed through anthropogenic forces (e.g., the restoration of a reef) is not considered artificial reef development under this definition.

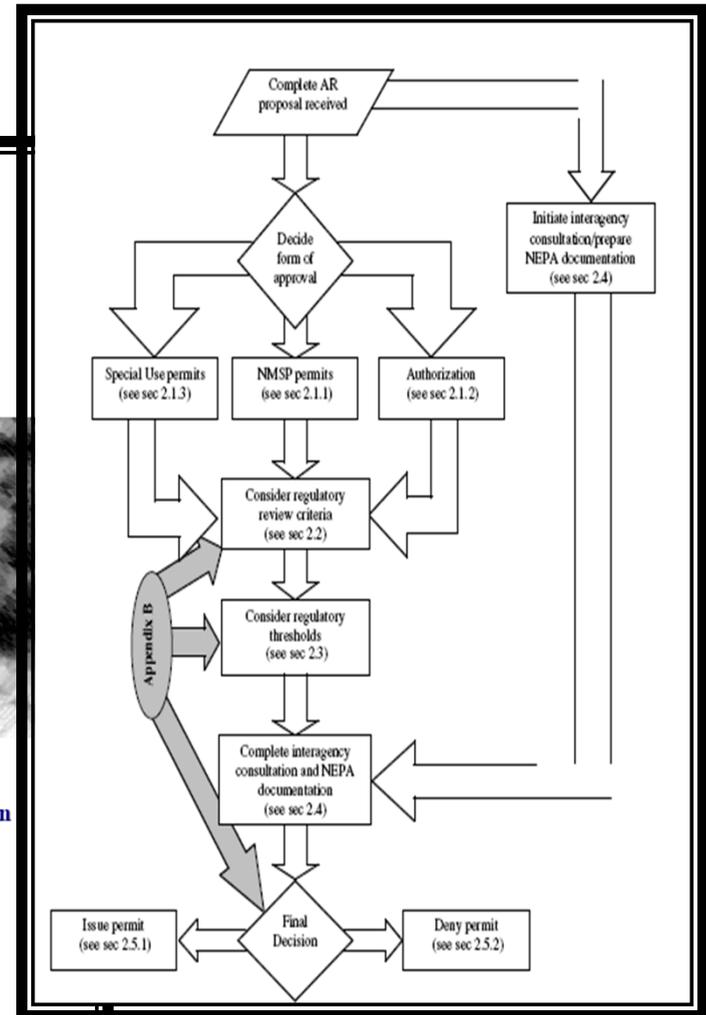
POLICY STATEMENT

It is the policy of the NMSP to review permit applications for artificial reef development consistent with the guidelines contained herein. The NMSP will approve artificial reef development projects only when they are found to be consistent with the guidelines described in these guidelines.

**National Artificial Reef Plan
(as Amended):
Guidelines for Siting, Construction,
Development, and Assessment of
Artificial Reefs**



**United States Department of Commerce
National Oceanic and Atmospheric Administration
February 2007**

5. Management for the artificial reef

-Reef Construction Procedure Comparison with US

National Aquatic Resource Conservation Action Plan

State Council of PRC
January, 2006

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Action 1: Fishing regulation and resource rational exploration

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Among these action, ARTIFICIAL REEF was proposed for :

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- (2) Increase the quantity of manageable species

农业部办公厅 财政部办公厅关于印发 《2011年渔业资源保护和转产转业项目实施指导意见》的通知

各有关省（自治区、直辖市、计划单列市）农业厅（局、委）、财政厅（局），新疆生产建设兵团水产局、财务局，中国水产科学研究院：

为贯彻落实党的十七届三中全会提出的“加强水生生物资源养护，加大增殖放流力度”，进一步加大对水生生物资源的养护和修复力度，2011年中央财政继续安排转产转业和渔业资源保护转移支付专项资金。现将《2011年转产转业和渔业资源保护项目实施指导意见》印发给你们，请遵照执行。

附件：2011年度渔业资源保护和转产转业项目实施指导意见

二〇一一年四月二十九日

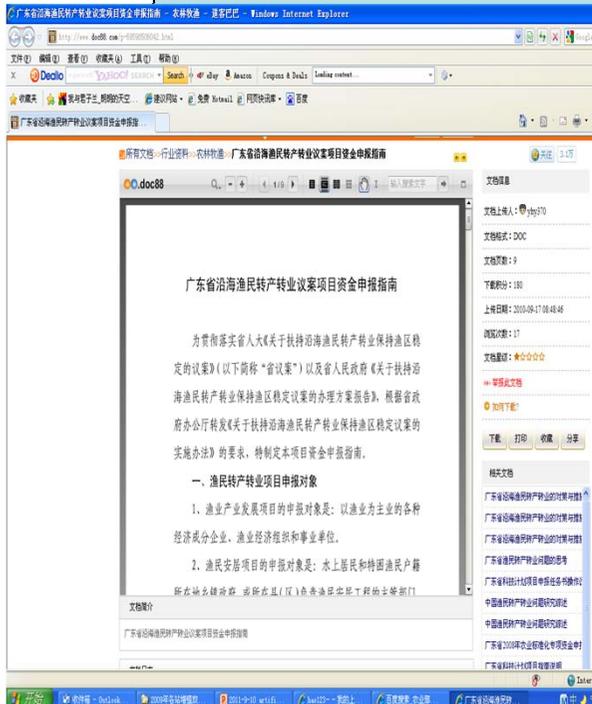
附件：

2011年渔业资源保护和转产转业项目实施指导意见

一、项目内容

渔业资源保护和转产转业项目主要包括水生生物增殖放流、海洋牧场示范区建设、沿海渔民减船转产三项内容。

Projects for reef construction usually evaluated by experts, There is fixed guidelines to regulate artificial reef siting , construction, development, and assessment of artificial reefs clearly



6. Sum up for China artificial reefs practices

A large amount of money were invested in reef construction and sea ranching, artificial reefs distributed all over along the coast where it may be suited: however,

- (1) habitats creation: mainly based on small reefs with varied materials; lack of techniques related to large scale reefs with fair organism affiliation and improving deserted sea bed;
- (2) Stock enhancement: fingerlings released were mainly larvae and junior fish; lack of techniques related to junior fish protection and feed organism cultivation;
- (3) Target species domestication: only found for inland waters such as lakes and reservoirs, there is no report found for marine species;
- (4) Control of output: the key procedure for reef based sea ranching, however, there is lack of long term monitoring for most reef species including the size and number of fish for catching;
- (5) Planning and site selection: a complicated man made eco-system; however, RS and GIS are not fully used; basic investigation are also not implemented for all the reef site selection;
- (6) Management capability: lack of fully supported reef management institutional and policies research;

7. Further Studies

- (1) Techniques for deep sea reef constructed;
- (2) Techniques for timely **last** reefs?
- (3) Studies on carrying capacity for reef area stock enhancement;
- (4) Project phase-over management, government or enterprise initiated;
- (5) Techniques for spawning ground protection reefs while the species is suitable;
- (6) Techniques for regulating upwelling and primary productivity;
- (7) Regulations both for reef construction procedure and techniques;
- (8) Improving capability for result monitoring and assessment;
- (9) Affirmance and management for reef protected waters;
- (10) Resource management and admittance to avoid competition fishing.



Thank you !