The marine fisheries resource utilization, ecosystem impacts and fisheries management in China

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Systematic distortions in world fisheries catch trends

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Over 75% of the world marine fisheries catch (over 80 million tonnes per year) is sold on international markets, in contrast to other food commodities (such as rice)[1,2]. At present, only one institution, the Food and Agriculture Organization of the United Nations (FAO) maintains global fisheries statistics. As an intergovernmental organization, however, FAO must generally rely on the statistics provided by member countries, even if it is doubtful that these correspond to reality. Here we show that misreporting by countries with large fisheries, combined with the large and widely fluctuating catch of species such as the Peruvian anchoveta, can cause globally spurious trends. Such trends influence unwise investment decisions by firms in the fishing sector and by banks, and prevent the effective management of international fisheries.

World fisheries catches have greatly increased since 1950, when the FAO of the United Nations began reporting global figures[3]. The reported catch increases were greatest in the 1960s, when the traditional fishing grounds of the North Atlantic and North Pacific became fully exploited, and new fisheries opened at lower latitudes

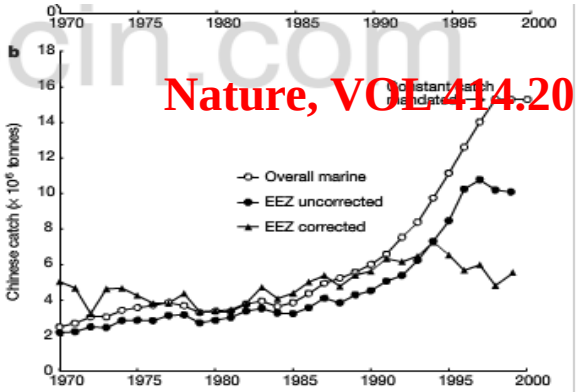
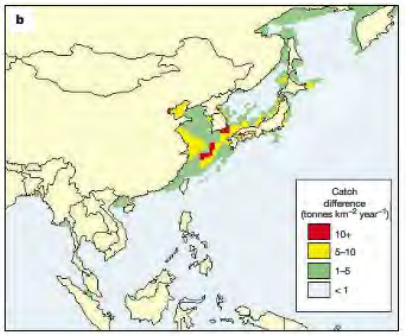


Figure 1 Time series of global and Chinese marine fisheries catches (1950 to present). **a**, Global reported catch, with and without the highly variable Peruvian anchoveta. Uncorrected figures are from FAO (ref. 3); corrected values were obtained by replacing FAO figures by estimates from **b**. The response to the 1982–83 El Niño/Southern Oscillation (ENSO) is not visible as anchoveta biomass levels, and hence catches were still very low from the effect of the previous ENSO in 1972 (ref. 4). **b**, Reported Chinese catches (from China's exclusive economic zone (EEZ) and distant water fisheries) increased exponentially from the mid-1980s to 1998, when the 'zero-growth policy' was introduced. The corrected values for the Chinese EEZ were estimated from the general linear model described in the Methods section.

Nature, VOL 414.2011



Nature, news, 2011

✓ **Over-reported China coastal fisheries;**

FISH and FISHERIES

China's distant-water fisheries in the 21st century

Daniel Pauly[1], Dyhia Belhabib[1], Roland Blomeyer[2], William W W L Cheung[3], Andrés M Cisneros-Montemayor[4], Duncan Copeland[1], Sarah Harper[1], Vicky W Y Lam[3,4], Yining Mai[1], Frédéric Le Manach[1,5], Henrik Österblom[6], Ka Man Mok[1], Liesbeth van der Meer[2], Antonio Sanz[2], Soohyun Shon[1], U Rashid Sumaila[4], Wilf Swartz[4], Reg Watson[7], Yunlei Zhai[1] & Dirk Zeller[1]

Abstract

We conservatively estimate the distant-water fleet catch of the People's Republic of China for 2000–2011, using a newly assembled database of reported occurrence of Chinese fishing vessels in various parts of the world and information on the annual catch by vessel type. Given the unreliability of official statistics, uncertainty of results was estimated through a regionally stratified Monte Carlo approach, which documents the presence and number of Chinese vessels in Exclusive Economic Zones and then multiplies these by the expected annual catch per vessel. We find that China, which over-reports its domestic catch, substantially under-reports the catch of its distant-water fleets. This catch, estimated at 4.6 million t year^{-1} (95% central distribution, 3.4–6.1 million t year^{-1}) from 2000 to 2011 (compared with an average of 368 000 t year^{-1} reported by China to FAO), corresponds to an ex-vessel [illegible] (95% [illegible] billion). Chinese distant-water fleets extract the largest catch in African waters (3.1 million t year^{-1}, 95% central distribution, 2.0–4.4 million t), followed by Asia (1.0 million t year^{-1}, 0.56–1.5 million t). Oceania (198 000 t year^{-1}, 144 000–262 000 t), Central and South America (182 000 t year^{-1}, 94 000–299 000 t) and Antarctica (48 000 t year^{-1}, 8 000–129 000 t). The uncertainty of these estimates is relatively high, but several sources of inaccuracy could not be fully resolved given the constraints inherent in the underlying data and method, which also prevented us from distinguishing between legal and illegal catch.

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4.6 million tons per year

✓ **Under-reported China distant-water fisheries;**

Towards sustainability in world fisheries

Daniel Pauly, Villy Christensen, Sylvie Guénette, Tony J. Pitcher, U. Rashid Sumaila, Carl J. Walters, R. Watson & Dirk Zeller

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About

Fish feed for aquaculture. Unidentified species of finfish, mollusks, crustaceans, and cnidaria from the trash fish component of nontargeted fisheries packaged and frozen for delivery for a fishmeal factory in Maoming, Guangdong province, China.

Science, 2015

GLOBAL FOOD SUPPLY

China's aquaculture and the world's wild fisheries

Curbing demand for wild fish in aquafeeds is critical

By **Ling Cao[1], Rosamond Naylor[1]*, Patrik Hen**

decades (SM). Aquaculture systems throughout the country are intensifying as producers seek higher returns on scarce land, water, and coastal zone resources (*2*). Intensification is reflected in higher stocking densities, greater reliance on commercial feeds, and

lated feeds) to monocultures or polycultures containing high-valued species dependent on feeds (*2*, *11*).

Fish farming remains a highly diverse industry in China and is influenced by a variety of government directives and policies (SM). More than 100 freshwater and 60 marine fish species are raised in habitats and infrastructures that include ponds, cages in lakes and coastal waters, and raft and bottom-sowing systems in shallow seas and mud flats (*2*,

trade (*7*, *8*) makes it especially difficult to

2 comments

China's aquaculture industry may tip balance in world fish supplies, Stanford researchers report

The deep trut

By Jim Haw

By Justi

What is the truth of China fisheries?

China's economy and population are growing rapidly. As their population increases, so does the demand for food. Feeding 1.3 billion people is no small feat, so being resourceful is essential; China has started looking everywhere possible for food, including the world's oceans, lakes, and rivers. Can a country so large remain resourceful *and* sustainable in its search to find enough seafood to support its people? The answer to this question will have worldwide ramifications, as most major oceanic fisheries are in decline and may not be able to withstand increased fishing pressure.

At a factory in Guangdong, China, piles of frozen assorted fish are used to produce low-quality fishmeal. (Courtesy of Stanford University) (Patrik Henriksson: courtesy of Stanford University)

By Benjamin Alexander-Bloch, NOLA.com | The Times-Picayune

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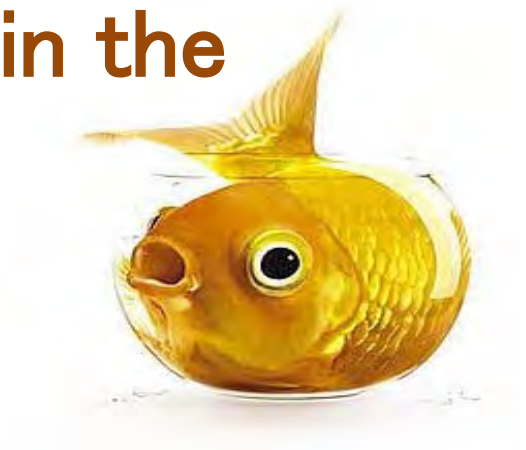
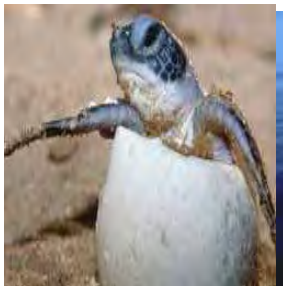
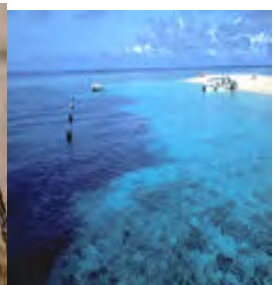
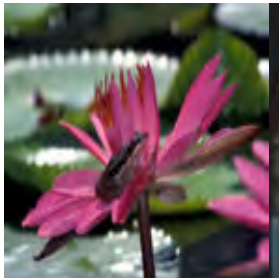
Goal of this presentation

- What is the truth of China fisheries?
- What are current and expected ecosystem impacts?
- What mitigation actions are in the fisheries management?

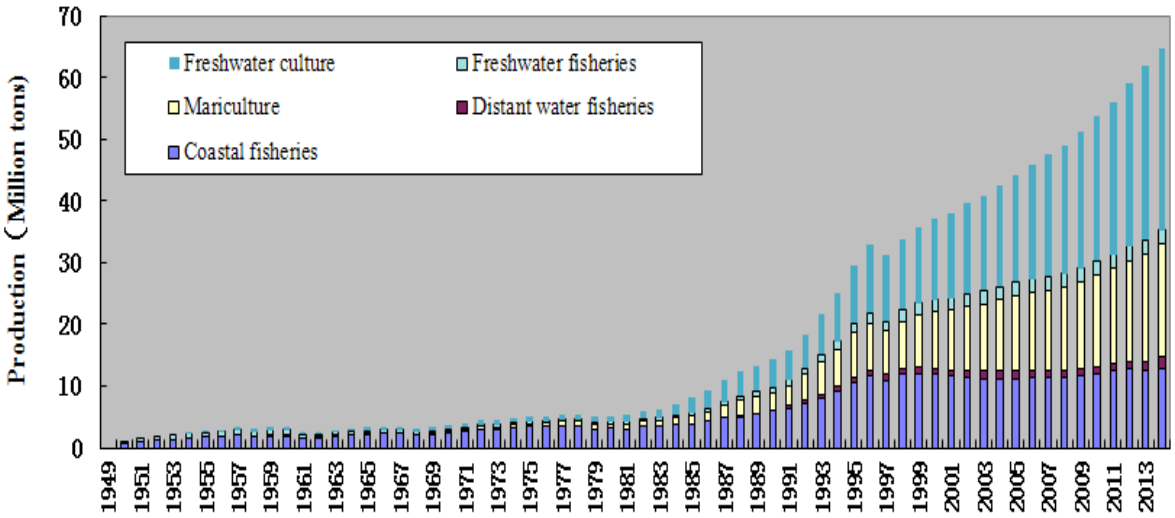


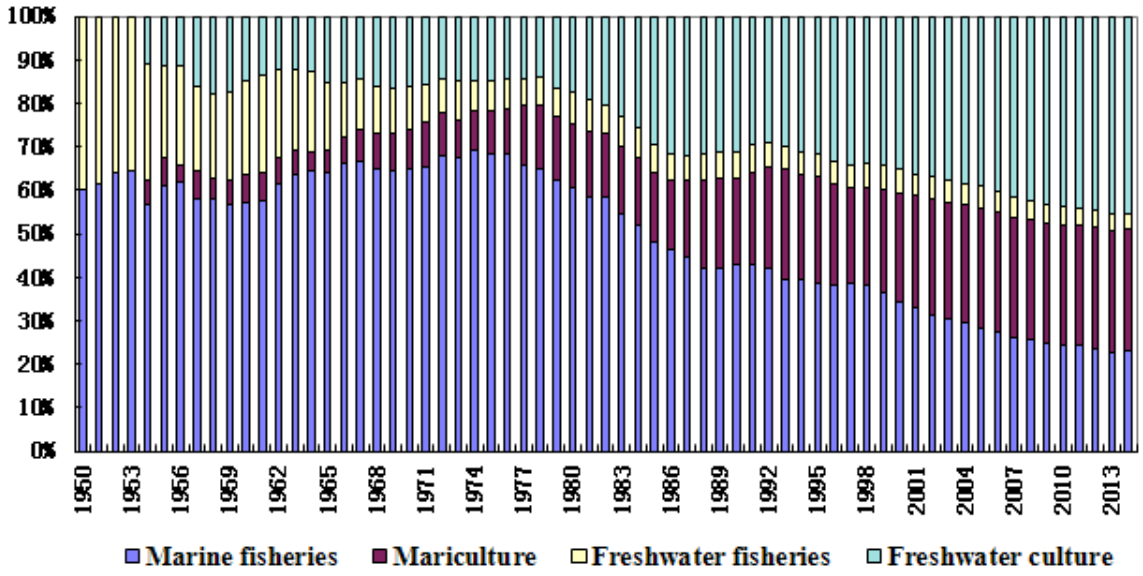
What is the truth of China fisheries?


What is the current status of fisheries?





2014 (Tons)

- **Total：64.61 million**
- **Marine capture： 14.827 million (12.80 million +2.027 million)**
- **Mariculture：18.12 million**
- **Freshwater culture：29.35 million**
- **Freshwater capture：2.295 million**

Year	Marine fisheries	Mari-culture	Freshwater Fisheries	Freshwater culture
1950s	60.2	5.5	21.6	14.2
1960s	63.0	6.4	16.2	14.4
1970s	66.4	11.0	7.5	15.0
1980s	50.6	16.6	6.6	26.2
1990s	39.7	22.9	5.5	31.9
2000s	29.1	26.9	4.9	39.1
2010s	23.5	27.8	4.0	44.5

Landings/catch data?

- Discard (developed countries) --30%, FAO;
- No discard in China, and the catch data also included *Acetes* shrimps, shellfish, jellyfish, algae.

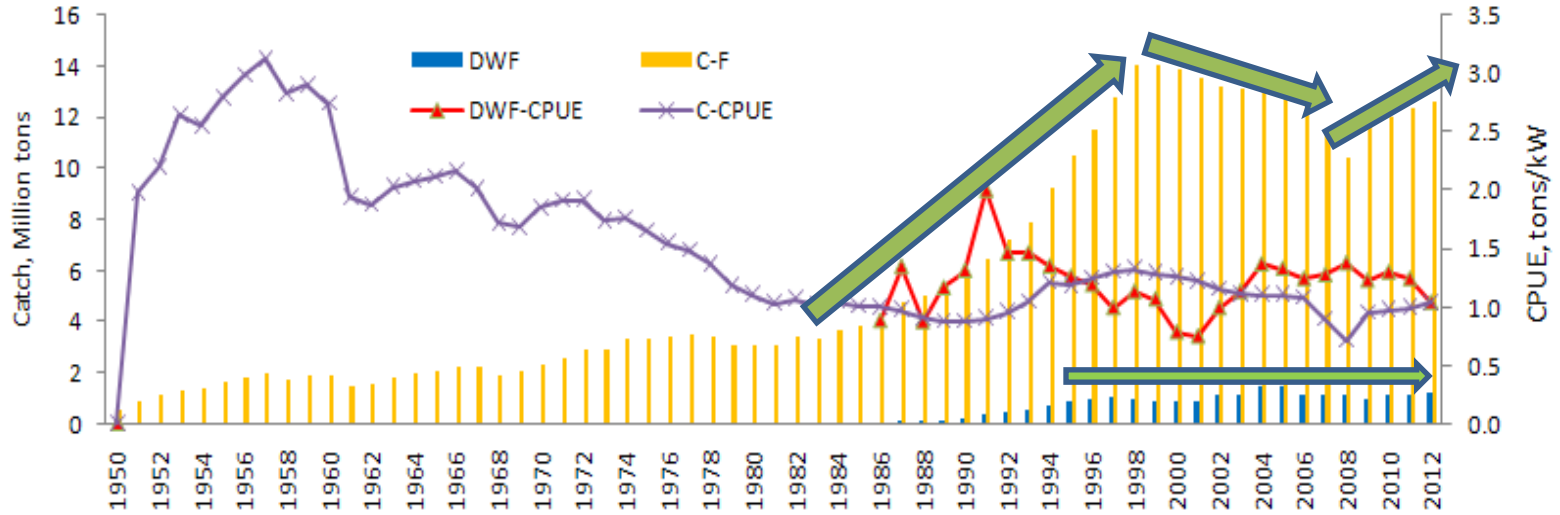
Low trophic level harvest

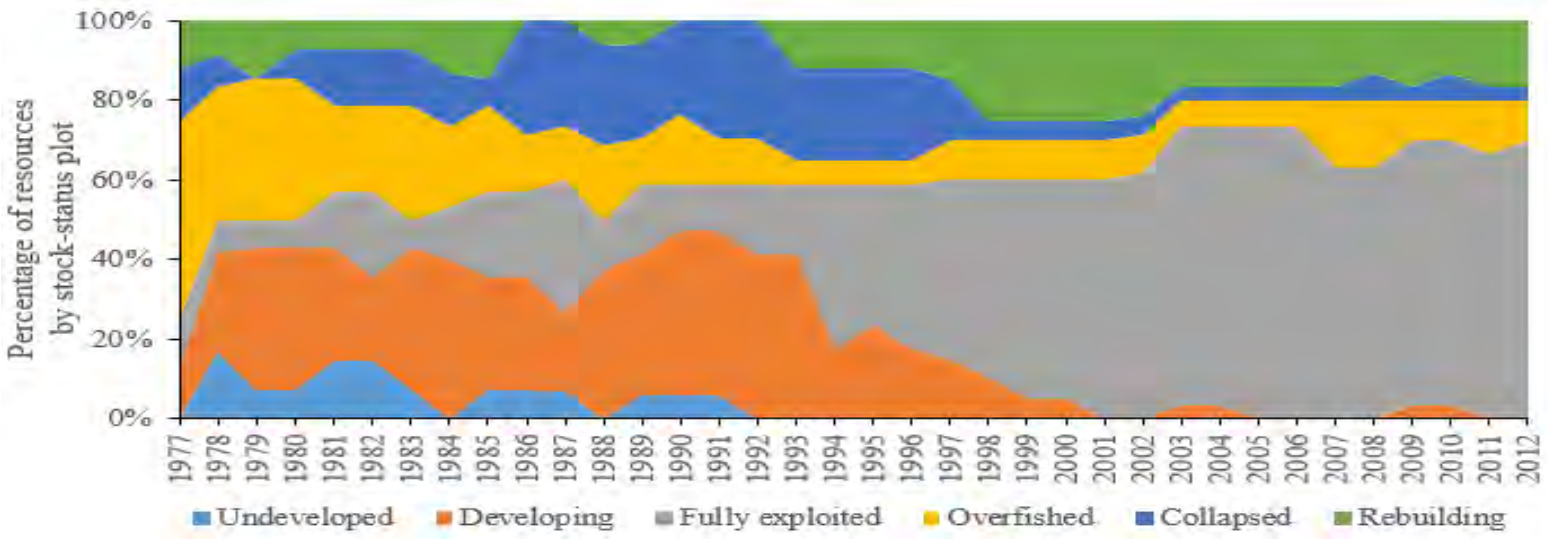
- ✓ phyto---seaweeds
- ✓ Zoo- Acetes shrimps, jellyfish
- ✓ mollusks (shellfishs, squids)
- ✓ Small sized fish (so called trash fish)
- ✓ Predators

Whole food chain

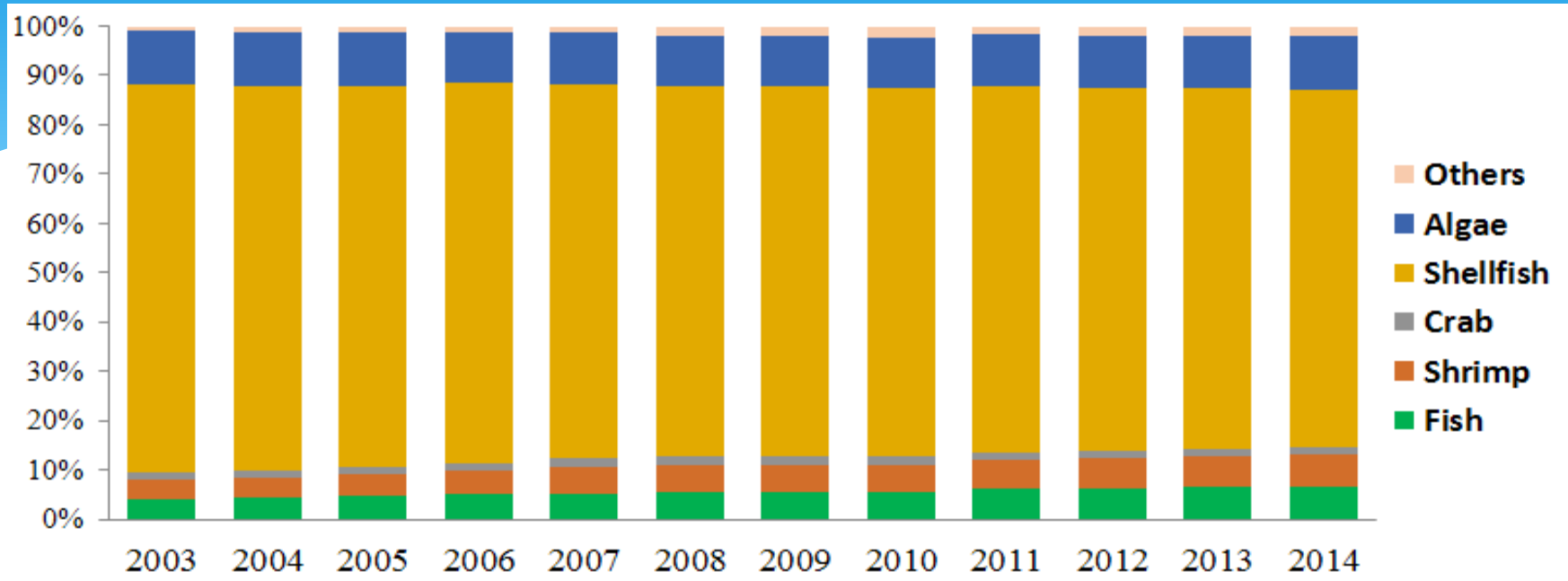
Food culture; Huge population

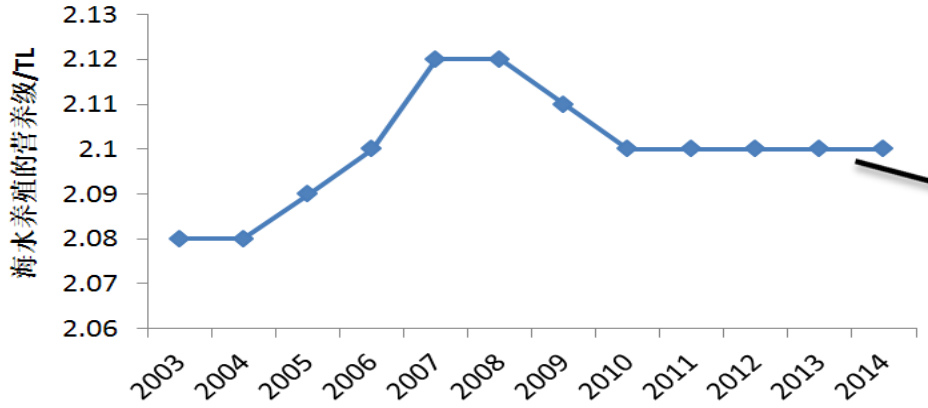
China coastal fisheries





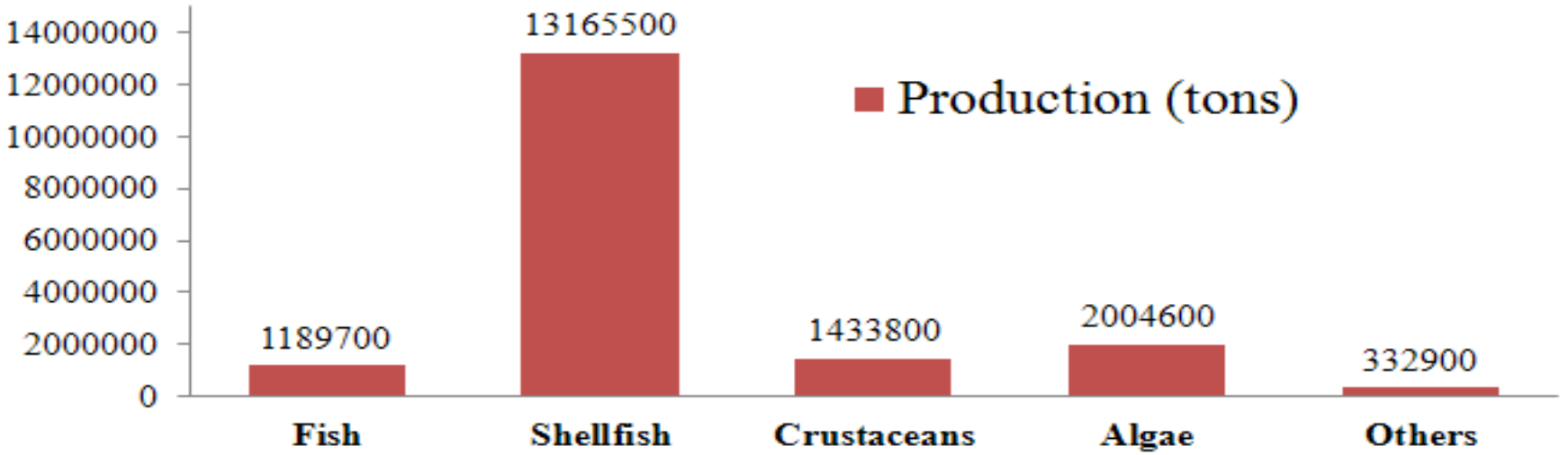
China Mariculture





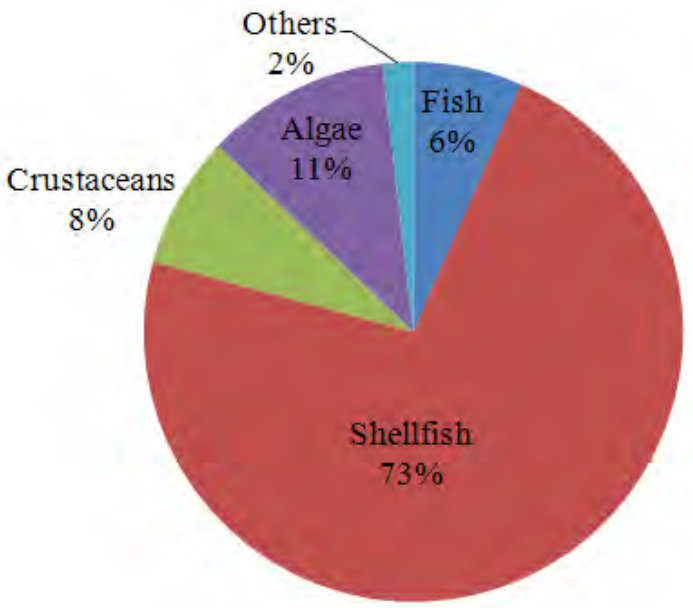
Changes of mean trophic level of China mariculture ;

Much lower than 3-3.5 (the TL in the other countries from Mariculture



2014

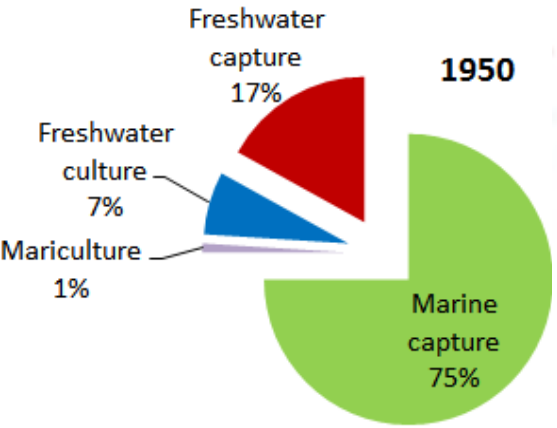
- **No-feeding production (shellfish & algae) in mariculture: 15.17 million, 83.69%;**
- **No feeding production in freshwater culture and mariculture: 29.7 million, 54.8% (>30% average no feeding production ratio, Orsen, 2011)**



Changes in fishery production mode and structure

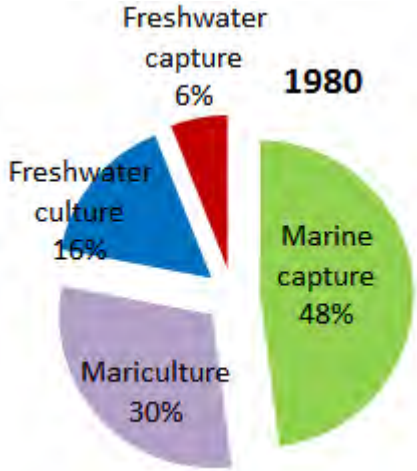
0.5 million tons

C:A=92:8



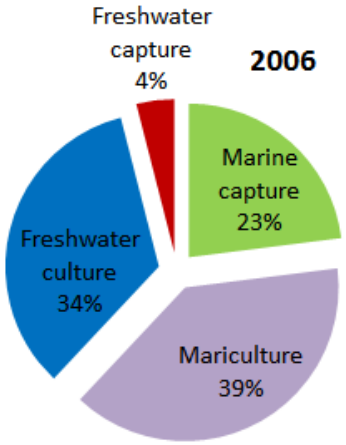
5 million tons

C:A=54:46



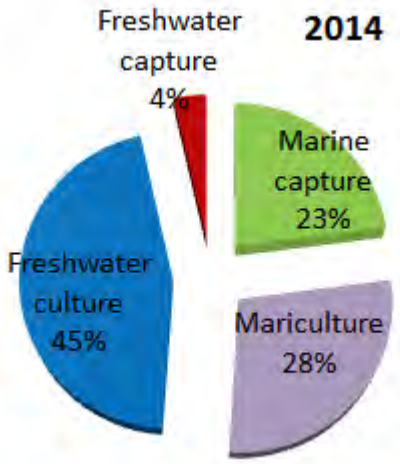
51.16 million tons

C:A=27:73



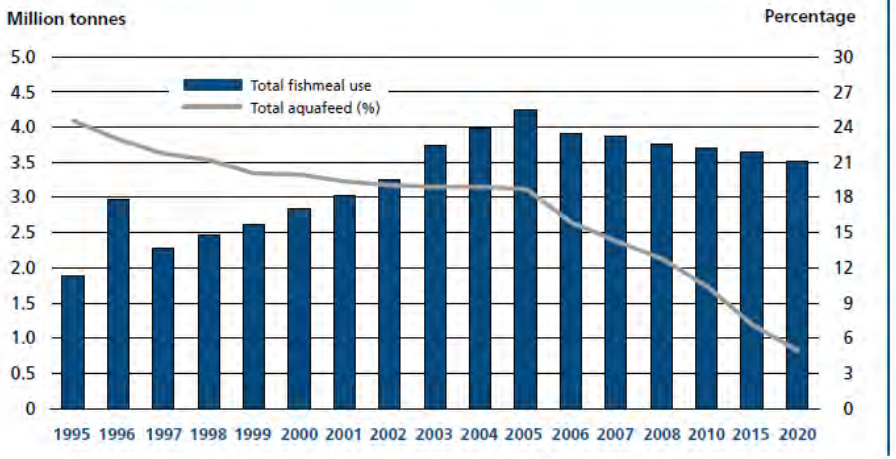
64.61 million tons

C:A=27:73



C:A=Capture production/Aquaculture production

Actual and predicted reduction in fishmeal use relative to the global production of compound aquafeed



Source: Adapted from Tacon, A.G.J., Hasan, M.R. and Metian, M. 2011. *Demand and supply of feed ingredients for farmed fish and crustaceans: trends and prospects.* FAO Fisheries and Aquaculture Technical Paper No. 564. Rome, FAO. 87 pp.

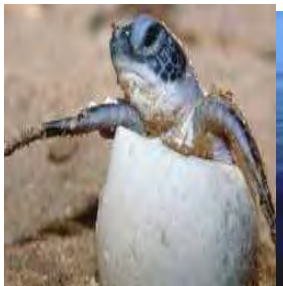
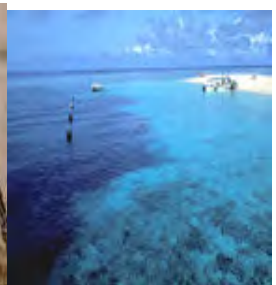
Table 5
Aquaculture production by region: quantity and percentage of world total production

Selected groups and countries		1970	1980	1990	2000	2006	2010
Africa	(tonnes)	10 271	26 202	81 015	399 676	991 183	1 288 320
	(percentage)	0.40	0.60	0.60	1.20	1.80	2.20
Sub-Saharan Africa	(tonnes)	4 243	7 048	17 184	55 690	276 906	359 790
	(percentage)	0.20	0.10	0.10	0.20	0.50	0.60
North Africa	(tonnes)	6 028	19 154	63 831	343 986	714 277	928 530
	(percentage)	0.20	0.40	0.50	1.10	1.30	1.60
Americas	(tonnes)	173 491	198 850	548 479	1 423 433	2 512 829	2 576 428
	(percentage)	6.80	4.20	4.20	4.40	4.50	4.30
Caribbean	(tonnes)	350	2 329	12 169	39 704	42 514	36 871
	(percentage)	0.00	0.00	0.10	0.10	0.10	0.10
Latin America	(tonnes)	869	24 590	179 367	799 234	1 835 888	1 883 134
	(percentage)	0.00	0.50	1.40	2.50	3.30	3.10
North America	(tonnes)	172 272	171 931	356 943	584 495	634 427	656 423
	(percentage)	6.70	3.70	2.70	1.80	1.10	1.10
Asia	(tonnes)	1 799 101	3 552 382	10 801 356	28 422 189	49 538 019	53 301 157
	(percentage)	70.10	75.50	82.60	87.70	88.90	89.00
Asia (excluding China and Near East)	(tonnes)	1 034 703	2 222 670	4 278 355	6 843 429	14 522 862	16 288 881
	(percentage)	40.30	47.20	32.70	21.10	26.10	27.20
China	(tonnes)	764 380	1 316 278	6 482 402	21 522 095	34 779 870	36 734 215
	(percentage)	29.80	28.00	49.60	66.40	62.40	61.40
Near East	(tonnes)	18	13 434	40 599	56 665	235 286	278 061
	(percentage)	0.00	0.30	0.30	0.20	0.40	0.50
Europe	(tonnes)	575 598	916 183	1 601 524	2 050 958	2 499 042	2 523 179
	(percentage)	22.40	19.50	12.20	6.30	4.50	4.20
European Union (27)	(tonnes)	471 282	720 215	1 033 982	1 395 669	1 275 833	1 261 592
	(percentage)	18.40	15.30	7.90	4.30	2.30	2.10
Non-European Union countries	(tonnes)	26 616	38 594	567 667	657 167	1 226 625	1 265 703
	(percentage)	1.00	0.80	4.30	2.00	2.20	2.10
Oceania	(tonnes)	8 421	12 224	42 005	121 482	173 283	183 516
	(percentage)	0.30	0.30	0.30	0.40	0.30	0.30
World	(tonnes)	2 566 882	4 705 841	13 074 379	32 417 738	55 714 357	59 872 600

- **China consumes about 30% world fishmeal and produce about 60% aquaculture production;**
- **China aquaculture provides food for the world and then reduces the demand on wild fisheries;**

http://www.fao.org/docrep/016/i2727e/i2727e.pdf

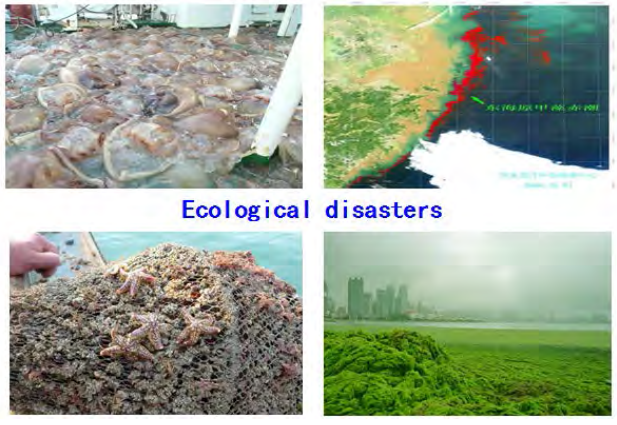
What are current and expected ecosystem impacts?

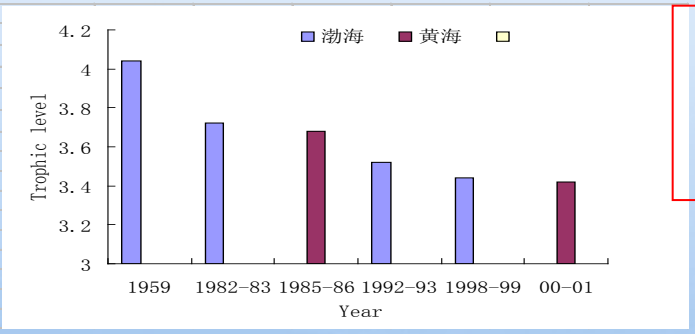


Stresses on the marine fisheries

- The main:
  - Overfishing
  - Reclamation
  - Pollution
  - Climate Change
  - Ecological disasters



Overfishing



0.2 / 10 years in China coastal waters, Zhang & Tang, 2004)

0.1 / 10 years in global waters

Fishing

Cod, largehead hairtail, Spanish mackerel, etc.

Anchovies、sandlance Loligo etc.

Acetes &Euphausia

Top predators

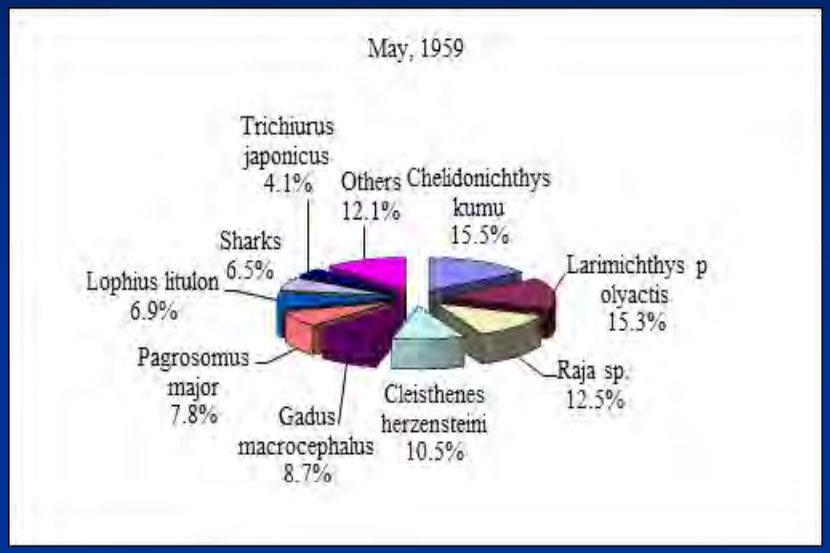
Small sized fish species (& invertebrates)

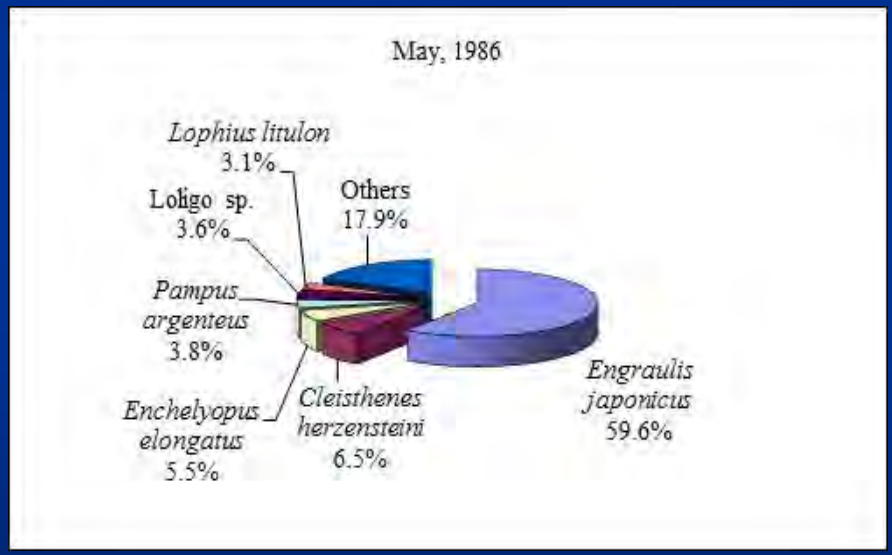
Zoo-

Phyto-

Sharp decline in important fish stock

Increasing ratio of low-valued species

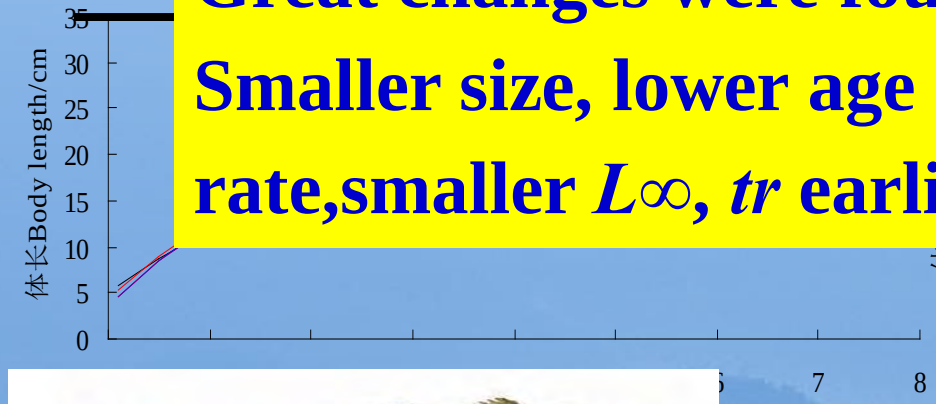


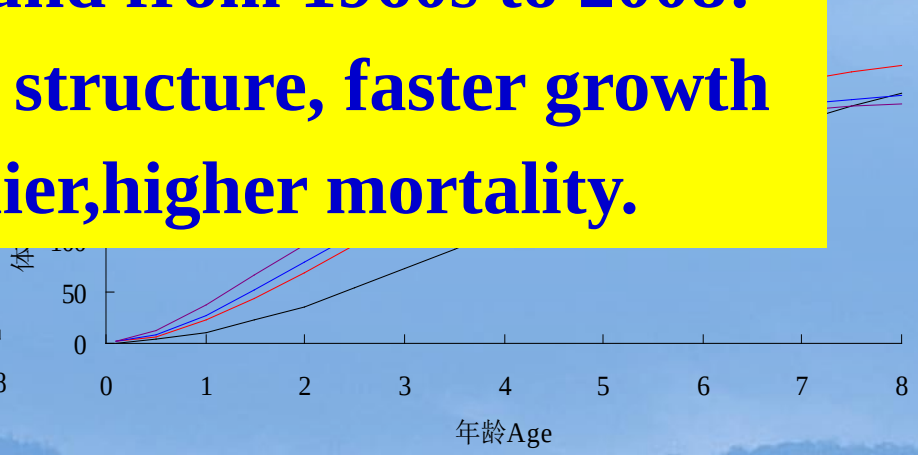


Variations in biological parameters of small yellow croaker

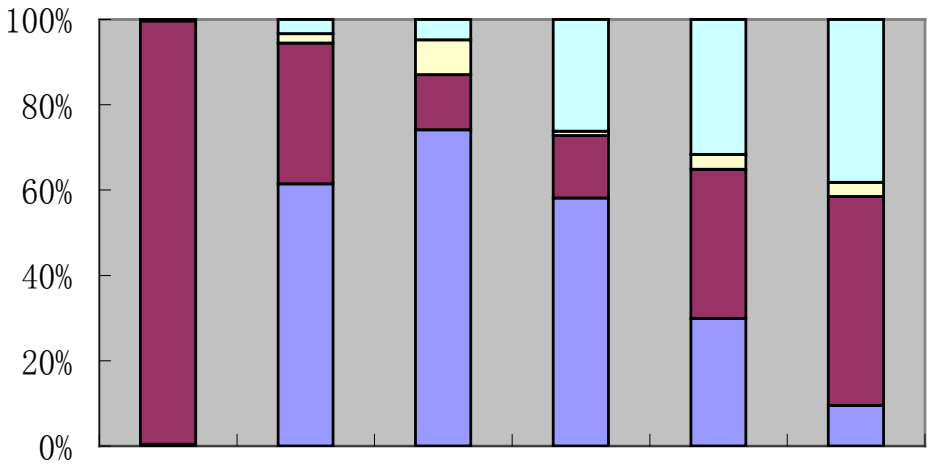
Biological parameters	1960	1985	1998	2008
Growth coefficient k	0.26	0.4	0.48	0.56
Zero-length age t_0	-0.58	-0.37	-0.3	-0.25
Asymptotic length L_∞/cm	34.21	30.17	25.54	24.06
Inflexion age of body weight growth t_r	3.78	2.44	1.99	1.61
Total mortality coefficient Z	0.51	1.80	2.84	2.89
Natural mortality coefficient M	0.24	0.33	0.39	0.43
Fishing mortality coefficient F	0.27	1.47	2.45	2.46
Go				

Great changes were found from 1960s to 2008: Smaller size, lower age structure, faster growth rate,smaller $L\infty$, tr earlier,higher mortality.

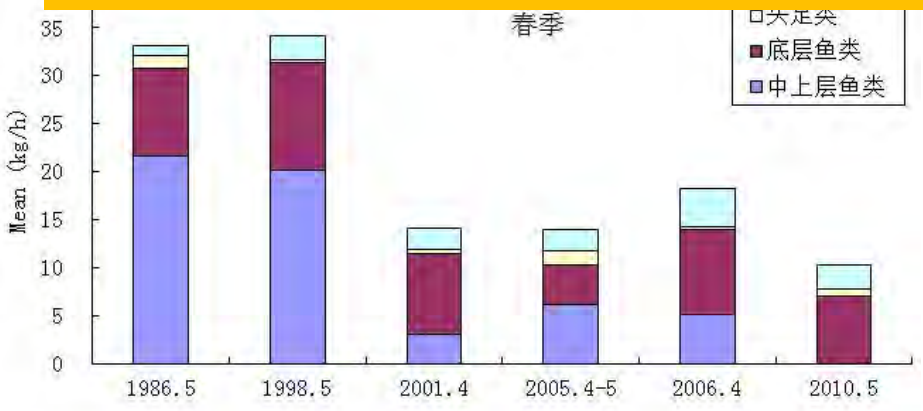




China coastal fisheries

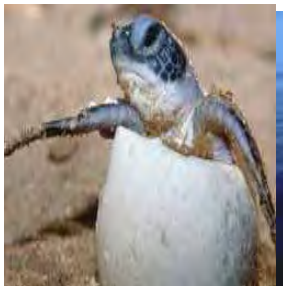
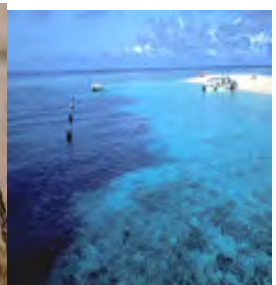


To restock and conserve fishery stocks is needed in coastal fisheries



- **The community structure changed considerably.**
- **The large-sized demersal species have been replaced by the low-valued and small-sized pelagic fish, early maturity.**
- **Changes in food web and food chain.**

What mitigation actions are in the fisheries management?



Management measures

Ministry of Agriculture & China Coast Guard

Management measures	Year of issue
Closed season/areas	Since 1950's in limited areas; Trawling was banned from 1988 in whole Bohai Sea; **Two or three months closed season were issued from 1995 in Bohai Sea, Yellow Sea and East China Sea, and from 1998 in South China Sea**
Fishery genetic resource protection area system	2007
The fishing license system	1979
Limits of catchable size and the proportion of juveniles in the catch	2000
Environmental fee system for stock protection and enhancement activities	2000
Control fishing capacity	1987
The fishing vessel scrapping program	2003
Reduce fuel subsidies-(40%-2019)	2015

Mitigation measures

National fishery stock enhancement programs

- Stock enhancement was carried out in China since the 1980s.
- In 2006, The State Council of China launched "**Conservation Action Plans for Aquatic Living Resources**".

国务院关于印发中国水生生物资源养护行动纲要的通知

国发〔2006〕9号

各省、自治区、直辖市人民政府，国务院各部委、各直属机构：

现将农业部会同有关部门和单位制定的《中国水生生物资源养护行动纲要》印发给你们，请结合实际，认真贯彻执行。

国务院

二〇〇六年二月十四日

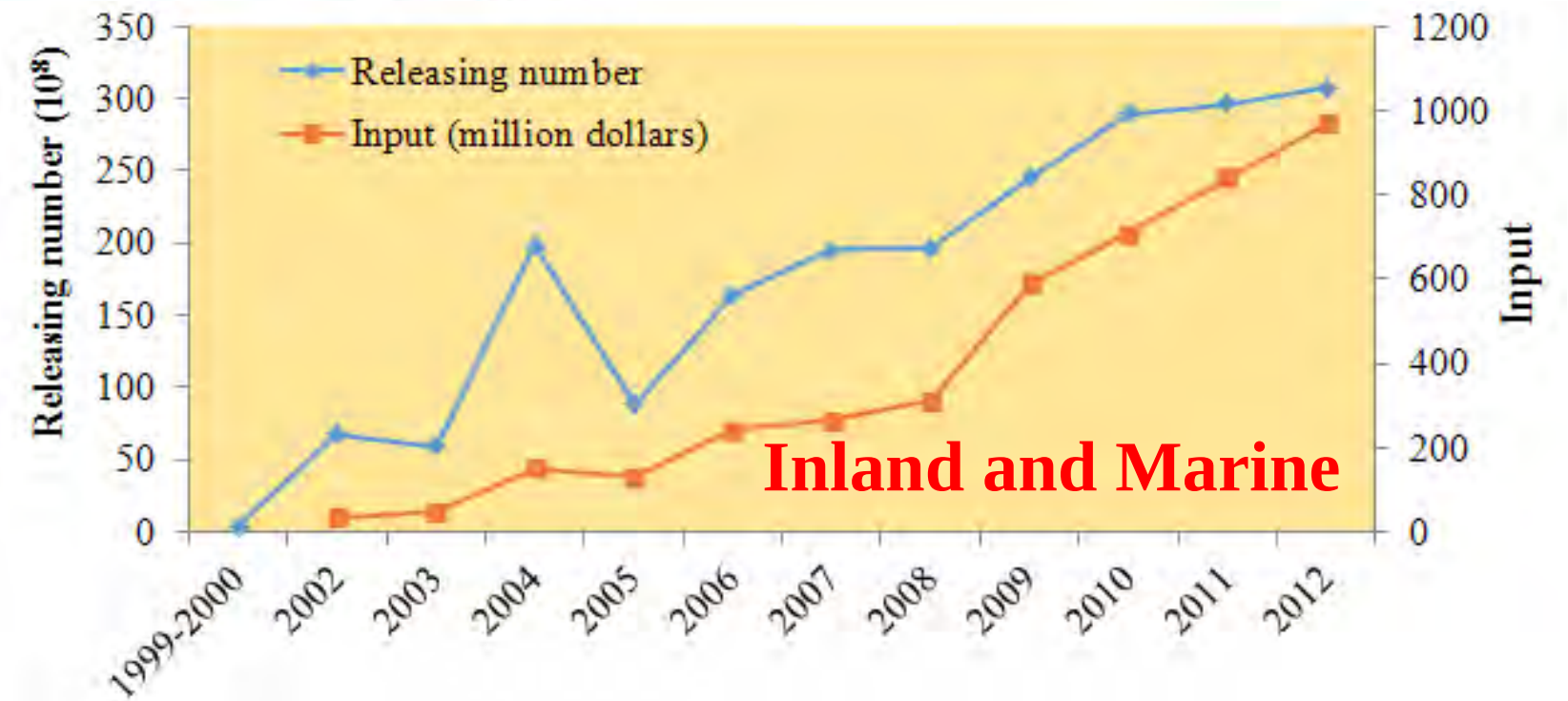
Stock enhancement

National fishery stock enhancement programs

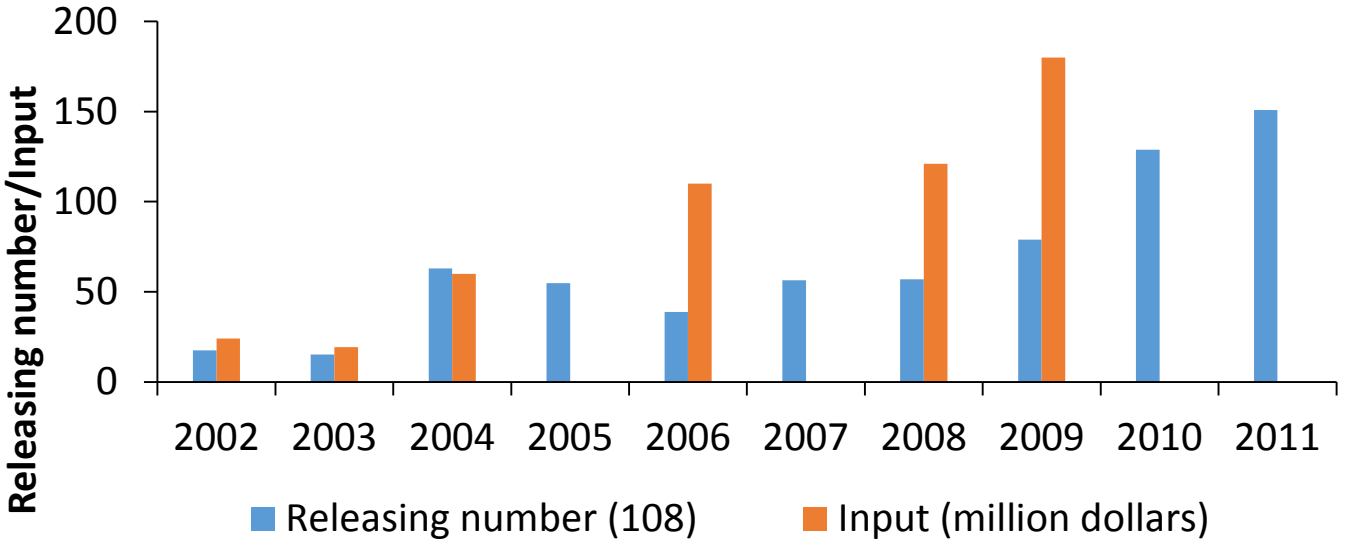
In 2010, The Ministry of Agriculture promulgated **“ National Programs of Stock Enhancement (2011-2015)”**, releasing number of commercial fishery species will reach **to 25 .3 billion by 2015**.

Stock enhancement

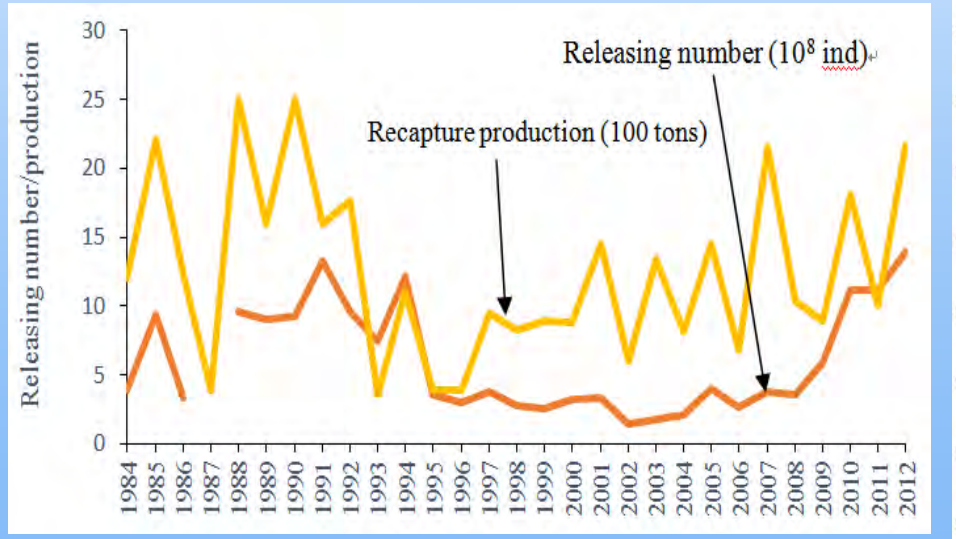
- More than 100 species of fish, shrimp, mollusca and other species with economic value were released.;
- The total number of animals released was 30.07 billion;
- Total investment on release was 970 million Yuan (RMB).

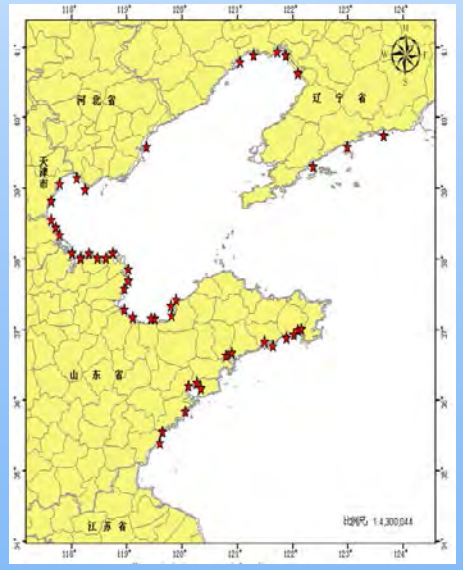


Marine stock enhancement



A case of Chinese shrimp stock enhancement

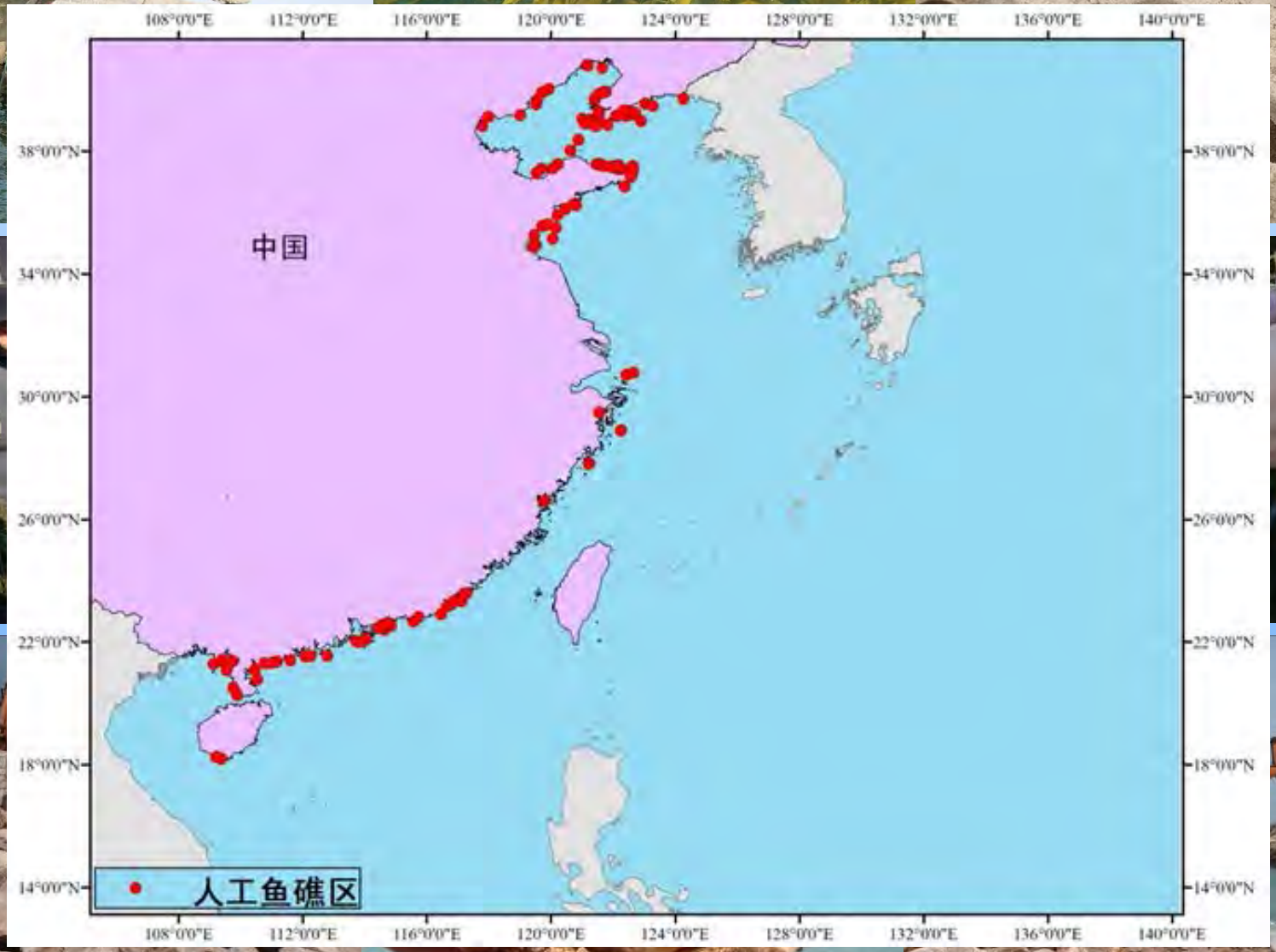




Year	Fishing vessels (ind)	Production (tons)	Production value (10000 RMB)
2010	4 844	1 686	28 053
2011	4 938	1 009	17 908
2012	4 896	2 163	35 194
Average	4 893	1 619	27 052

Releasing number, catch, and production value of Chinese shrimp *Fenneropenaeus chinensis*from the 1980s to 2012 (Southern waters of Shandong Penisula ,From Qiu, 2014)

Sea ranching



Mitigation measures

Integrated multi-trophic aquaculture (IMTA)

Developed the IMTA for Sea Ranching practiced in China

Diet

Cage culture

Hydrodynamic

Nutrients (N, P)

Phytoplankton

Bivalves

N, P

Longline culture of macro seaweeds

N, P

Abalone

The IMTA Practiced for Suspending Mariculture in Sungo Bay, China

From Fang, J

IMTA-Mitigation measures


"In the penultimate chapter on the Yellow Sea LME, Professor Qisheng Tang and Dr. Jianguang Fang review the variable states of productivity and biomass yields under the influence of climate change and anthropogenic forcing. ……The IMTA technology includes the production of algae (kelp), mollusks (abalone) bivalves (bay scallop), and echinoderms (sea cucumber) to help close the fisheries protein gap, while capture fisheries recover to sustainable levels. Preliminary results suggest that the IMTA pilot should be expanded throughout the YSLME and into other Asian LMEs, where applications could provide job opportunities and food security. **The pilot IMTA project proved to be highly energy efficient and optimized the carrying capacity of coastal embayment while improving water quality, increasing protein yields, and, through carbon capture, contributing to mitigation of the effects of climate change.**"

Dr. K. Sherman, NOAA, 2012

Sanggou Bay: FISH+KELP+SHELLFISH

From Fang, J

Some challenges in China fisheries

1. Social and economic issues

- Increasing demand on aquatic products
- Fast development of mariculture area along coastal waters

2. Scientific and EBFM issues

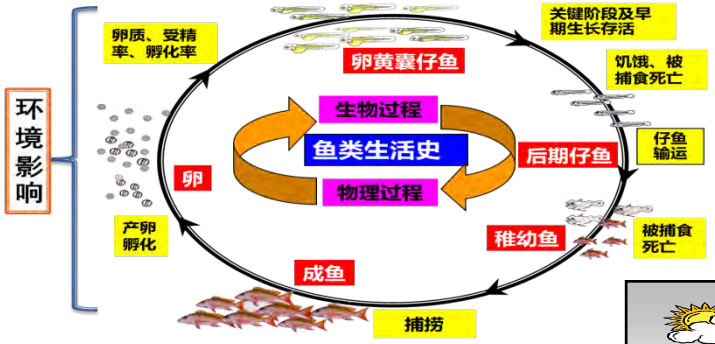
- Overfishing
- Pollution
- Reclamation

There is no free lunch

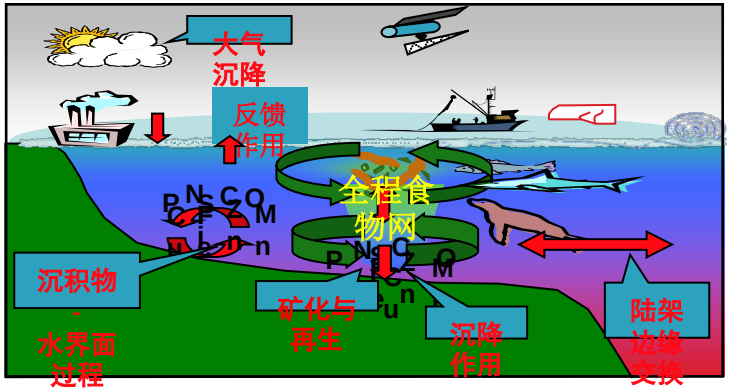
Some National Basic Research Programs launched in China

中国渔业种群补充研究计划
China Recruitment Programme

2015-2019



MARINE ECOSYSTEM



China - GLOBEC
Global Ocean Ecosystem Dynamics

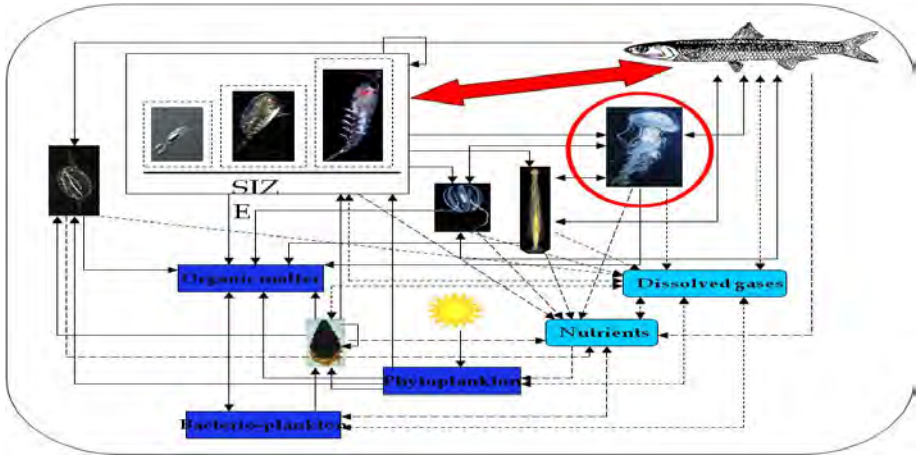
2001-2010

中国海洋生态系统研究计划
CHINA GLOBEC-IMBER

2011-2015

中国水母研究计划
China Jellyfish Project

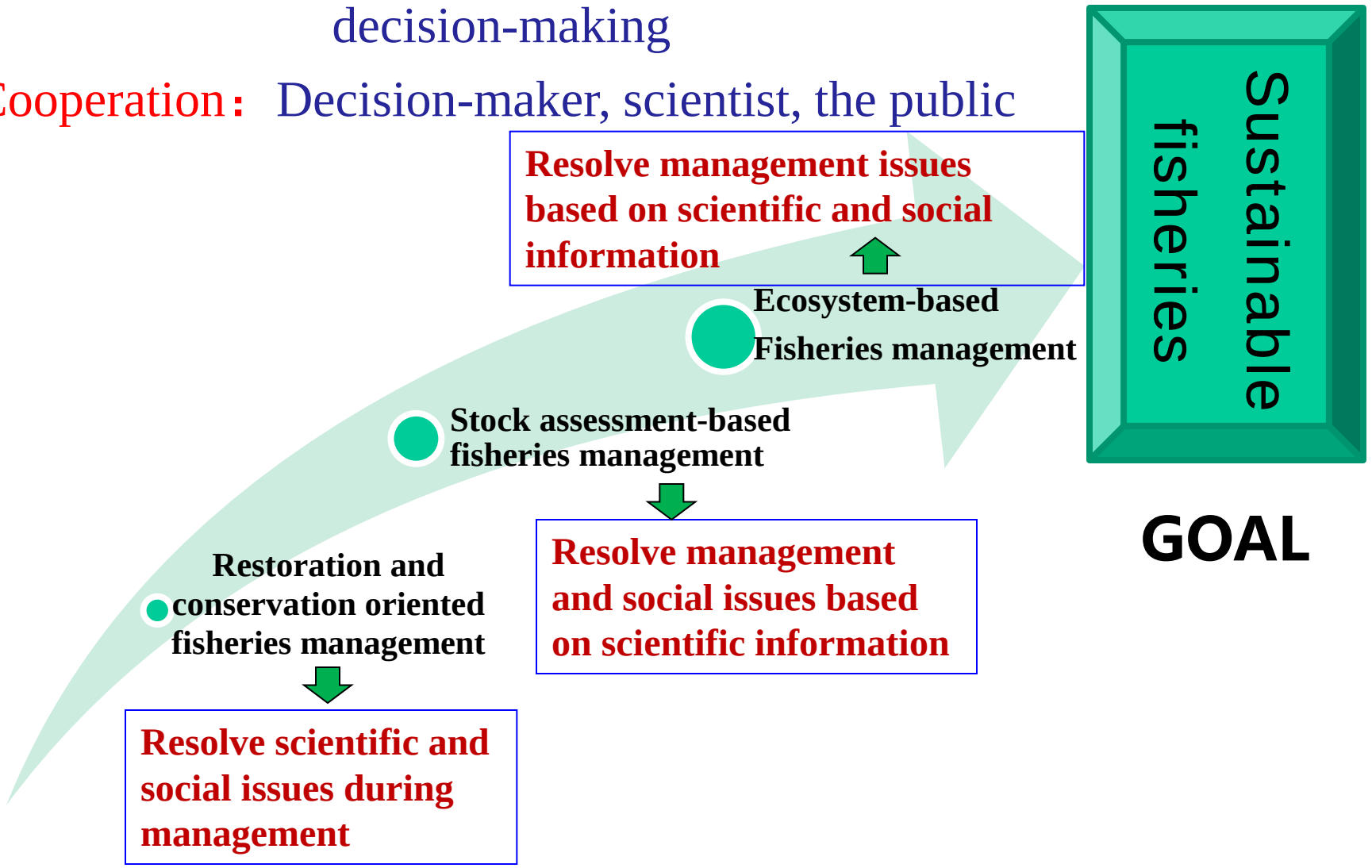
2011-2015



Final remarks

Communication: Science ⇔ human ⇨ information, knowledge ⇨ decision-making

Cooperation： Decision-maker, scientist, the public




Thank you for your attention!