中国海水鱼类设施养殖技术与装备

Engineering and technology of Marine Fish Culture in China

关长涛

(GUAN CHANGTAO)

国家海水鱼产业技术体系

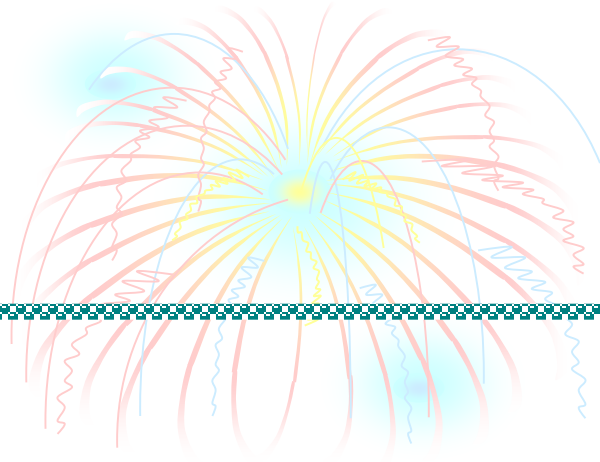(China Agriculture Research System for Marine Fish Culture Industry)

中国水产科学研究院黄海水产研究所

(Yellow Sea Fisheries Research Institute, CAFS)

2018-10-23 青岛(Qingdao)

主要内容

一、中国海水鱼类养殖**发展概况**

General description of marine fish culture in China

二、中国海水鱼类养殖的**科技进步**

Science and technology progress of marine fish aquaculture in China

三、中国海水鱼类**主养模式及设施**

Aquaculture models, facilities and engineering

四、国家海水鱼产业技术**体系简介**

**Introduction of China Agriculture Research System for Marine Fish Culture Industry**

一、中国海水鱼类养殖发展概况

General description of marine fish culture in China

Development and status of marine fish aquaculture in China

1.发展历程与现状
Development and status of marine fish aquaculture in China

中国的海水鱼类规模化养殖始于20世纪80-90年代。尤其自90年代中期开始，发展迅速。养殖产量由1984年的0.94万吨，发展到2017年的141.94万吨。

China's large scale marine fish auqaculture began in early 1980s and developed rapidly from the middle of 1990s. The annual production in 1984 was only 9,400 tons while the production reached 1.42 million tons in 2017.
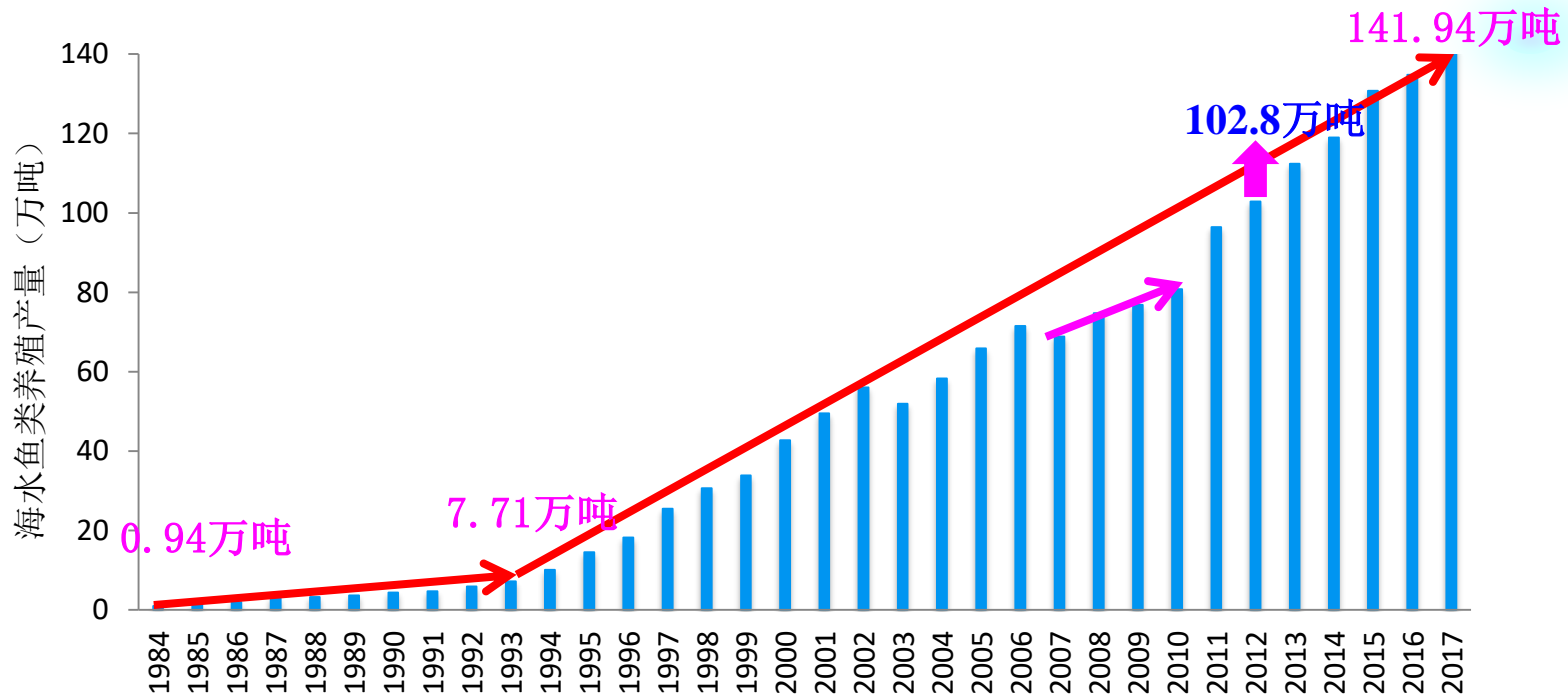
中国海水鱼类养殖产量（中国渔业统计年鉴，1985-2018年）

Annual production of marine fish culture in China (China Fishery Statistical Yearbook, 1985-2018)

2.海水鱼养殖种类
Marine fish species developed for farming in China

据有关资料, 世界海水鱼类约有**13,000** 种，我国有**1694** 种。目前我国已开发养殖的有近**100**种。

According to some references, there are about 13,000 marine fish species all over the world and about 1,600 species were found in China. Up till now, 99 species from 33 fish families have been developed for farming.

我国海水鱼养殖种类（2016，引自姜志强）

33科
99种

33 families
99 species

须鲨科 Orectolobidae	25. 巨石斑鱼 *Epinephelus tauvina*	裸颊鲷科 Lethrinidae	76. 银鲳 *Pampus argenteus*
1. 条纹斑竹鲨 *Chiloscyllium plagiosum*	26. 驼背鲈（老鼠斑）*Chromileptes altivelis*	53. 长鳍裸颊鲷 *Lethrinus erythropterus*	弹涂鱼科 Periophthalmidae
鲟科 Acipenseridae	27. 斜带石斑鱼 *Epinephelus coioides*	鲷科 Sparidae	77. 大弹涂鱼 *Boleophthalmus pectinirostris*
2. 中华鲟 *Acipenser sinensis*	28. 七带石斑鱼 *Hyporthodus septemfasciatus*	54. 真鲷 *Pagrosomus major*	塘鳢科 Eleotridae
3. 西伯利亚鲟 *Acipenser baeri*	29. 棕点石斑鱼(老虎斑) *Epinephelus fuscoguttatus*	55. 黑鲷 *Acanthopagrus schlegelii*	78. 中华乌塘鳢 *Bostrychus sinensis*
鲑科 Salmonidae	30. 豹纹鳃棘鲈（东星斑）*Plectropomus leopardus*	56. 黄鳍鲷 *Acanthopagrus latus*	鲉科 Scorpaenidae
4. 虹鳟 *Oncorhynchus mykiss*	31. 褐石斑 *Epinephelus bruneus*	57. 金头鲷 *Sparus aurata*	79. 许氏平鲉 *Sebastes schlegelii*
5. 大西洋鲑 *Salmo salar*	鳕科 Sillaginidae	58. 灰鳍鲷 *Sparus berda*	80. 褐菖鲉 *Sebastiscus marmoratus*
鳗鲡科 Anguillidae	32. 多鳞鳕 *Sillago sihama*	59. 平鲷 *Rhabdosargus sarba*	81. 鬼鲉 *Inimicus japonicus*
6. 日本鳗鲡 *Anguilla japonica*	鲹科 Carangidae	石鲷科 Oplegnathidae	六线鱼科 Hexagrammidae
7. 欧洲鳗鲡 *Anguilla anguilla*	33. 卵形鲳鲹 *Trachinotus ovatus*	60. 条石鲷 *Oplegnathus fasciatus*	82. 大泷六线鱼 *Hexagrammos otakii*
海鳗科 Muraenesocidae	34. 布氏鲳鲹 *Trachinotus blochii*	61. 斑石鲷 *Oplegnathus punctatus*	鲆科 Bothidae
8. 海鳗 *Muraenesox cinereus*	35. 杜氏鰤（高体鰤）*Seriola dumerili*	石鲈科 Pomadasyidae	83. 大菱鲆 *Scophthalmus maximus*
遮目鱼科 Chanos	36. 五条鰤 *Seriola quinqueradiata*	62. 花尾胡椒鲷 *Plectorhinchus cinctus*	84. 牙鲆 *Paralichthys olivaceus*
9. 遮目鱼 *Chanos chanos*	37. 黄条鰤 *Seriola aureovittata*	63. 斜带髭鲷 *Hapalogenys nitens*	85. 大西洋牙鲆 *Paralichthys dentatus*
鲱科 Clupeidae	军曹鱼科 Rachycentridae	64. 断斑石鲈 *Pomadasys hasta*	86. 漠斑牙鲆 *Paralichthys lethostigma*
10. 斑鰶 *Konosirus punctatus*	38. 军曹鱼 *Rachycentron canadum*	65. 三线矶鲈 *Parapristipoma trilineatum*	鲽科 Pleuronectidae
海龙科 Syngnathidae	鲯鳅科 Coryphaenidae	金钱鱼科 Scatophagidae	87. 石鲽 *Platichthys bicoloratus*
11. 三斑海马 *Hippocampus trimaculatus*	39. 鲯鳅 *Coryphaena hippurus*	66. 金钱鱼 *Scatophagus argus*	88. 圆斑星鲽 *Verasper variegatus*
12. 大海马 *Hippocampus ramulosus*	石首鱼科 Sciaenidae	丽鱼科 Cichlidae	89. 条斑星鲽 *Verasper moseri*
13. 日本海马 *Hippocampus japonicus*	40. 大黄鱼*Larimichthys crocea*	67. 尼罗罗非鱼 *Oreochromis niloticus*	90. 大西洋庸鲽 *Hippoglossus hippoglossus*
14. 线纹海马 *Hippocampus erectus*	41. 红拟石首鱼*Larimichthys crocea*	68. 奥利亚罗非鱼 *Oreochromisco aureus*	91. 黄盖鲽 *Pseudopleuronectes yokohamae*
鲻科 Mugilidae	42. 云纹犬牙石首鱼*Cynoscion nebulosus*	篮子鱼科 Siganidae	鳎科 Soleidae
15. 鲻 *Mugil cephalus*	43. 黄姑鱼 *Albiflora croaker*	69. 点篮子鱼 *Siganus guttatus*	92. 欧鳎 *Solea solea*
16. 大鳞鲻 *Mugil macrolepis*	44. 鮸状黄姑鱼 *Nibea miichthioides*	70. 褐篮子鱼 *Siganus fuscessens*	93. 塞内加尔鳎 *Solea senegalensis*
17. 鮻 *Liza haematocheila*	45. 浅色黄姑鱼 *Nibea albiflora*	71. 长鳍篮子鱼 *Siganus canaliculatus*	舌鳎科 Soleidae
18. 棱鮻 *Liza carinata*	46. 鮸 *Miichthys miiuy*	鲭科 Scombrida	94. 半滑舌鳎 *Cynoglossus semilaevis Gunther*
鲈科 Serranidae	47. 褐毛鲿 *Megalonibea fusca*	72. 鲐 *Pneumatophorus japonicus*	鲀科 Tetraodontidae
19. 花鲈 *Lateolabrax maculatus*	48. 褐石斑 *Epinephelus bruneus*	73. 蓝鳍金枪鱼 *Thunnus thynnus*	95. 红鳍东方鲀 *Takifugu rubripes*
20. 鞍带石斑鱼 *Epinephelus lanceolatus*	笛鲷科 Lutjanidae	狼鲈科 Moronidae	96. 假睛东方鲀 *Takifugu pseudommus*
21. 青石斑鱼 *Epinephelus awoara*	49. 勒氏笛鲷 *Lutjanus russelli*	74. 条纹狼鲈 *Morone saxatilis*	97. 暗纹东方鲀 *Takifugu obscurus*
22. 赤点石斑鱼 *Epinephelus akaara*	50. 红鳍笛鲷 *Lutjanus erythopterus*	尖吻鲈科 Latidae	98. 双斑东方鲀 *Takifugu bimaculatus*
23. 鲑点石斑鱼 *Epinephelus trimaculatus*	51. 紫红笛鲷 *Lutjanus argentimaculatus*	75. 尖吻鲈 *Lates calcarifer*	99. 黄鳍东方鲀 *Takifugu xanthopterus*
24. 点带石斑鱼 *Epinephelus coioides*	52. 白斑笛鲷 *Lutjanus bohar*	鲳科 Stromateidae	

大黄鱼 **Large yellow croaker**

大菱鲆 **Turbot**

军曹鱼 **Cobia**

鲈鱼 **Sea bass**

牙鲆 **Flounders**

鲷类(真鲷) **Seabream**

石斑鱼(云纹) **Groupers**

半滑舌鳎 **Half smooth tongue sole**

美国红鱼 **Red drum**

卵形鲳鲹 **Swallowtail**

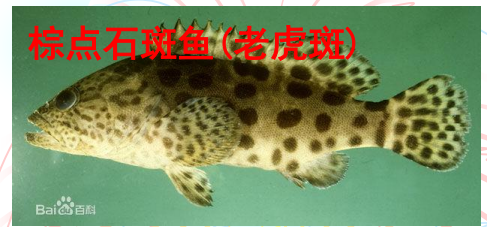河鲀(红鳍东方鲀) **Fugu**

黄条鰤(鰤鱼) **Yellowtail**

许氏平鲉(黑鲪)

Black rock fish

暗纹东方鲀

Takifugu obscurus
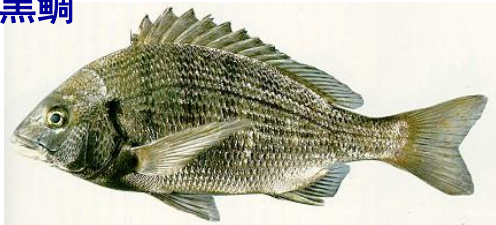
棕点石斑鱼（老虎斑）

Blotchy rock cod

大泷六线鱼

Greenling

菊黄东方鲀

Takifugu flavidus

豹纹鳃棘鲈（东星斑）

Plectropomus leopardus

黑鲷

Black Seabream
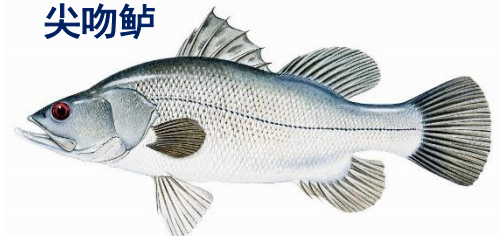
斑石鲷

Spotted knifejaw

珍珠龙胆石斑鱼（龙虎斑）

梭鱼

mullet

花尾胡椒鲷

Plectorhinchus cinctus

尖吻鲈

Silver sea perch

《中国渔业统计年鉴》中列在前**10**位的种类有：大黄鱼、鲈鱼、石斑鱼、鲆鱼、鲷鱼、美国红鱼、军曹鱼、河鲀、鰤鱼、鲽鱼等。**10个主要养殖品种2017年的总产量为82.93万吨，约占全年海水鱼类养殖总产量的65%。**此外，南方的卵形鲳鲹（金鲳，约**10万吨**）、北方的许氏平鲉（黑鲪、黑头，约**2万吨**）等尚未列入《**年鉴**》中。

The production of 10 major farmed marine fish species are listed in China Fishery Statistical Yearbook. They are Large yellow croaker, Sea bass, Groupers, Bothidae, Sea bream, Red drum, Cobia, Fugu, Amberjack and Pleuronectidae. In 2017 the production from these 10 species amounted to 829,000 tons, accounted for 65% of the total farmed marine fish production of China. Besides, other species, farmed in large scale in recent years, such as swallowtail (*Trachinotus ovatus*) and black rockfish (*Sebastes schlegelii*) are not included in the Yearbook.

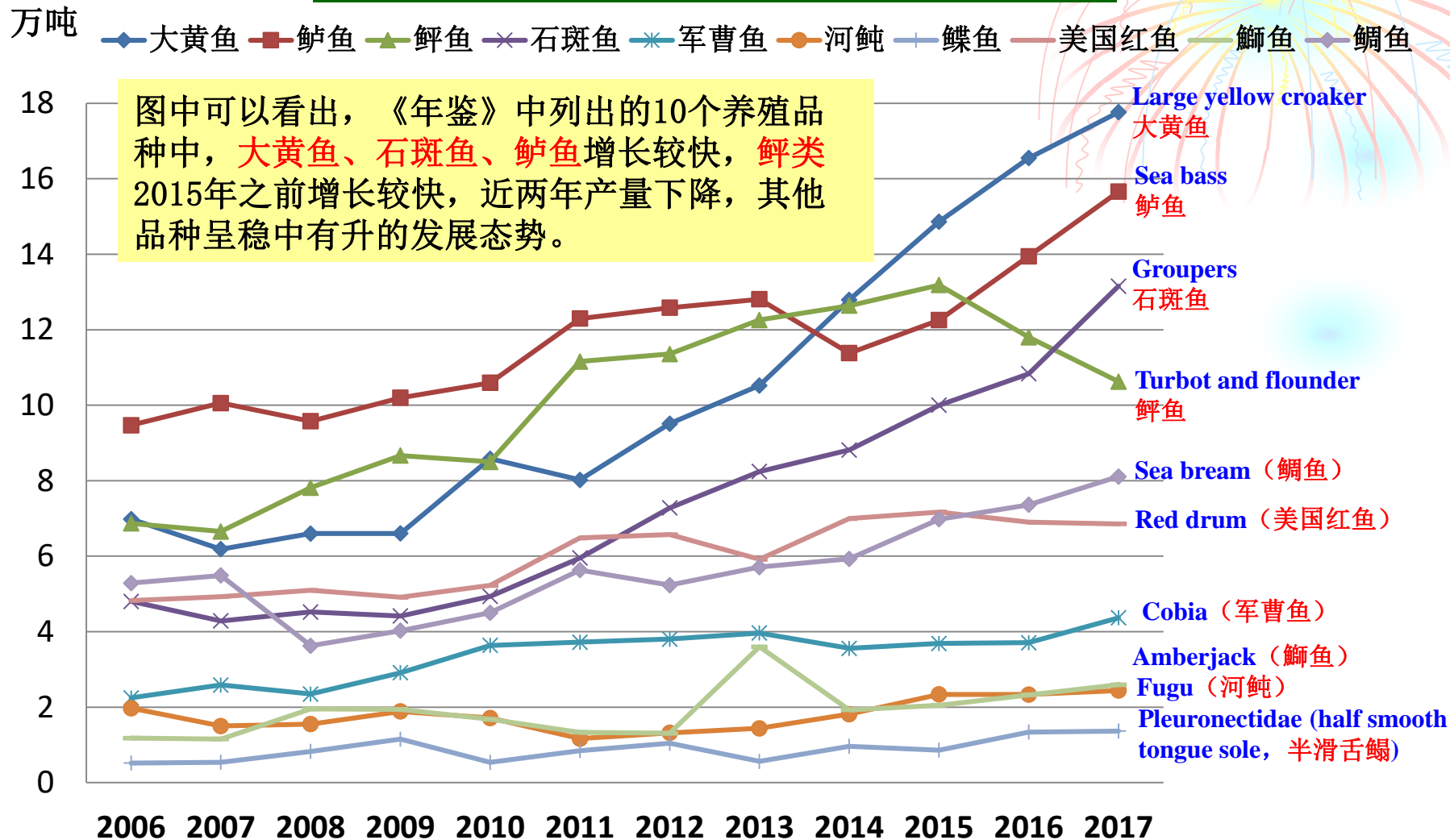| 大黄鱼 Large yellow croaker	鲈鱼 Sea bass	石斑鱼 Groupers	鲆鱼 Bothidae	鲷鱼 Sea bream	美国红鱼 Red drum	军曹鱼 Cobia	河鲀 Fugu	鰤鱼 Amberjack	鲽鱼 Pleuronectidae
177640	156595	131536	106237	81107	68559	43657	24403	25933	13655
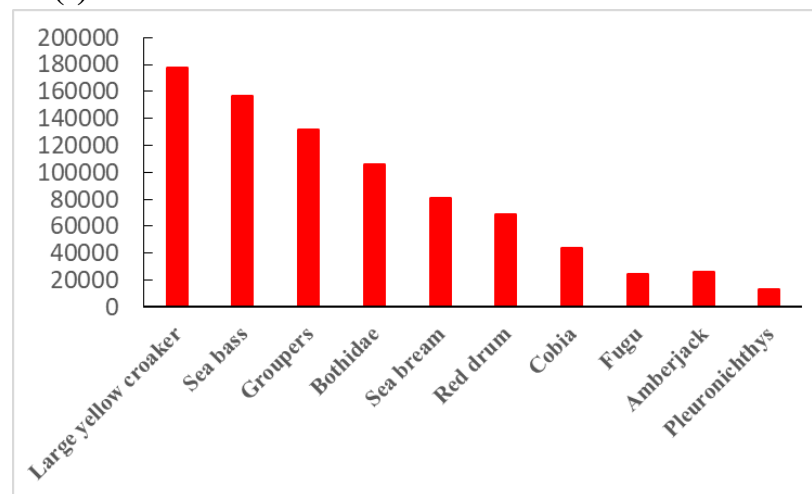
2017年我国10种主要海水鱼类养殖产量(吨)
Production of 10 major marine fishes farmed in China in 2017 (t)

来源：**2018**年中国渔业统计年鉴
China Fishery Statistical Yearbook 2018

On top of the list is large yellow croaker, last year the production was over 177,000 tons, then the sea bass, groupers and turbot, etc.

Production variation of major farmed marine fish in China (2006-2017)
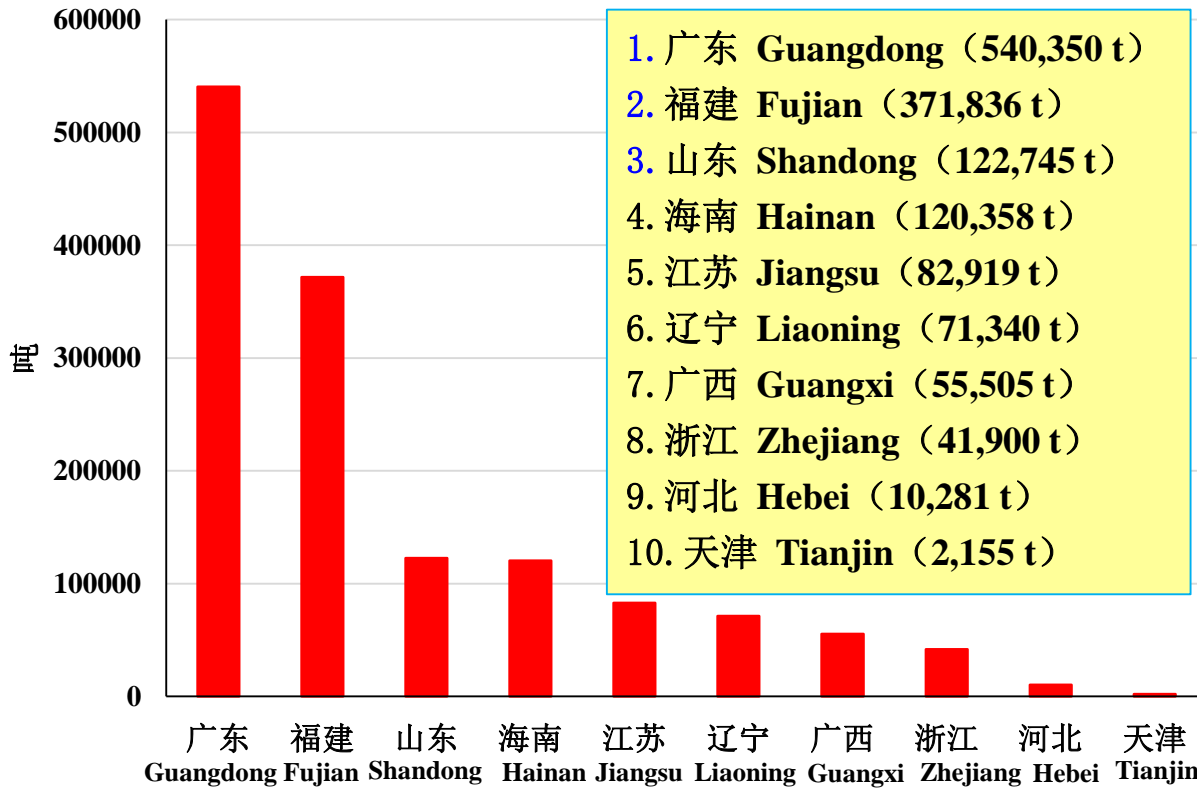
2006-2017我国主要海水养殖鱼类产量变化

万吨

◆大黄鱼 ■鲈鱼 ▲鲆鱼 ✕石斑鱼 ✳军曹鱼 ●河鲀 ┼鲽鱼 美国红鱼 鰤鱼 鲷鱼

图中可以看出，《年鉴》中列出的10个养殖品种中，大黄鱼、石斑鱼、鲈鱼增长较快，鲆类2015年之前增长较快，近两年产量下降，其他品种呈稳中有升的发展态势。

Large yellow croaker 大黄鱼
Sea bass 鲈鱼
Groupers 石斑鱼
Turbot and flounder 鲆鱼
Sea bream（鲷鱼）
Red drum（美国红鱼）
Cobia（军曹鱼）
Amberjack（鰤鱼）
Fugu（河鲀）
Pleuronectidae (half smooth tongue sole，半滑舌鳎)

This figure shows the production variation of major farmed marine fishes in China during the last 10 years. You may see that the production of large yellow croaker, groupers and sea bass have been growing fast, while the production of turbot and flounder decreased in these two years and other species also kept increasing but not as fast.

3.海水鱼类养殖产区分布
Distribution of marine fish aquaculture in China

海水鱼类养殖产区分布（按产量，**2017年**）
Distribution of marine fish aquaculture in China
(in production of 2017)

1. 广东 **Guangdong（540,350 t）**
2. 福建 **Fujian（371,836 t）**
3. 山东 **Shandong（122,745 t）**
4. 海南 **Hainan（120,358 t）**
5. 江苏 **Jiangsu（82,919 t）**
6. 辽宁 **Liaoning（71,340 t）**
7. 广西 **Guangxi（55,505 t）**
8. 浙江 **Zhejiang（41,900 t）**
9. 河北 **Hebei（10,281 t）**
10. 天津 **Tianjin（2,155 t）**

Marine fish aquaculture in China distributed widely along the coastal provinces. This graph shows the production of the provinces in the year of 2017. Here you may see that the top three provinces are Guangdong, Fujian and Shandong and the production of Guangdong is 540,350 t, Fujian 371,836 t, Shandong 122,745 t.

二、中国海水鱼类养殖的科技进步

Science and technology progress of marine fish aquaculture in China

从上面的数据我们可以看到，在过去的20多年中，中国的海水鱼类养殖业发展较快，其中，科技发挥了重要作用。

As described above, over the past 20 years China has achieved rapid development in marine fish aquaculture. Many factors contributed to the remarkable achievements. The main impetus comes from the progress of science and technology.

1. 突破了多种海水鱼类的苗种规模化繁育技术，为产业发展奠定了基础。开展了大黄鱼、石斑鱼、鲈鱼、鲷科鱼类、河鲀、牙鲆、半滑舌鳎、卵形鲳鲹、黄姑鱼、许氏平鲉、六线鱼、银鲳等海水鱼类的生物学、生理生态学研究，突破其亲鱼培育、生殖生长调控和苗种繁育等关键技术，实现了多种海水鱼类的苗种规模化生产，奠定了产业发展基础。

Breakthroughs have been made in the large-scale breeding technology of many marine fish species, which lay a solid foundation for the development of the industry.

2. 良种引进与良种选育成效显著。大菱鲆的成功引种，有力推动了我国北方海水鱼工厂化养殖业的发展；培育海水鱼选育良种10个，并在产业中得到广泛的应用。

Great achievements have been made in the introduction of suitable farming species and selective breeding. For example, the success of turbot introduction from Europe to China has greatly promoted the development of marine fish farming in the northern coastal areas of China. Moreover, 10 new breeding varieties of marine fishes have been approved by the authorities and have been widely used for farming.

3. 主养品种的营养需求研究不断深入，配合饲料普及率逐步提高。

Studies on the nutrition requirements of main farming species have been strengthened and the amount of compound feeds used in the industry have gradually increased.

4. 查明多种病害病原，疫苗研制取得新进展。针对海水鱼养殖细菌性、寄生虫、病毒性、生理性及环境胁迫性等主要病害，开展系统的流行病学调查，查明主要病害的病原与致病机理，研发疾病健康防控技术，尤其是在海水鱼类疾病防控疫苗研制方面取得实质性进展（如，华东理工大学的大菱鲆腹水病疫苗、西安凯斯达生物制品公司的"鱼乐"多联疫苗等都已获生产批文）。

Researches on the cure and control of marine fish diseases have made progress and two anti-bacteria vaccines have been developed and used.

5. 养殖工程技术不断进步，推动产业快速发展。

The progress of aquaculture models, facilities and engineering technology has greatly promoted the rapid development of China's marine fish aquaculture industry.

三、中国海水鱼类主养模式及设施装备

Aquaculture models, facilities and engineering

1. 主要养殖模式
Major marine fish aquaculture models in China

目前，我国的海水鱼类养殖主要有：陆基工厂化、海上网箱和岸带池塘三大养殖模式。

At present, there are three major marine fish aquaculture models in China. They are industrial indoor aquaculture, net cage farming and pond culture.

Industrial indoor aquaculture
陆基工厂化

Net cage farming
海上网箱

Pond culture
池塘

Others (Pen farming)
其他 (围网、围栏等)

2017年，三个主要养殖模式的产量分别为：

工厂化：24.01万吨（约占当年总产量的16.9%）

网　箱：70.24万吨（约占当年总产量的49.5%）

池塘+其他：47.69万吨（约占当年总产量的33.6%）

In 2017, the production of cultured marine fish from three major models are:

Industrial indoor aquaculture: 240,100 tons (accounted for 16.9% of the total production)

Net cage farming: 702,400 tons (accounted for 49.5% of the total production)

Pond culture + others: 476,900 tons (accounted for 33.6% of the total production)

海水鱼类养殖产量组成（按照养殖方式，**2017年**）

Production composition of cultured marine fish in models

工厂化
Industrial indoor culture

池塘
Pond culture

普通网箱
Traditional cage farming

深水网箱
Deep sea cage farming

17%
14%
20%
40%
9%

陆基工厂化
普通网箱
深水网箱
池塘
其他
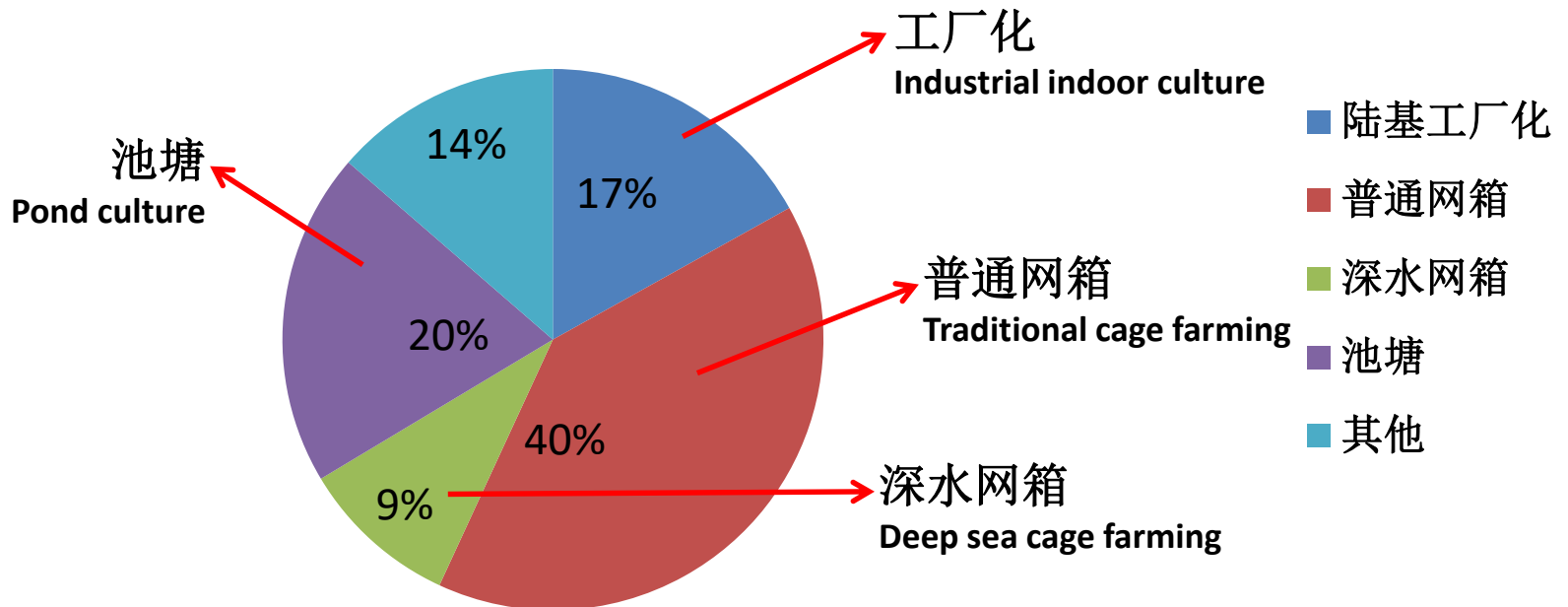
2. 养殖设施与工程技术
Development of marine fish aquaculture engineering

（1）工厂化养殖 Industrial indoor aquaculture

中国的海水鱼类工厂化养殖起始于**20**世纪**90**年代初。初期主要采用的是全流水养殖方式，后来发展了部分水处理系统，目前已发展了循环水养殖并具有一定的规模。

Industrial indoor fish farming started in China in early 1990s.

At the beginning: the farming system were mainly the flowing water system (water being pumped in and out without treatment)

Development stage: the water was partly treated through some facilities.

Present: Recirculating Aquaculture Systems (RAS) have been developed and used in certain scale.

Flowing water system

Economy system

RAS

2004/ 9/14 3:28pm

Flowing Diagram of Sea Water Treatment for the Fish Farming Recirculating System

海水RAS系统流程图

养鱼池
Fish farming tank

弧形筛
sieve-bend
screen

蛋白分离器
Protein skimmer

生物滤池
Bio-Chem. tank

O₃

泵
Pump

固液分离
Separation (water and solid waste)

紫外或臭氧杀菌
Ultraviolet or ozone disinfection

高效增氧
High efficiency DO
(oxygenation)

一级提水，两次过滤
部分消毒，充分净化
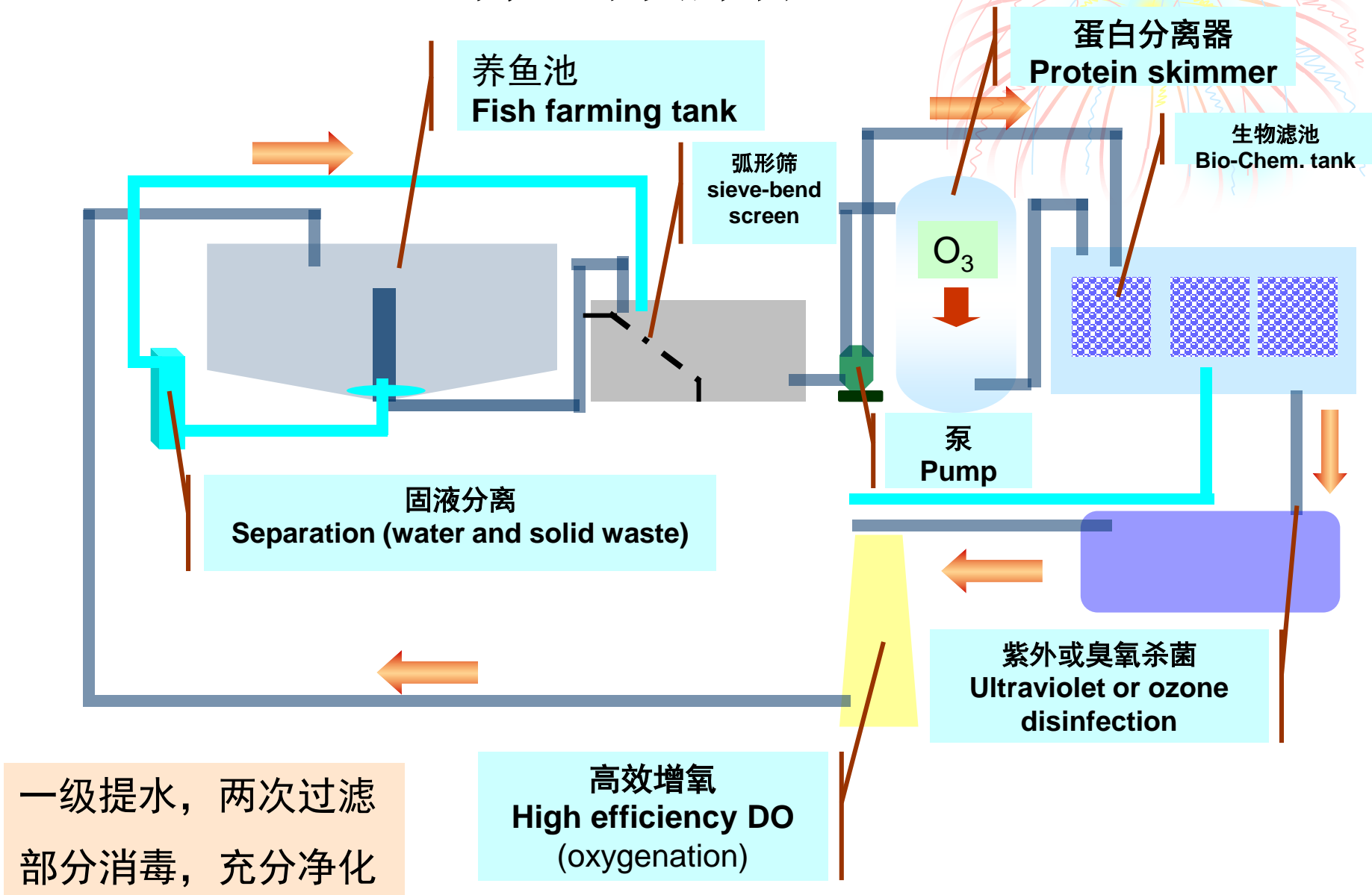
典型的工厂化循环水系统
Typical Recirculating Aquaculture Systems in China

（2）海上设施养殖 Sea based aquaculture

中国海水鱼类的海上设施养殖起始于20世纪70年代，并自80年代后期开始发展迅速。初期主要为小型网箱养殖，2000年以后深水网箱养殖逐步发展，目前全国海水网箱总数超过200万只，其中深水网箱约11000多只（养殖水体1218万立方米）。

近年来，在国家拓展深远海养殖相关政策支持下，国内先后研发了大型围栏（围网）、养殖工船、大型钢结构网箱、深海渔场等养殖设施，推动中国海上设施养殖技术不断进步。

Sea based marine fish aquaculture in China started in early 1970s and developed rapidly since the late 1980s. At the beginning, small wooden net cages with size of 9 m^2 to 25 m^2 were commonly used for farming. Since the year of 2000, offshore or deep sea cage culture has gradually developed. At present, there are more than 2million net cages in all, among which about 11,000 cages are deep sea cages with total water volume up to 12.2 million cubic meters.

In recent years, with the strong support of relevant policies for developing deep sea or open ocean culture in China, new marine fish aquaculture models, equipment and facilities, such as the large steel structure pens, aquaculture vessels, large steel structure cages, deep sea farms or platforms, etc., have been developed, which greatly promotes the technology progress of sea based marine fish aquaculture in China.

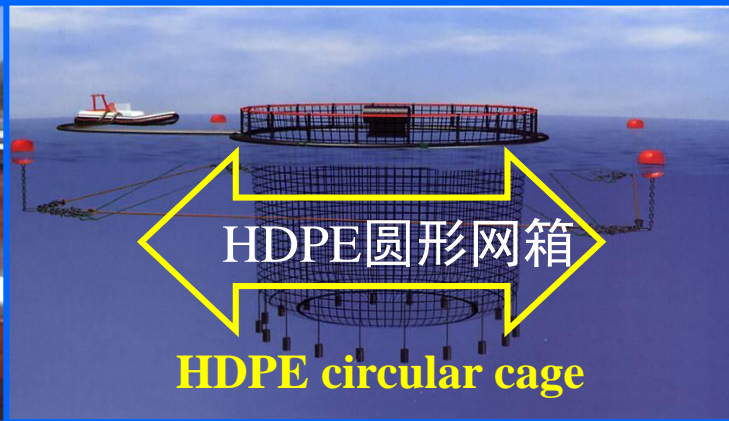Bamboos

Hardwood beams

Steel pipes
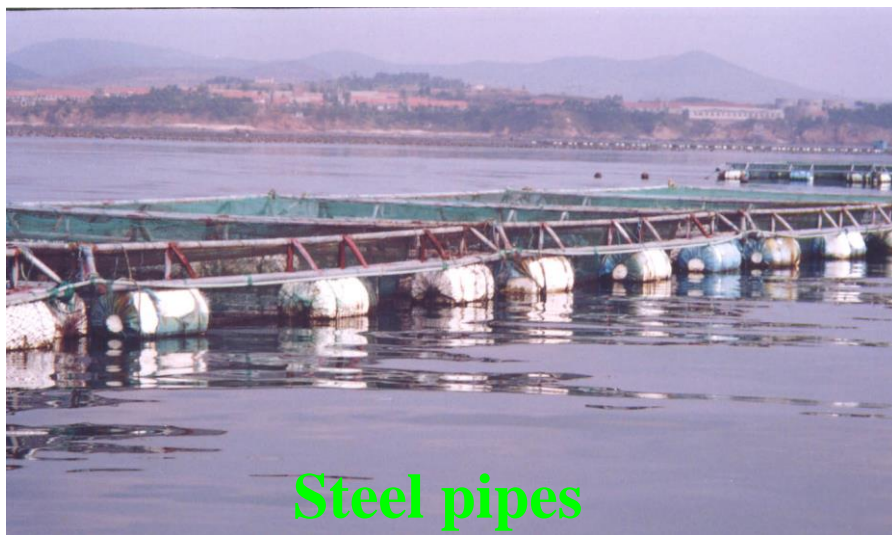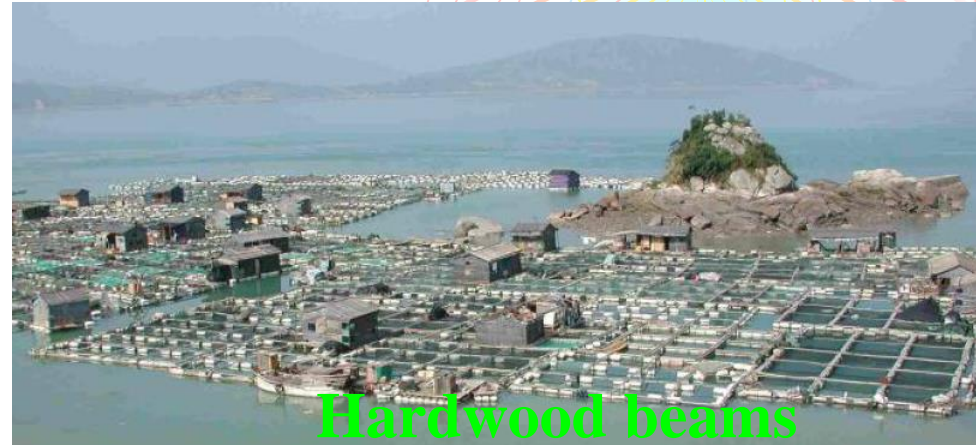
Typical structures and sizes

Structure: 3 types (photos)
Size: 3×3 to 5×5 m in square with net depth of 3~5m.

With hundreds or thousands of cages connected together

21

B.深水网箱结构型式（**Major types and structures of deep sea cages**）

① HDPE浮式
floating cage

HDPE圆形网箱

HDPE circular cage

②HDPE升降式
submersible cage

③碟形网箱

Two-cones-shaped net cage

④浮绳式网箱

Cage made from ropes and floats
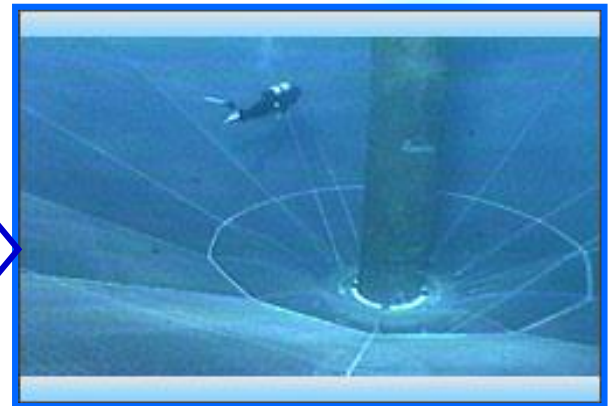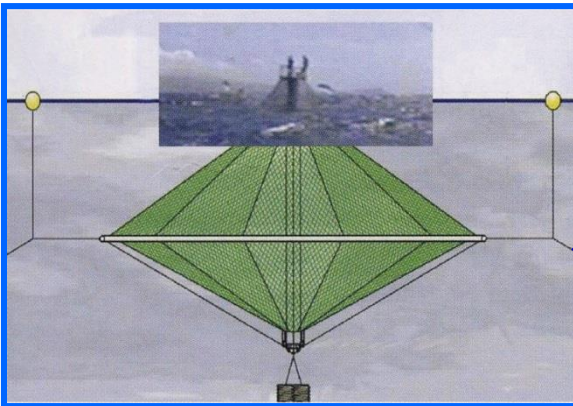
⑤金属网箱 **Steel structure cage**

优点：
- 耐流性好，不易变形
- 网衣不易破损
- 耐附着性较好

Advantage：
- **Resistant to current**
- **Net not easy to be broken**
- **Not easily fouled**

缺点：
- 组装和更换网衣较不方便

Disadvantage:
- **Not easy to operate (change and lift the net)**

C. 大型深远海养殖新设施
Equipment and facilities for deep sea or open ocean aquaculture

① 挪威在中国建造的"半潜式深海养殖平台"（深海渔场）
Norwegian Semi-submerged deep sea aquaculture platform (deep sea farm) made in China

总高 (height)：68m（水下45m）

直径 (diameter)：110m

容量 (water volume)：25万 m³

总重 (total weight)：7700 t

养鱼 (farming capacity)：150万尾 (1.5 million individual)

（about 7000-10000 t）

抗风浪能力：12级
使用寿命：25年

2016.07.11

2017.5.18

2017.5.18

海洋牧场
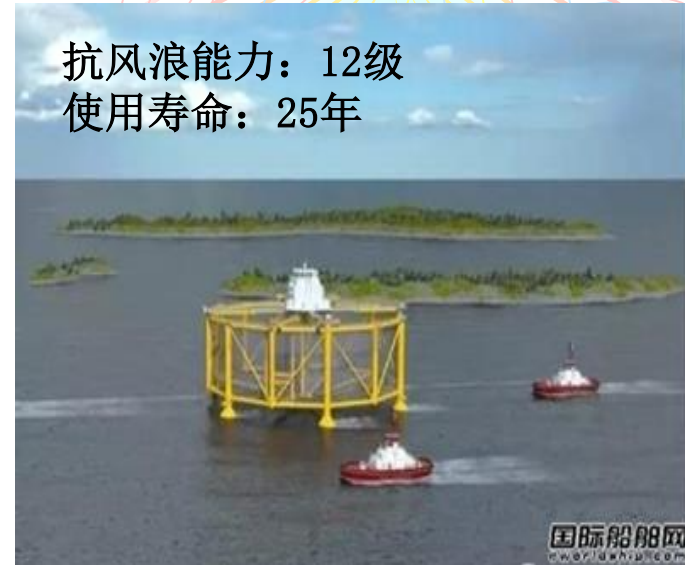
We are carrying out the studies on the hydrodynamic characteristics of the structure via experiments in flume tanks and simulation

链接：水槽试验录像

流速15cm/s
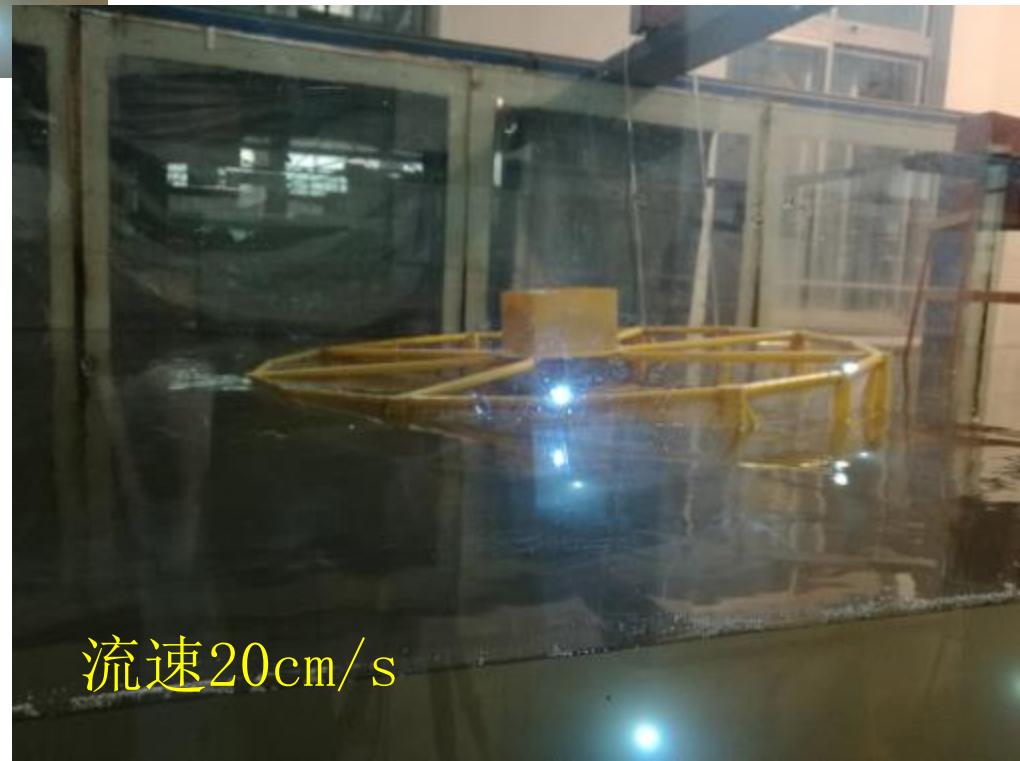
流速20cm/s
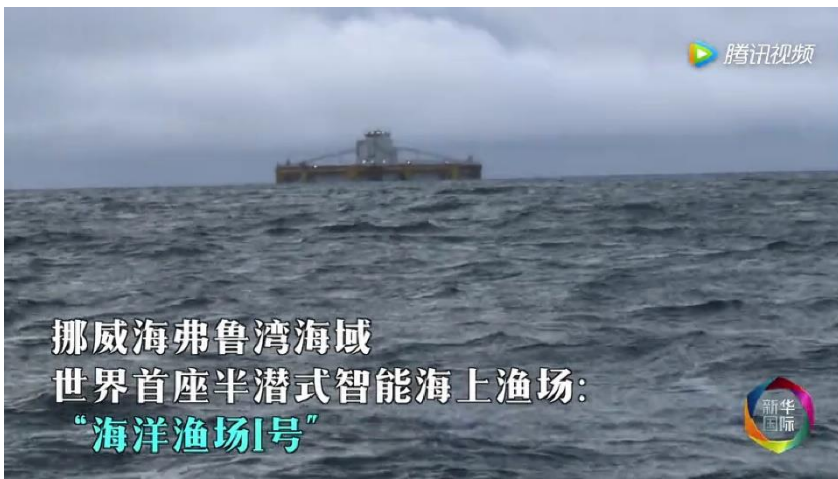
挪威海弗鲁湾海域
世界首座半潜式智能海上渔场：
"海洋渔场1号"

2017年6月14号驶离青岛，9月运抵挪威海域，10月6日完成海上安装调试后正式交付使用。

× "Ocean Farm 1" hit by salmon lea... · · ·

Ocean Farm 1

"Ocean Farm 1" hit by salmon leak after structure accidentally tilts

News by Aslak Berge - 4 September 2018

However SalMar has now put a 1.2 km of sea net around the cage.

On Monday, the crew on board discovered that "Ocean Farm 1"'s seabed moor was leaning. The issue was quickly corrected and measures were taken for capture the escaped fish, SalMar announced in a press release.

The Directorate of Fisheries was informed about the issue that took place at the huge
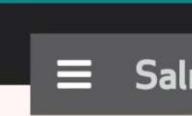
Ocean Farm 1

"Ocean Farm 1" hit by salmon leak after structure accidentally tilts

吕纳尔·西韦特森
挪威萨尔玛集团投资者关系主管
和海洋油气技术而建成的
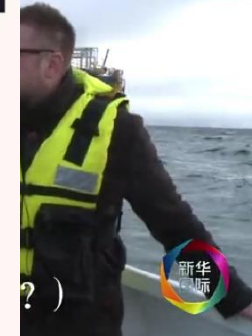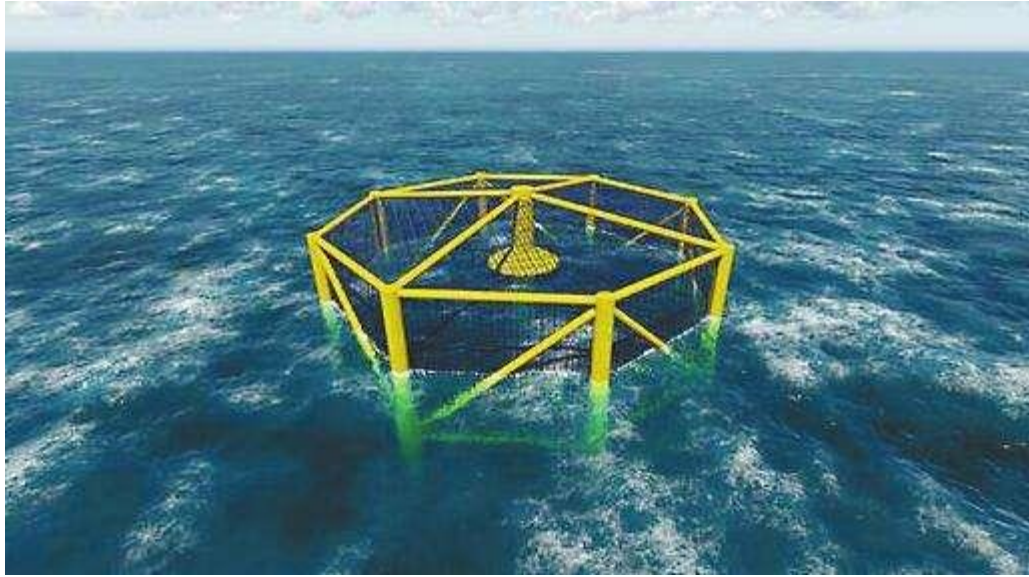
2018年5月在日照下海的国产化全潜式深海渔场"深蓝1号",养殖水体5万立方米,用于黄海冷水团鲑鳟鱼养殖

Newly developed submersible aquaculture farm named 'Shenlan No.1' used for salmon and trout farming in the cold water mass area in the Yellow Sea (put into us in May 2018)
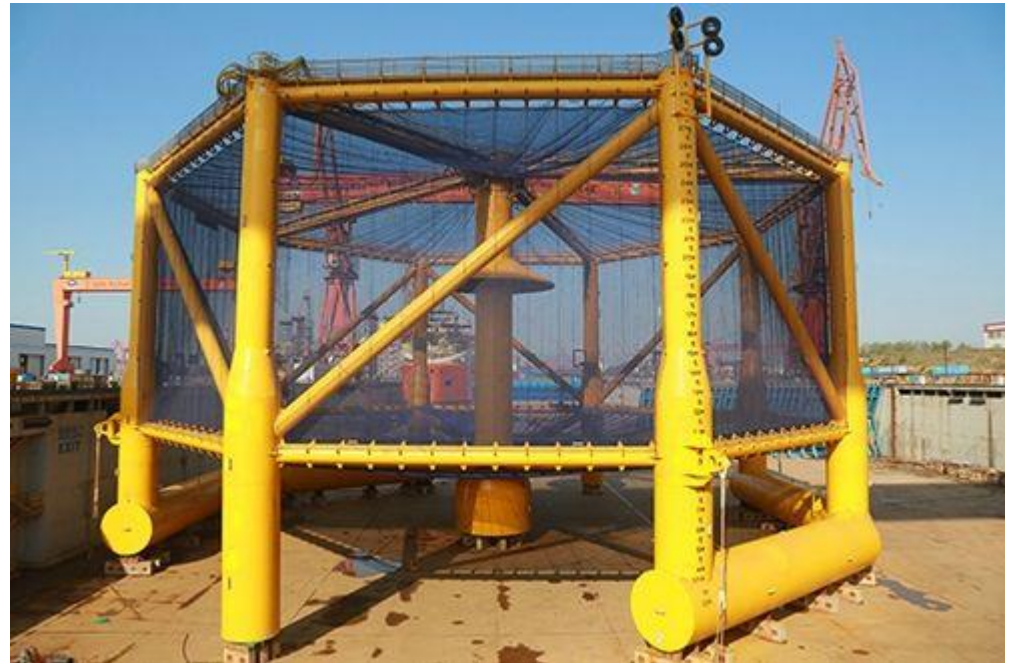
② 大型钢结构深水网箱（广西北海）

一组4个网箱呈"田字"型；

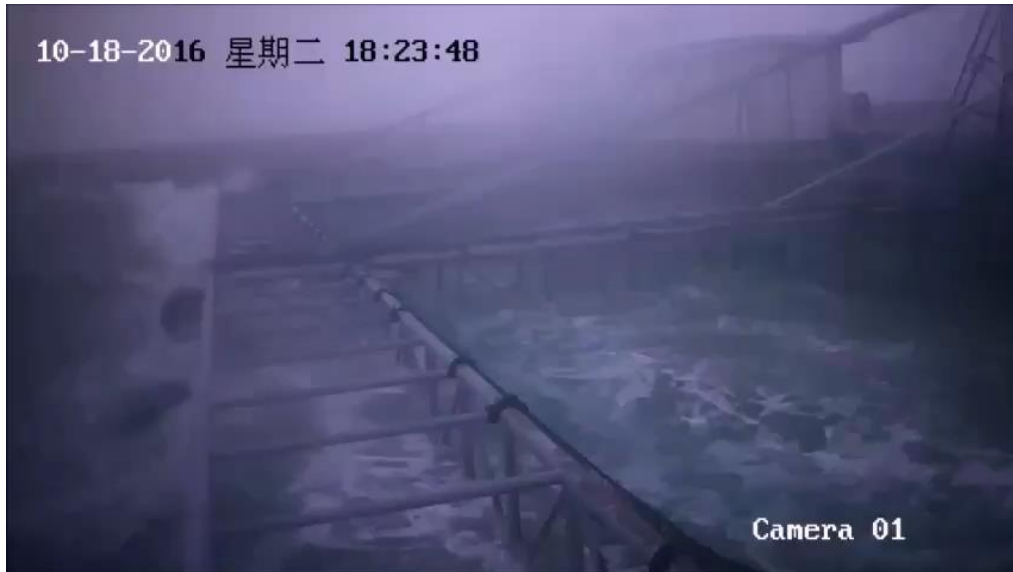网箱规格：$4 \times (15m \times 15m \times 8m) = 7200 \ m^3$；

设中央投饵系统。

Large steel structure cage
(used in Beihai, Guangxi Prov.)
1 group 4 cages in distribution of "田"
Cage size: $4 \times (15m \times 15m \times 8m) = 7200 \ m^3$

10-18-2016 星期二 18:23:48

Camera 01

Performance in a Typhoon of 13 force

③ 大型管桩围栏/围网（山东莱州）

围栏为内外两层环形结构，外环直径127m，圈围水体约16万立方米，设有2大、6小共8个多功能平台，供操作、管理和休闲垂钓等使用。

Large steel structure pen
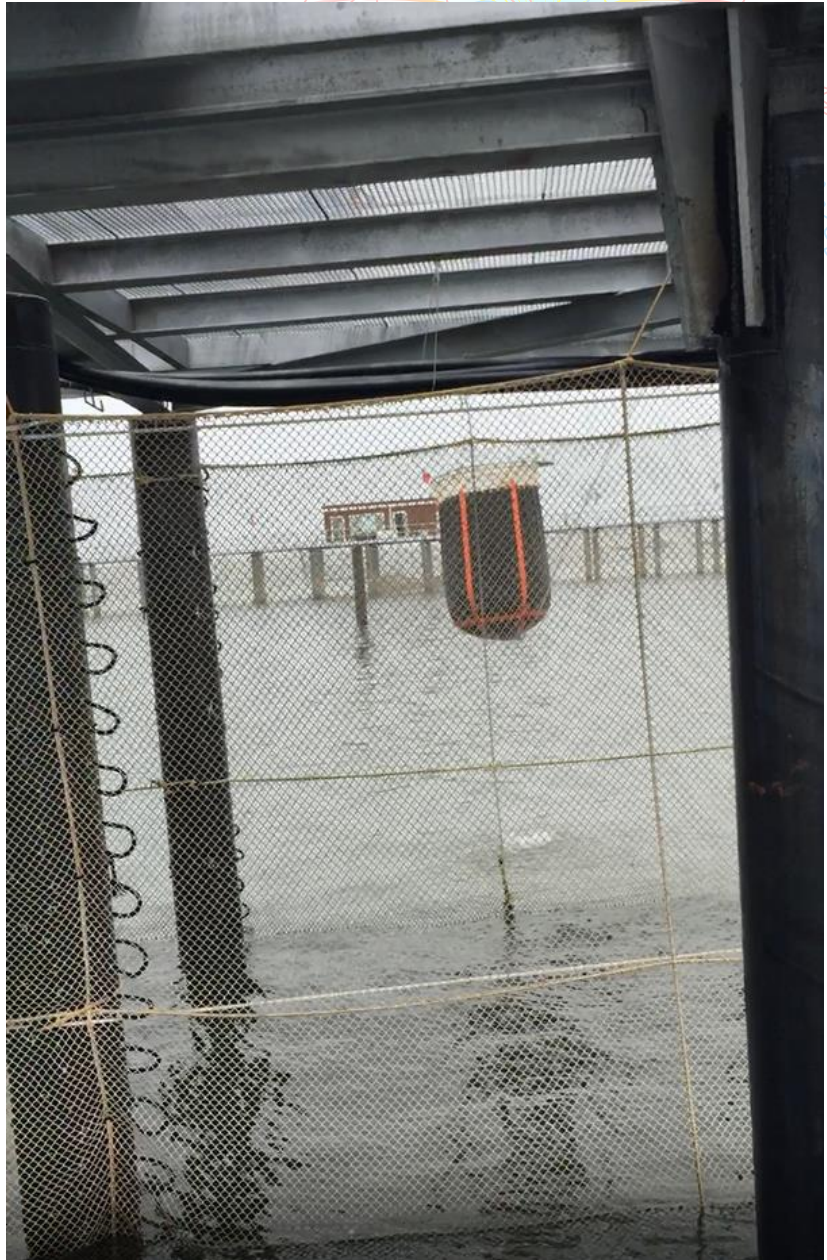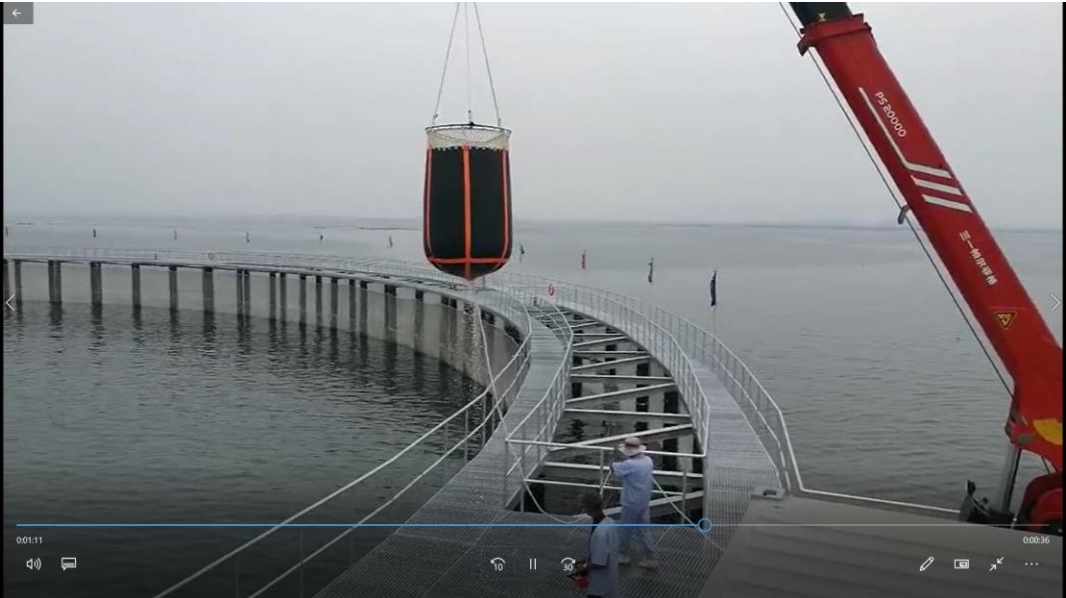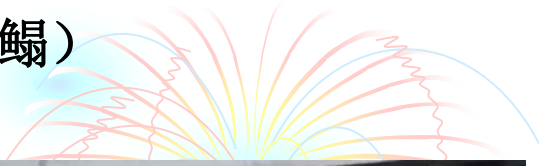(built in Laizhou, Shandong Prov.)
The pen consists of 2 rings with the diameter of the outer ring up to 127m and the total volume of the pen is about 160,000 m³.
Eight platforms built on top of the pen can be used for farming operation, management and recreation fishing

牧场化大型生态养殖围栏
（16万方水体）

莱州湾离岸大型浮绳式围网
规格：100m×50m×12m
水体：60000m³

大型生态围网
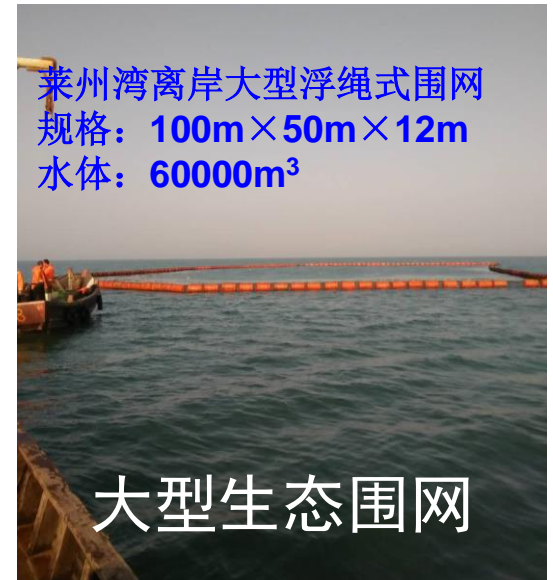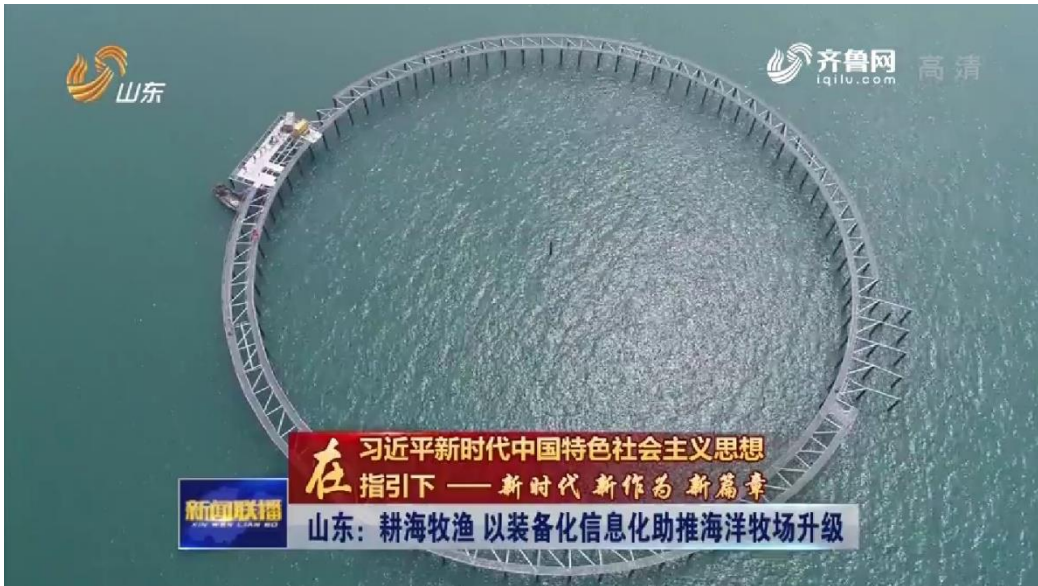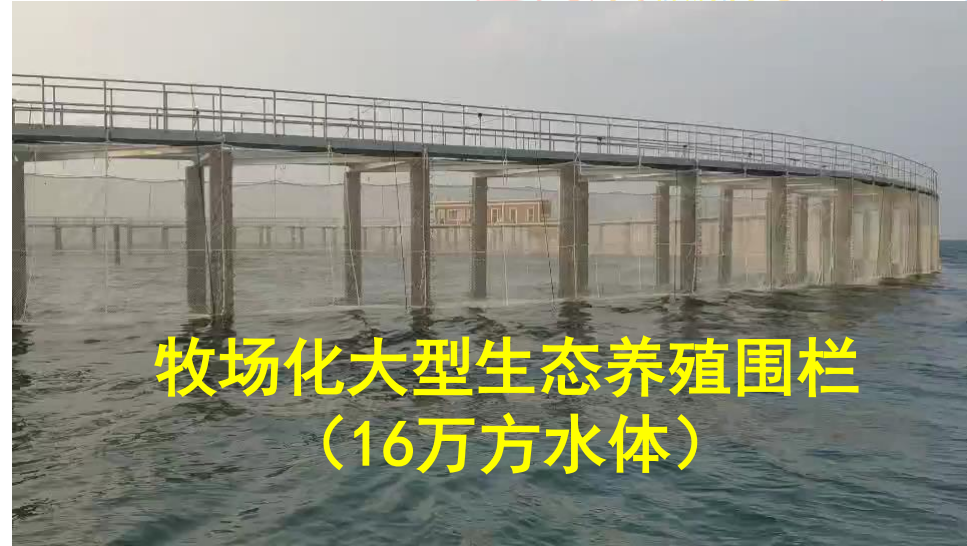
新型生态围栏已开始养殖试验（黄条鰤、斑石鲷、半滑舌鳎）
The new farm are now undergoing trials.

④ "德海1号" 智能养鱼场（广东珠海）

总长度91.3m，宽度27.6m，设置3+1养殖区，养殖水体可达3万立方米，年产量可达480吨，适于20-100m水深海域养殖。设有自动投饵、监控、起网和海水淡化等养殖操控装备。

"Dehai Farm No.1"
(built in Zhuhai, Guangdong Prov.)
Length：91.3m
Width：27.6m
Water volume (3 squar+1 triangle)：：30,000 m³
Farming capacity: 480 t
Equipped with feeding, monitoring, net lifting and desalination facilities.

2018年09月16日 星期日 11:53:25

成功经受了"山竹"台风高海况海试
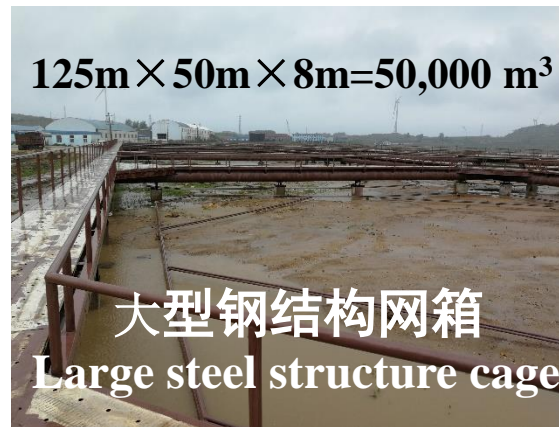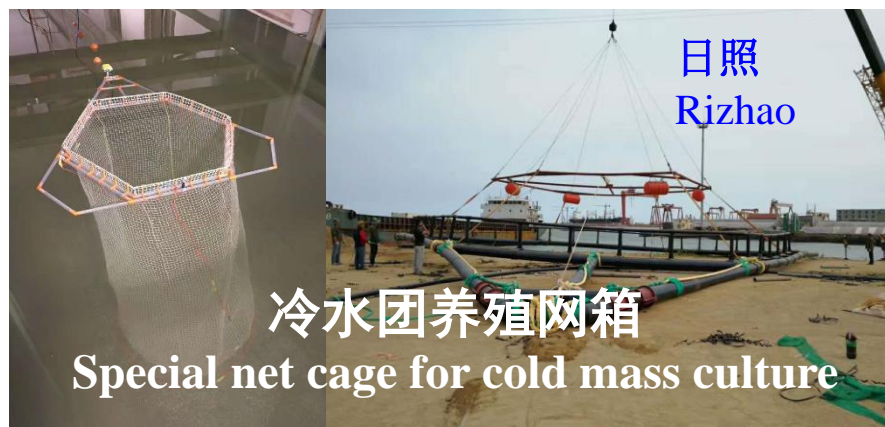**Performance in Typhoon Mangkhut**
发电舱

珠海桂山岛

⑤ 正在开发其他深远海养殖设施

养殖工船、浮箱组合式网箱、冷水团养殖网箱、大型钢结构网箱等

Other equipment and facilities being developed for deep sea or open ocean culture, including the aquaculture vessels, combined floating tanks, net cages for cold mass culture, various large steel structure cages, etc.

日照
Rizhao

养殖工船
Aquaculture vessel

浙江
Zhejiang

浮箱组合式网箱
Combined floating tanks

日照
Rizhao

冷水团养殖网箱
Special net cage for cold mass culture

125m×50m×8m=50,000 m³
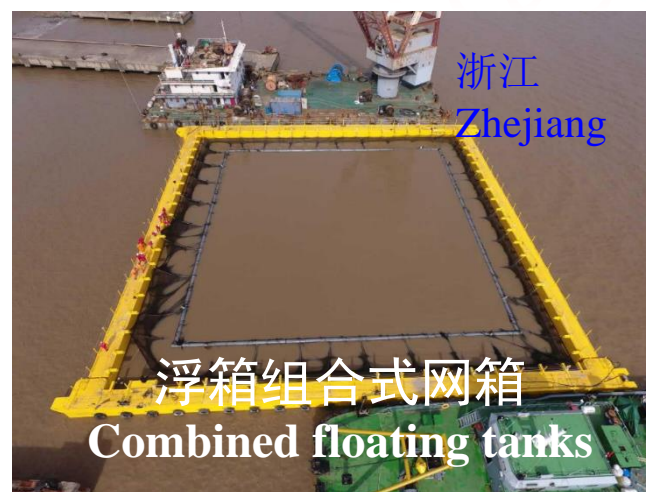
山东荣成
Rongcheng,
Shandong

大型钢结构网箱
Large steel structure cage

（3）池塘养殖 Pond culture

中国的海水鱼池塘养殖规模也较大，**2017年海水鱼池塘养殖产量约占当年海水鱼养殖总产量的20%**。但与工厂化和海上设施养殖相比，池塘养殖工程装备与技术研发方面起步则较晚。最近几年，循环水养殖理念被引入到池塘养殖中，并开发出了工程化循环水池塘养殖系统。

Marine fish pond farming in China is also in large scale, as mentioned above, about 20% of the cultured marine fish comes from pond farming. However, the research and development of pond farming engineering started relatively late in China as compared with cage facilities and industrial indoor farming systems. In recent years, the idea of recirculating aquaculture system has been introduced to the pond farming engineering and a Recirculating Pond System has been developed.

循环水池塘养殖系统工艺流程图
Diagram of Recirculating Pond System

循环水池塘养殖系统
Recirculating Pond System
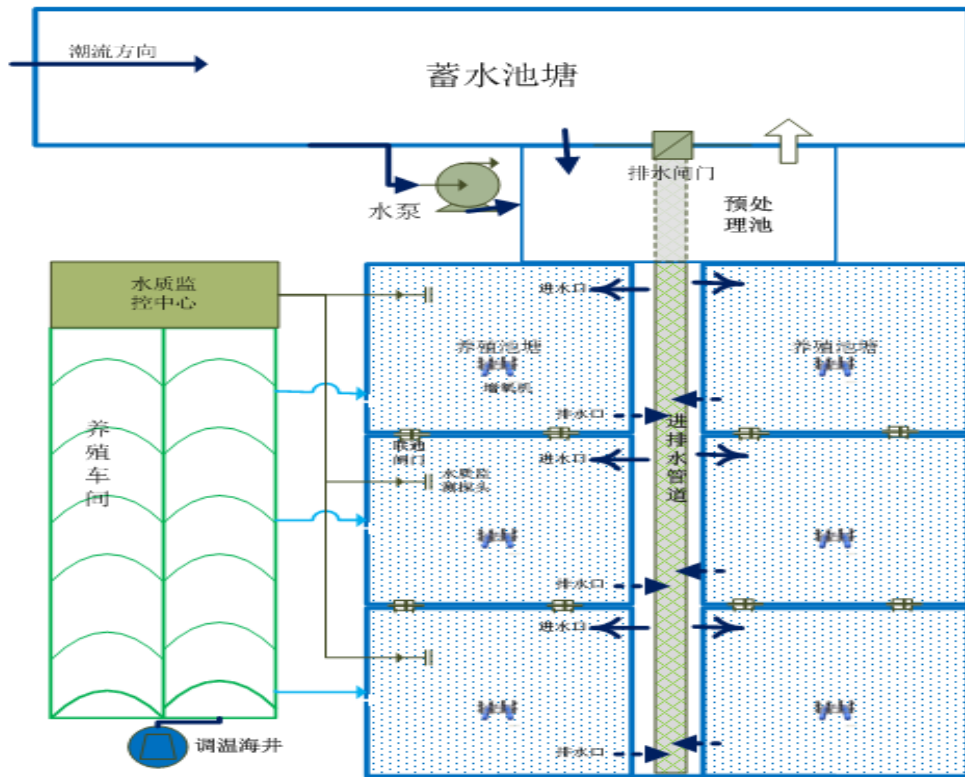
循环水池塘初步试验结果:

新水补充量: 可以减少50%

单位产量（以牙鲆为例）: 3.6kg/m² （传统普通池塘的单位产量一般少于1kg/m²）

The experiment results show that by using the Recirculating Pond System:

Changed water: decreased by 50%

Unit yield (flounder farming): 3.6kg/m² (the unit yield farmed in traditional pond less than 1kg/m²)

（4）养殖配套设施与装备

Auxiliary Farming Facilities and Equipment

Fish Size
Grading Device

大小分级装置

Live Fish
Harvesting Machine

活鱼起捕机

规格分级系统
Fish grading system

Live fish pump
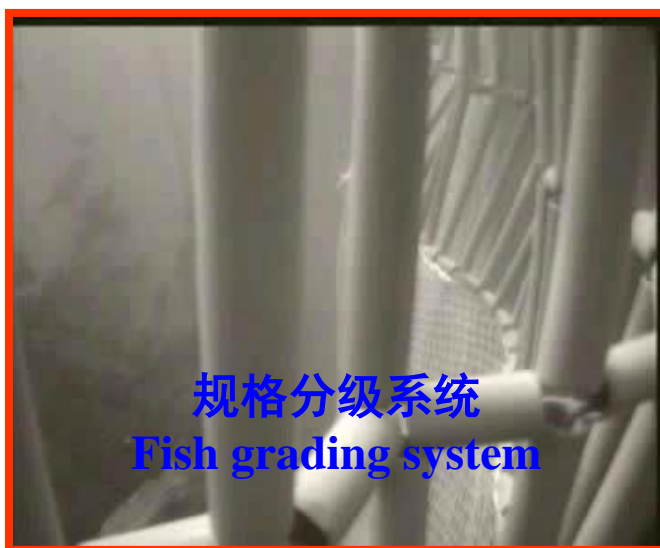
网箱水下监控系统　Under water monitoring system

第一代产品

水下监视系统

便携式单探头
深水网箱监视器

网箱养殖
配套设施

第二代产品

多视角 深水网箱水下监视器

可变焦水下监视器

ROV水下机器人

深度：0.0m
水温：11.3℃
内部温度：23.2℃
内部温度：22.4℃
艏首指向：045°

电池1：28%
电池2：18%

定像：开
定深：关
定航：关
加速：开

11:53:30
2014-11-07
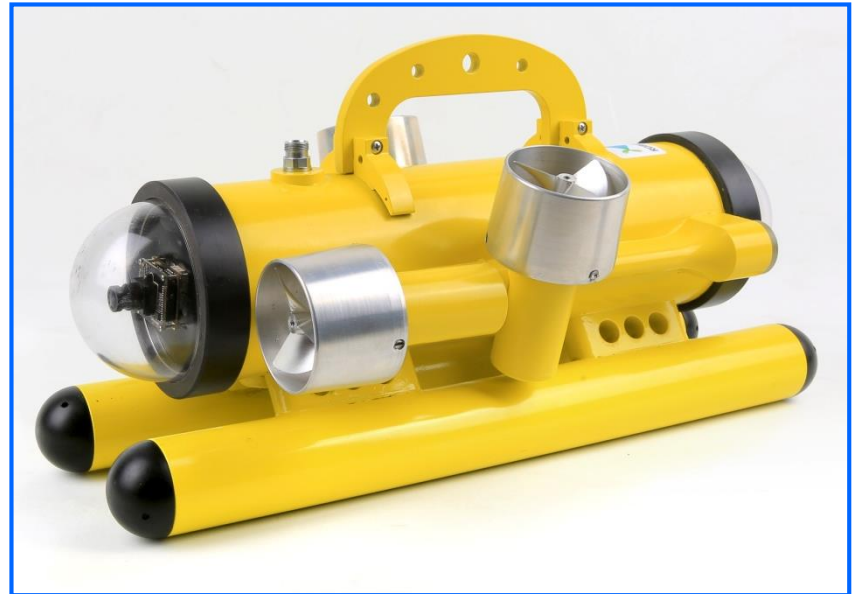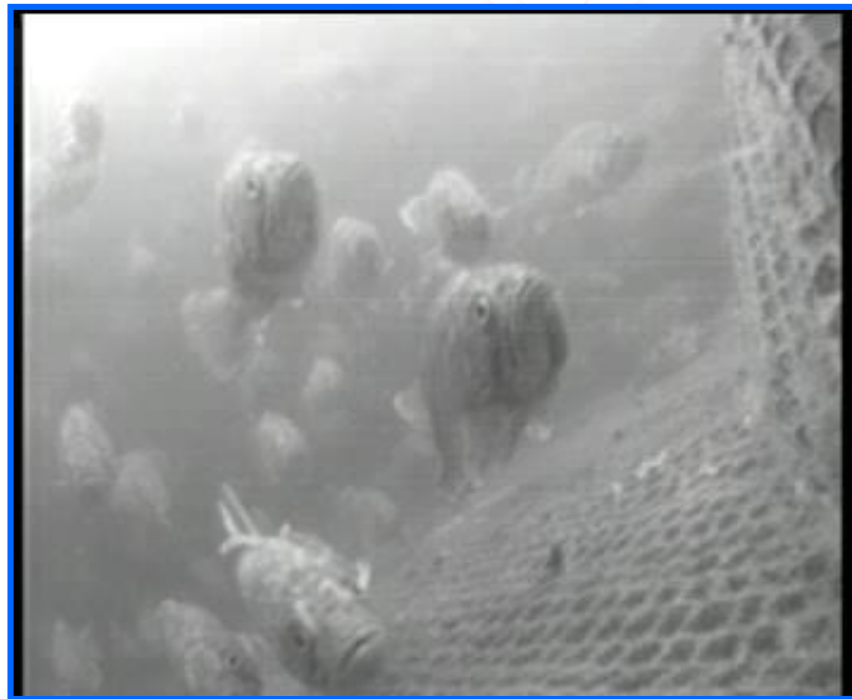
网箱养殖环境自动监测系统

Environment monitoring system

（流速、温度、溶解氧、盐度、pH值等6个环境因子）

（current, temp., DO, salinity, pH）

网箱养殖环境监测系统
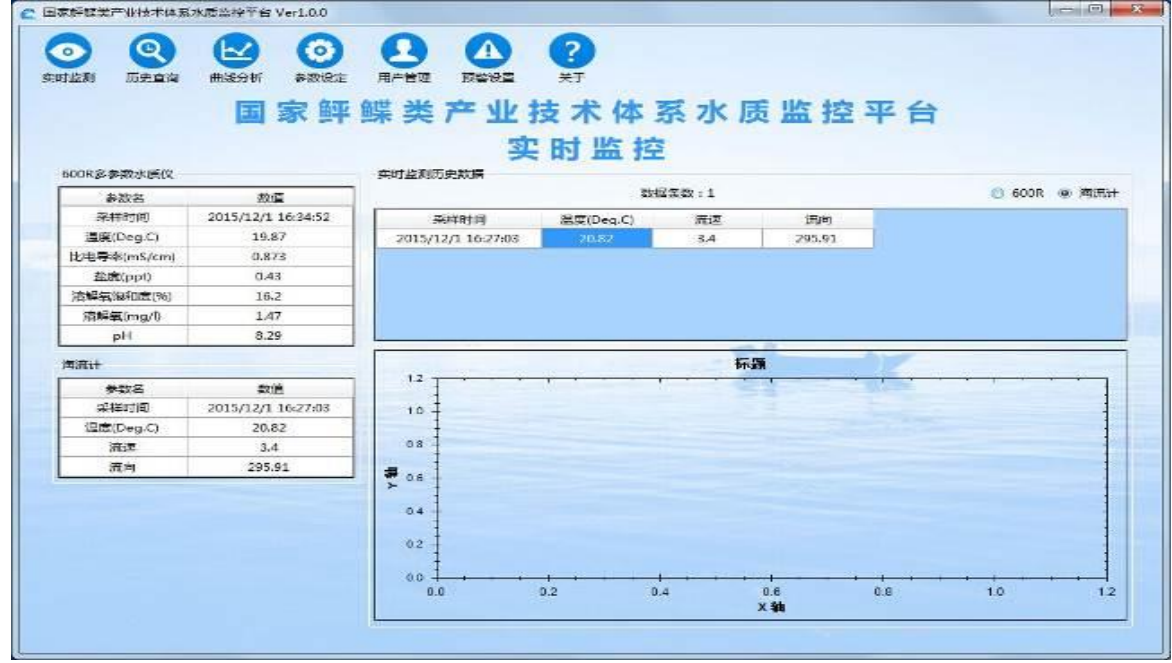
网箱投饵系统（**Feeding system for cage culture)**

气力输送集

Pneumatic conveying feeding system controlled on the platform

船载投饵装备

Feeding system installed on the working ship

四、国家海水鱼产业技术体系介绍

Introduction of China Agriculture Research System for Marine Fish Culture Industry

国家海水鱼产业技术体系组织结构图

The organization plan of the Research System for Marine Fish Culture Industry

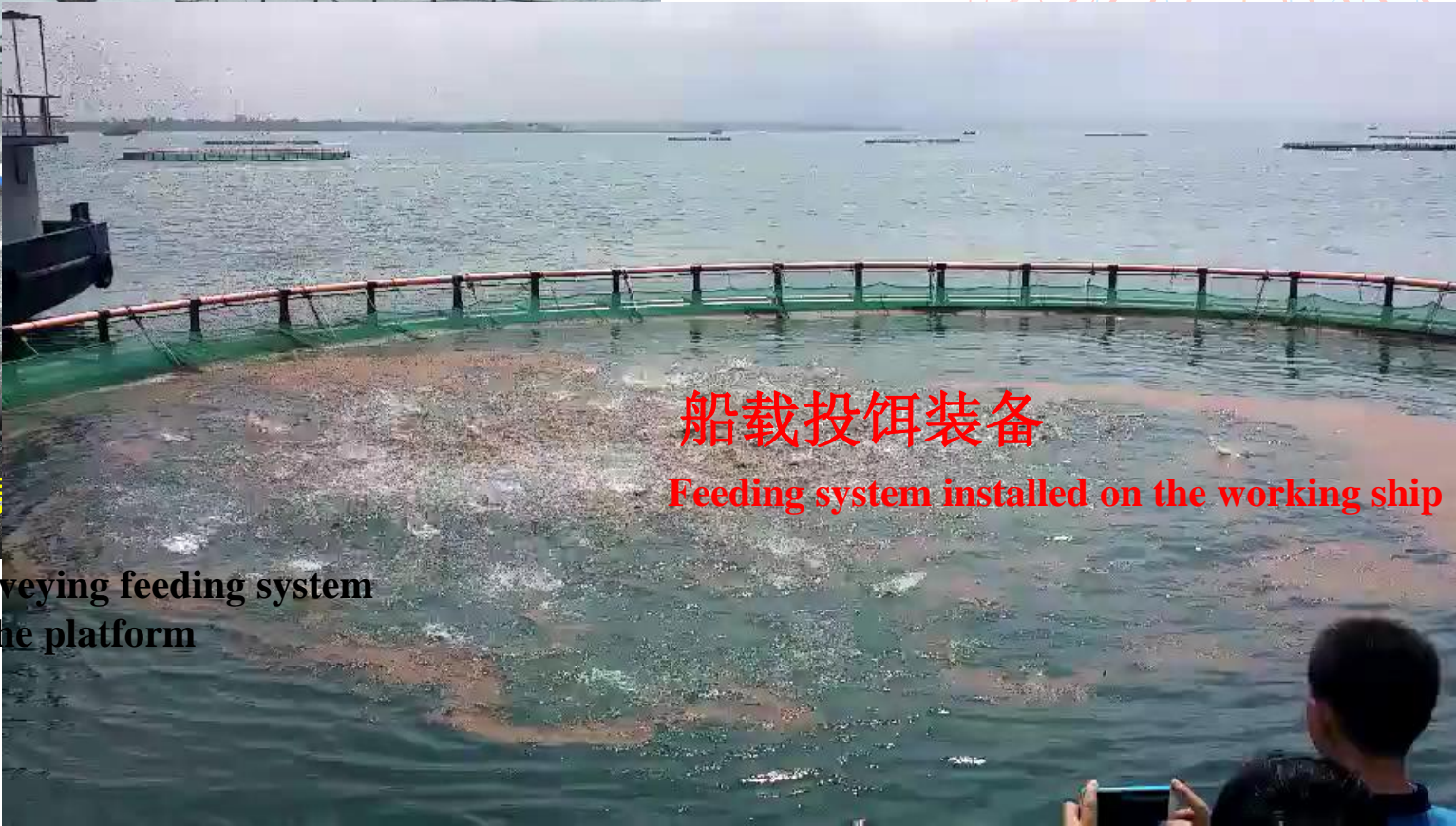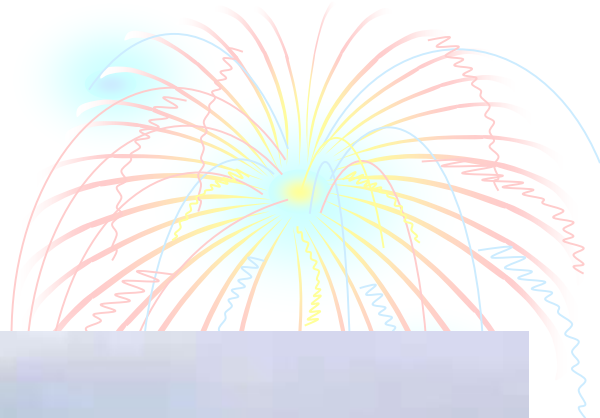The **Research System for Marine Fish Culture Industry is an enlarged research system from the original system of Flatfish Culture Industry (approved by the Ministry of Agriculture in 2017). It is one of the six research systems for China's aquaculture industry. The research center is affiliated to the Yellow Sea Fisheries Research Institute**

由2008年首批启动的国家鲆鲽类产业技术体系扩容而来（2017年）。为目前6个水产体系之一。

国家海水鱼产业技术体系

首席科学家、执行专家组
（首席办公室）

国家海水鱼产业技术研发中心
依托单位：中国水产科学研究院黄海水产研究所

功能研究室 6个

综合试验站 19个

功能研究室

遗传改良研究室
- 大菱鲆种质资源与品种改良
- 牙鲆种质资源与品种改良
- 半滑舌鳎种质资源与品种改良
- 大黄鱼种质资源与品种改良
- 石斑鱼种质资源与品种改良
- 海鲈种质资源与品种改良
- 卵形鲳鲹种质资源与品种改良
- 军曹鱼种质资源与品种改良
- 河鲀种质资源与品种改良

营养与饲料研究室
- 鲆鲽类营养需求与饲料
- 大黄鱼营养需求与饲料
- 石斑鱼营养需求与饲料
- 军曹鱼卵形鲳鲹营养需求与饲料
- 海鲈营养需求与饲料
- 河鲀营养需求与饲料

疾病防控研究室
- 环境胁迫性疾病与综合防控
- 病毒病防控
- 细菌病防控
- 寄生虫病防控

养殖与环境控制研究室
- 养殖设施与装备
- 养殖水环境调控
- 网箱养殖
- 池塘养殖
- 工厂化养殖
- 深远海养殖

加工研究室
- 保鲜与贮运
- 鱼品品加工
- 质量安全与营养品质评价

产业经济研究室
- 产业经济

综合试验站
- 天津综合试验站
- 秦皇岛综合试验站
- 北戴河综合试验站
- 大连综合试验站
- 丹东综合试验站
- 葫芦岛综合试验站
- 烟台综合试验站
- 青岛综合试验站
- 莱州综合试验站
- 东营综合试验站
- 日照综合试验站
- 南通综合试验站
- 宁波综合试验站
- 宁德综合试验站
- 漳州综合试验站
- 珠海综合试验站
- 北海综合试验站
- 陵水综合试验站
- 三沙综合试验站

示范县（市、区）

岗位科学家29位

95个

We have 29 post scientists in six research divisions and 19 experimental bases distributed in 95 administrative counties and districts all over the marine fish culture areas in China.

国家海水鱼产业技术体系的工作定位、目标与任务

The species, key tasks and aim of the Research System for Marine Fish Culture Industry

品种：涵盖全国所有海水养殖鱼类，尤其是大黄鱼、大菱鲆、石斑鱼、海鲈、卵形鲳鲹、河鲀、牙鲆、半滑舌鳎、军曹鱼等产量较大的种类。

Species: The research system covers all the marine fish species, especially the species farmed in large scale, such as the turbot, large yellow croaker, groupers, sea bass, ect.

任务：面向我国海水鱼类养殖产业发展需求，围绕制约产业的突出问题，开展共性关键技术研发、集成、试验和示范，突破制约瓶颈，为我国海水鱼类养殖产业健康稳步发展提供持续技术支撑。

Tasks: Focusing mainly on the demanding and restricting of the development of marine fish culture industry in China, we carry out the investigation, integration, testing and demonstration of common key technologies so as to overcome and breakthrough the bottlenecks, thus to provide the sustainable aquaculture technical support for marine fish culture industry in China.

定位/目标：绿色发展、增产增收、提质增效、富裕渔民

Goals: Green development, Increasing both production and income, Improving quality and increasing efficiency, Making fishermen become richer

联系方式：

黄海水产研究所 鱼类室/海水鱼体系办公室

联系人：关长涛（13964233159）；王琳（15266213657）

电　话：0532-58521672/85826770（体系办公室）

E-mail：guanct@ysfri.ac.cn

Yellow Sea Fisheries Research Institute
Chinese Academy of Fishery Sciences

GUAN CHANG TAO　Professor

Director, Division of Fish Culture and Engineering

106 Nanjing Road Qingdao,　　Tel: 86-532-85821672
266071 P.R.China　　　　　　Fax: 86-532-85811514/85821672
Mobile phone: 13964233159　　E-mail: guanct@ysfri.ac.cn

欢迎同行和同仁多联系、多合作、多交流！