# HABs and shellfish intoxication in China sea

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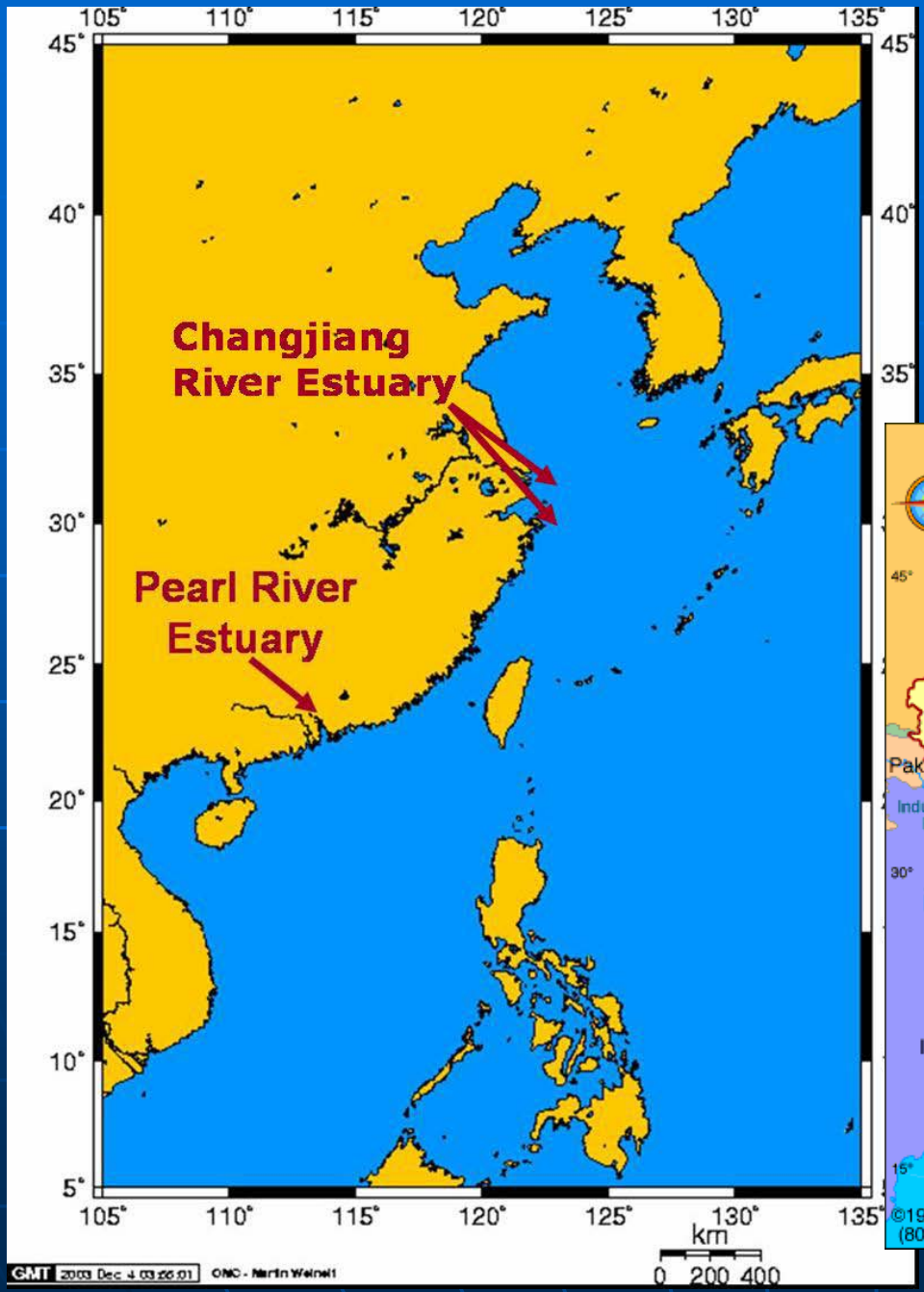
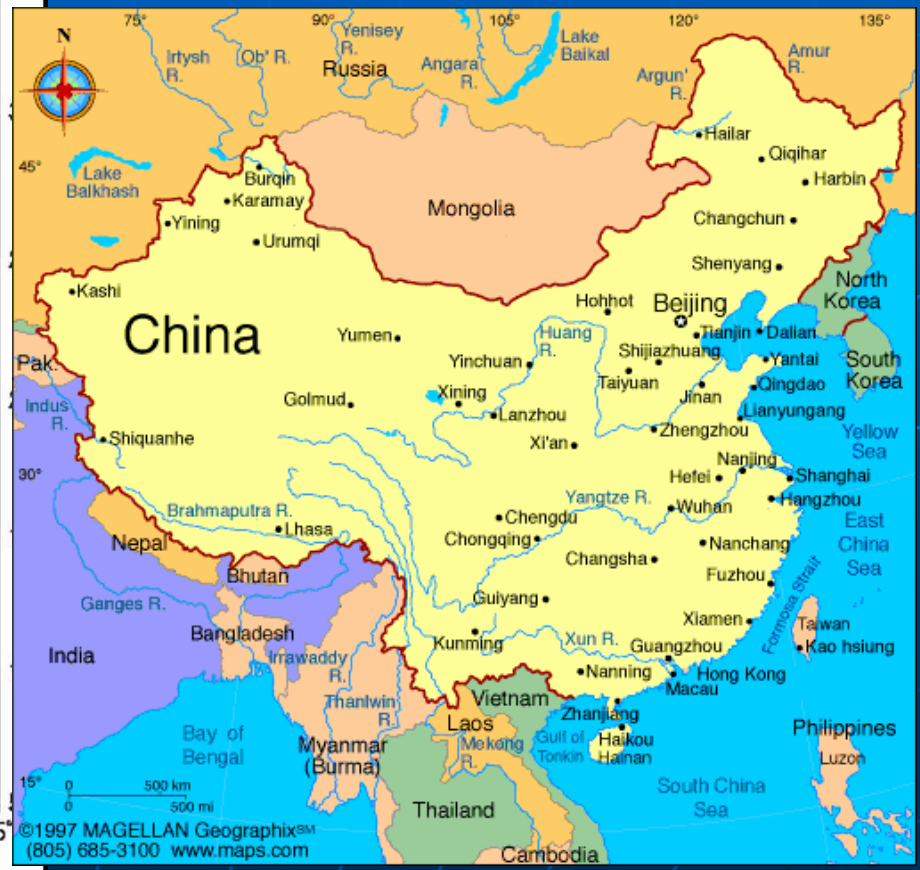
# Outline

- The HABs in China
- The intoxication by consuming shellfish in China

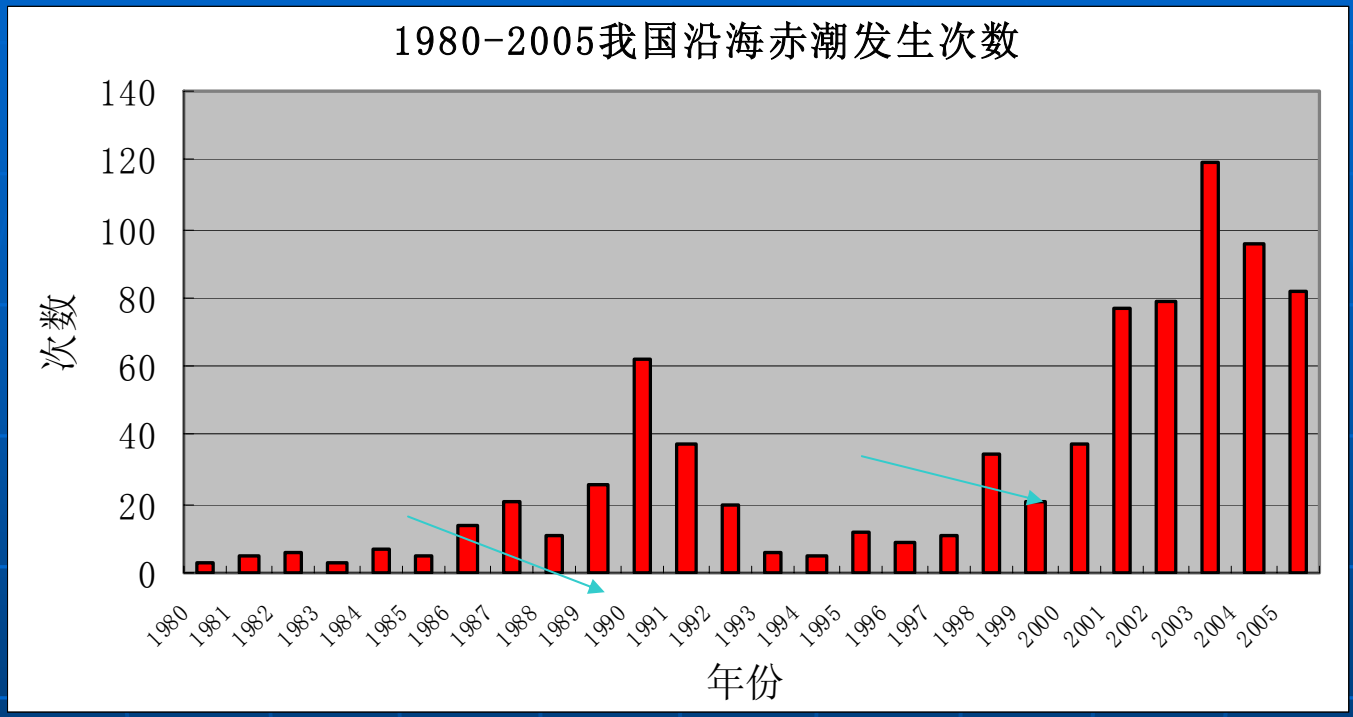



19 red tide monitoring zone with biweekly sample were carried out since 2002.

East China sea:10



# Tendency of red tide in China




There are 809 red tides recorded in China up to 2005, among them, the red tide during 2001 to 2005 is up to 453 which occupy 60% of total

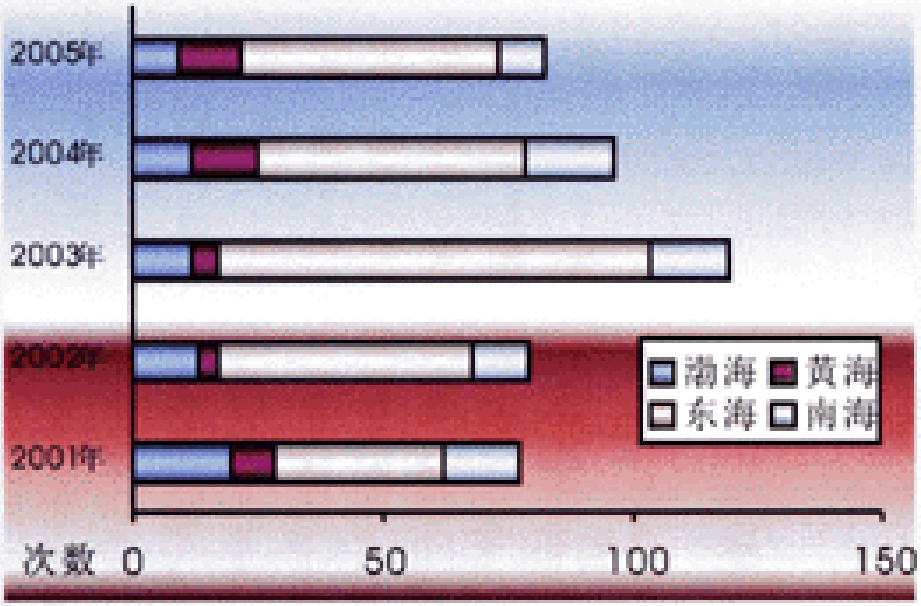
**there are 2 peak period with the increasing tendency。Recently stable around 80 times**

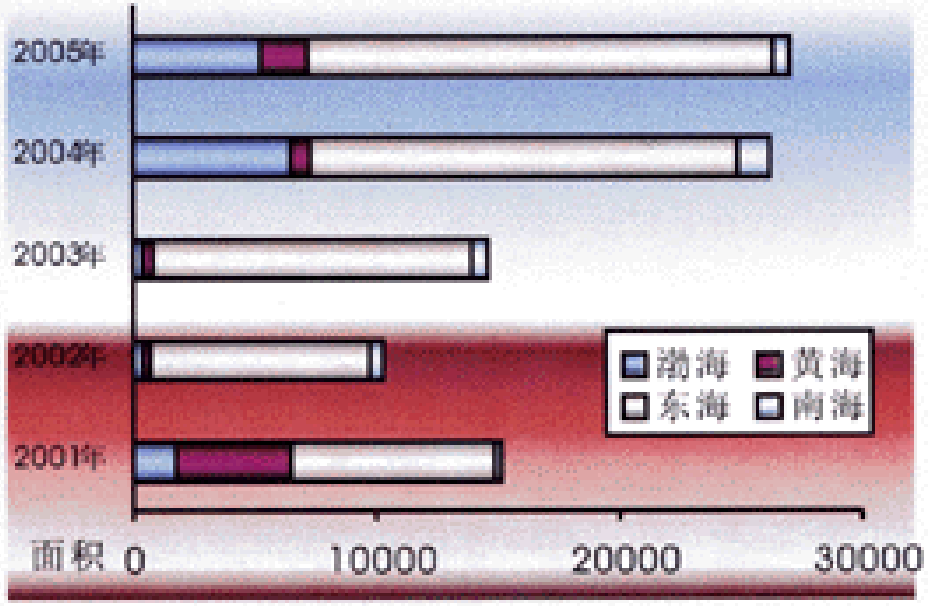
# The red tide during 2001 ~ 2005

- **Red tide sensitive zone**

453 red tides were recorded in China during 2001～2005, the affected area cover 93,260 $Km^2$。The most sensitive area is East China sea, the times and affected area of red tide occupied 61% and 72% of that in China separately; the notorious Zhejiang Coast( one part of East China sea) occupied 38% and 61% of that total in China separately.

Bohai sea, Yeallow sea, East China sea, South China sea



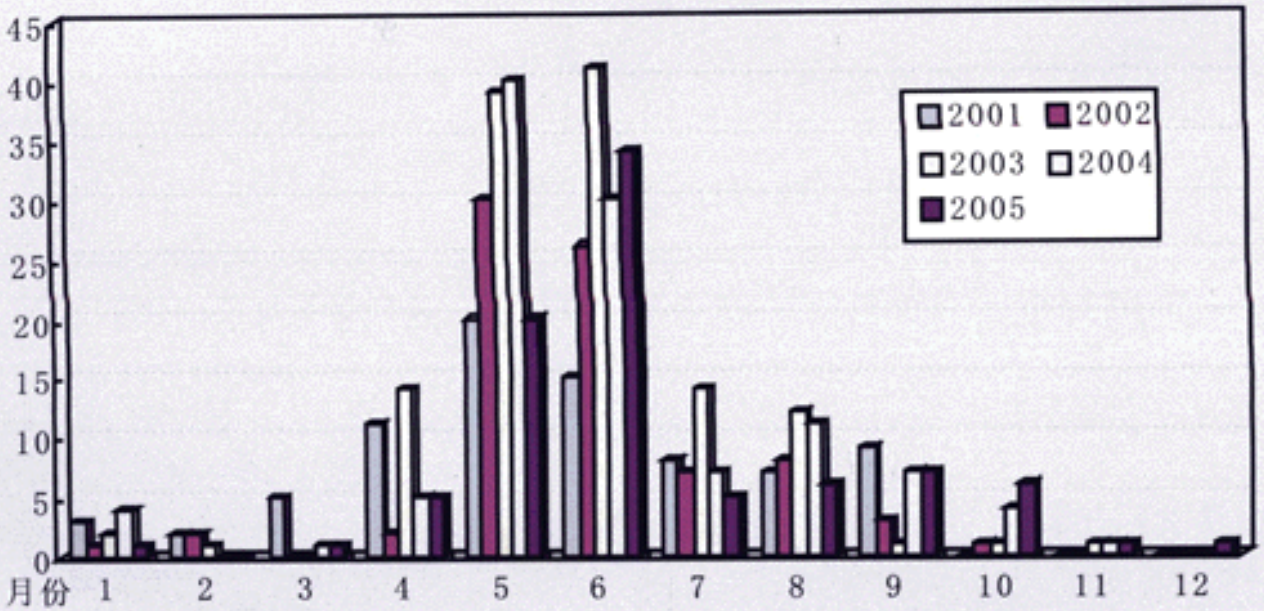




The occurrence comparation of red tide in different sea area

- Peak month of red tide

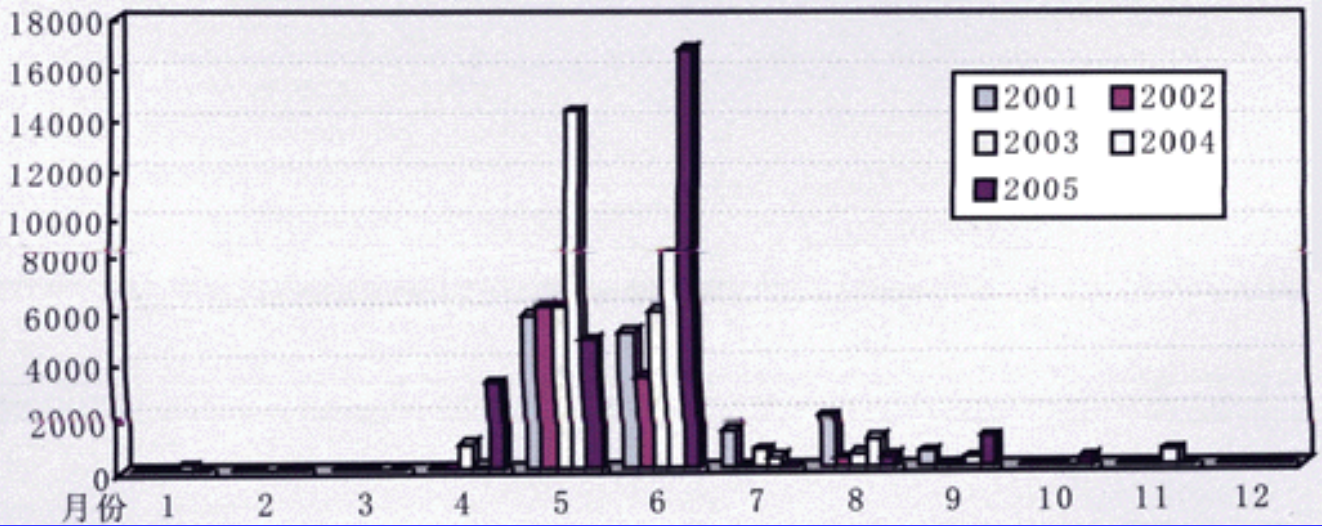
most red tides occurred on May or June during 2001～2005，the occurrence times and affected area of these 2 months occupied 62% and 83% of that in whole year 。

HAB tumes



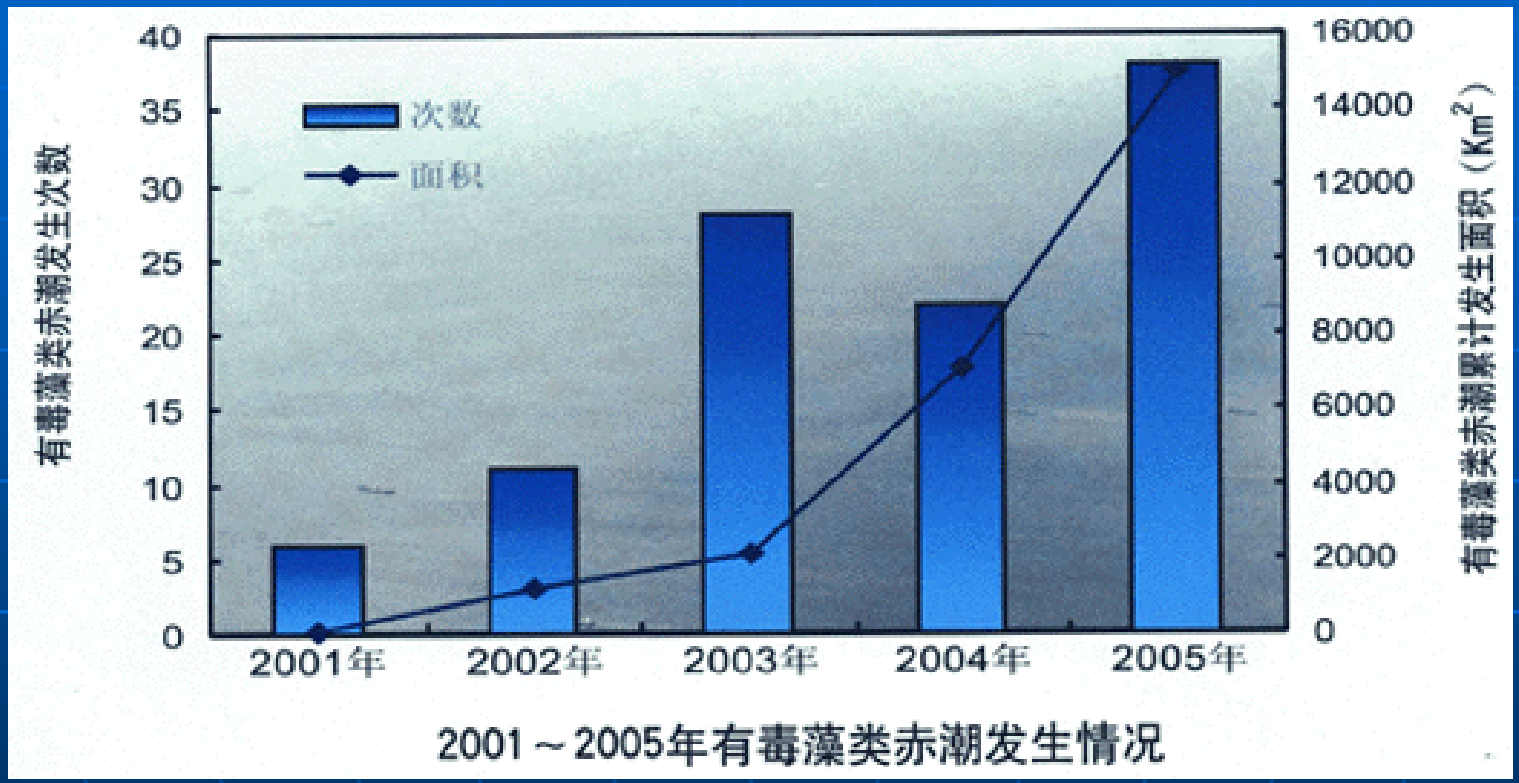

seasonal variation of HAB occurrence times in China

HAB affected area



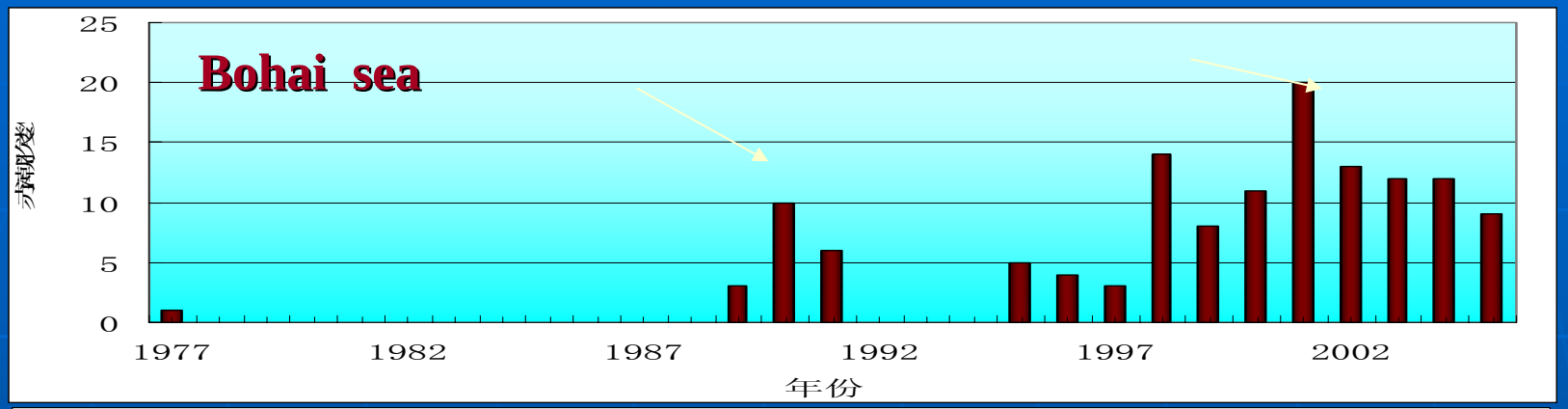

seasonal variation of HAB affected area in China

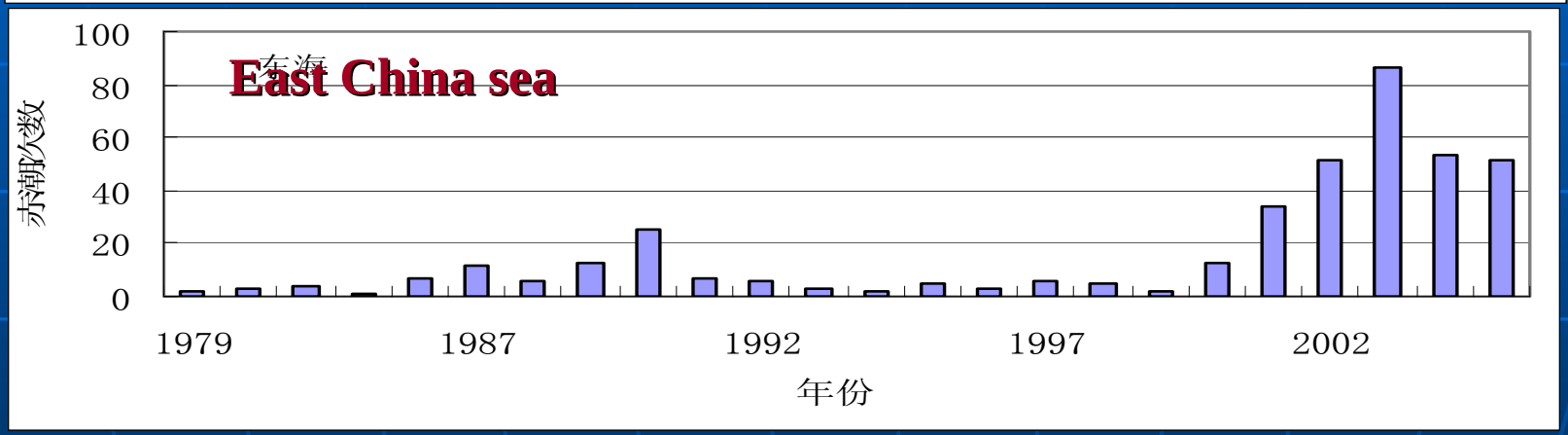
# The HAB events and affected area increase

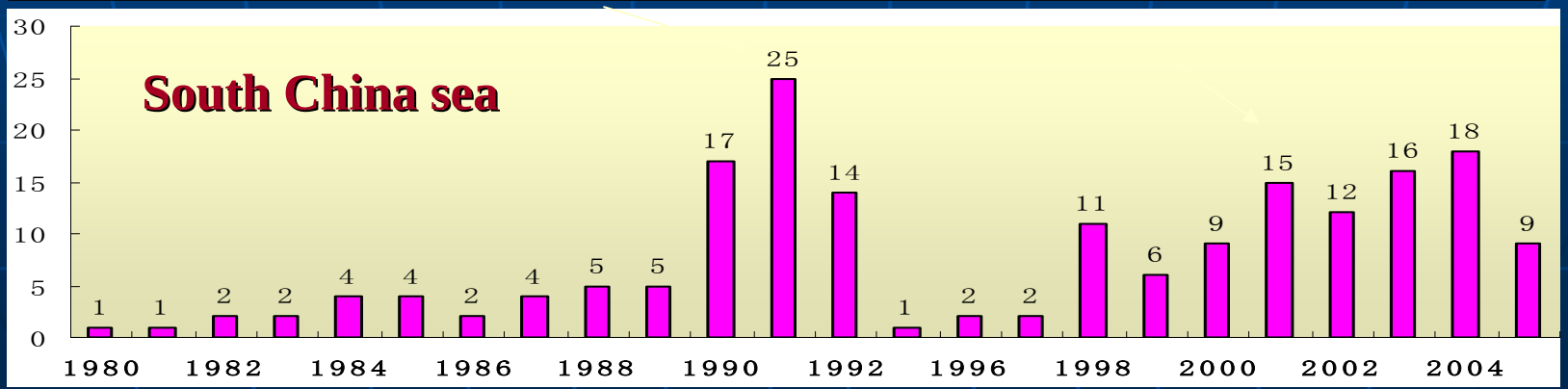


# 2. 南海、东海和渤海 3 个赤潮高发区赤潮发生比较分析

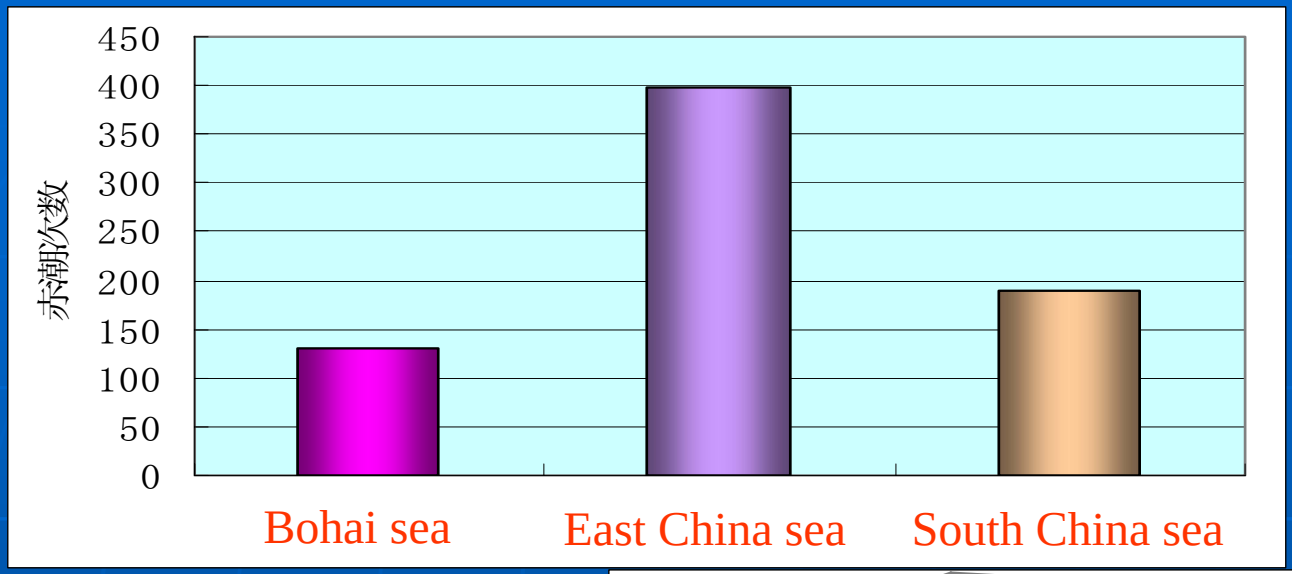
**red tide events variation during 1980~2005**

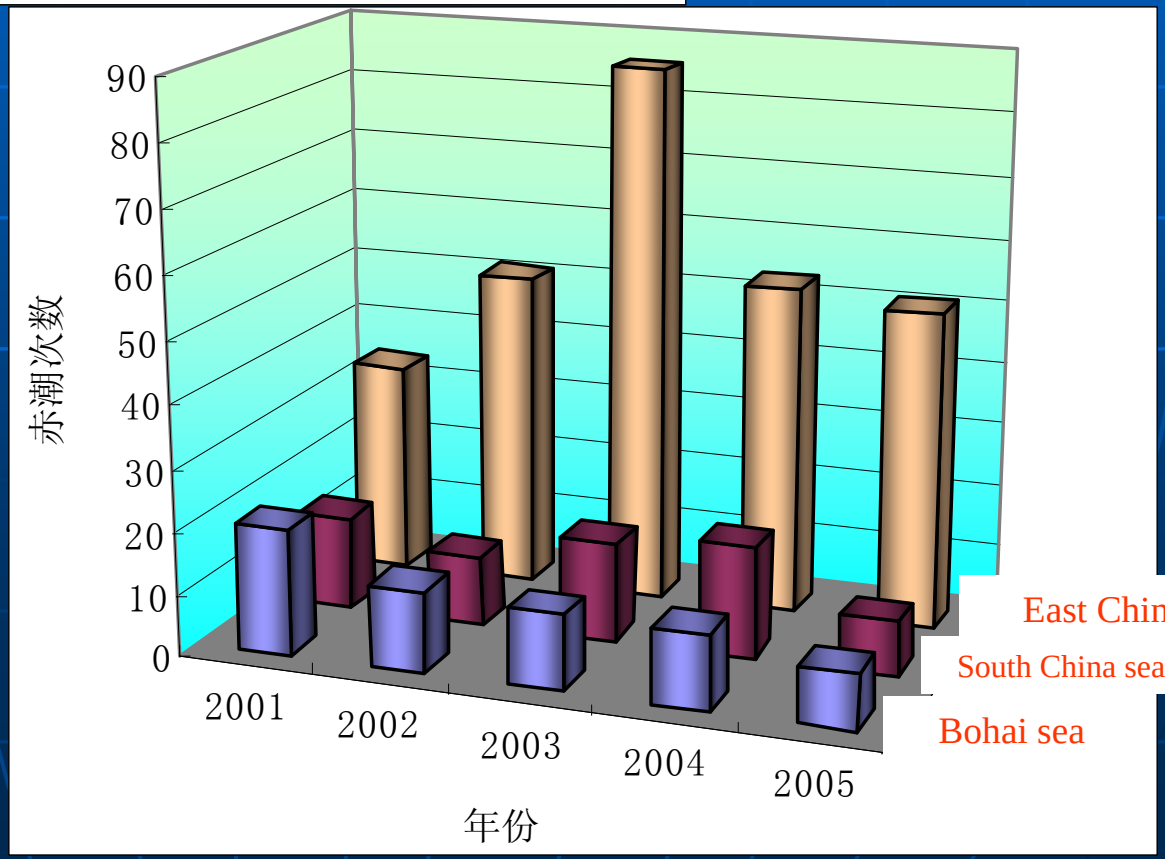


# Red tide events in different seas



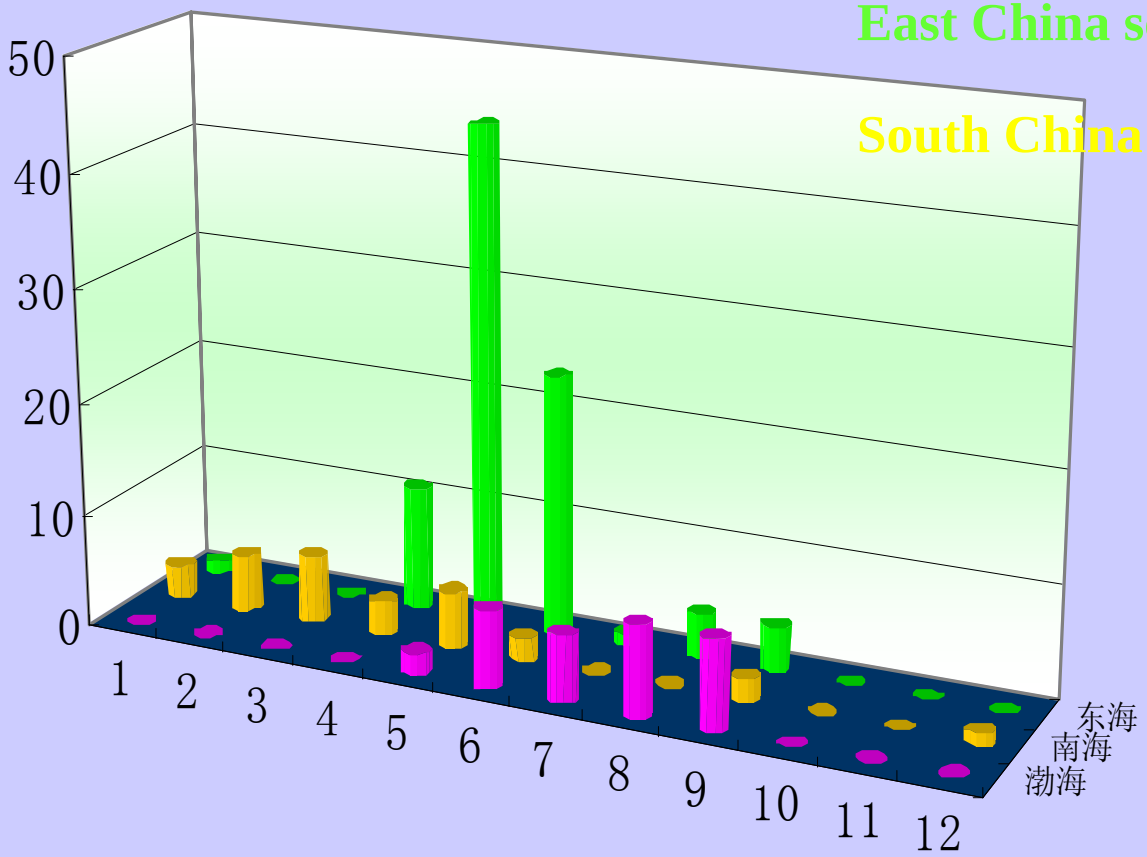



# Red tide peak season

Bohai sea: 6-9

East China sea: 5-7

South China sea: 1-5




2001-2002年

# Regular Red tide caused species in China

- Bohai sea: *Noctiluca scintillans* 、*Skeletonema costatum* 、*Mesodinium rubrum* 、*Phaeocystis sp* 、*karenia mikimotoi*
- East China sea: *Noctiluca scintillans* 、*Prorocentrum dentatum* 、 *Skeletonema costatum* 、 *k*arenia *mikimotoi*、*Heterocapsa circularisquama*
- East China sea:*Skeletonema costatum* 、*karenia mikimotoi*、 *Phaeocystis sp* 、*Trichodesmium sp*
-

# Red tide caused species

| 1980s | 1990s | 2001 | 2002 | 2003 |
|---|---|---|---|---|
| 13 | 8 | 5 | 8 | 19 |
| Thalassiosira weissflogii | Noctiluca scintillans | Chaetoceros sp | Noctiluca scintillans | Skeletonema costatum |
| Noctiluca scintillans | Skeletonema costatum | Skeletonema costatum | Alexandrium catenella | Noctiluca scintillans |
| Skeletonema costatum | Protoperidinium bipes | Prorocentrum dentatum | Prorocentrum dentatum | Prorocentrum dentatum |
| Gymnodinium sp | Prorocentrum sp | Biddulphia aurita | Skeletonema costatum | Thalassiosira subtilis |
| Datyliosolen mediterrancus | Prorocentrum micans | Prorocentrum micans | Mesodinium rubrum | Gymnodinium sp |
| 短弯角藻 | Phaeocystis *globsa* | | Gymnodinium breve | Alexandrium catenella |
| Pseudo-nitzschia pungens | CYANOPHYTA | | Chaetoceros socialis | 微型绿藻 |
| Prorocentrum sp | Prorocentrum dentatum | | Gymnodinium sanguineum | 赤潮异弯藻 |
| Eucampia zoodiacus | | | | Gymnodinium mikimotoi |
| Chaetoceros. debilis | | | | Scrippsiella trochoidea |
| Chaetoceros socialis | | | | 轮状斯克藻 |
| Gymnodinium simplex | | | | Mesodinium rubrum |
| Ceratium trichoceros | | | | Nitzschia closterium |
| | | | | Gonyaulax digitale |
| | | | | Datyliosolen mediterrancus |
| | | | | Prorocentrum minimum |
| | | | | Chaetoceros. debilis |
| | | | | Thalassiosira nordenskioldi |
| | | | | Heterocapsa circularisquam |

# *Prorocentrum dentatum*

## =*Prorocentrum donghaiese*

Before 1990s no records

Photo by Jinhui Wang

Photo by Douding Lu



上海

福建

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1996~1999, small scale red tide nearby the Changjiang anchoring sea area

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2000 May, 7000Km³

Changjiang Estuary to north Zhejiang Coast

Photo by Jinhui Wang

Photo by Douding Lu

上海

福建

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上海

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2004, cover all the Changjiang Estuary, Zhejiang Coast, North part of fujian Coast

Photo by Jinhui Wang

Photo by Douding Lu

上海

福建

introduced

Expand and Harm

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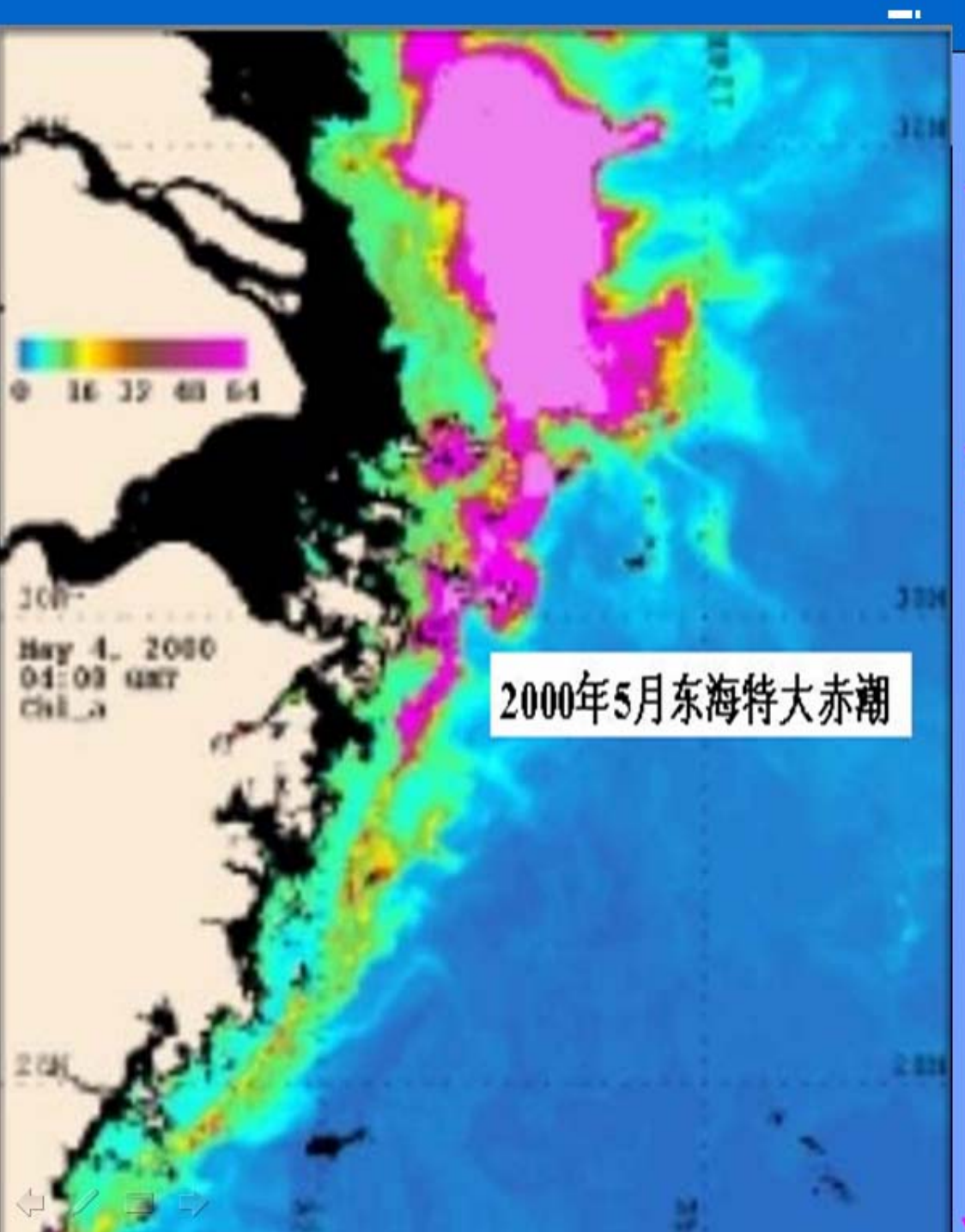


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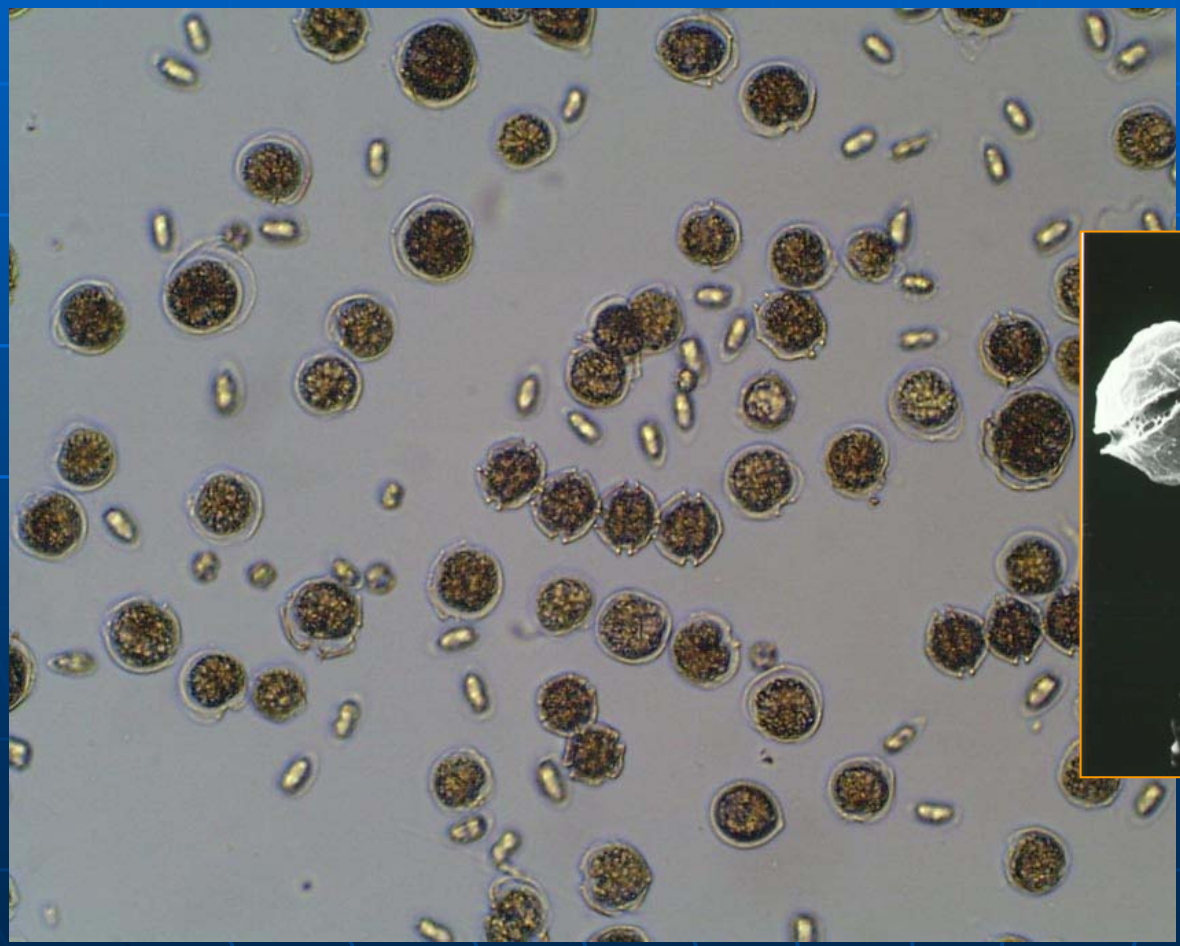
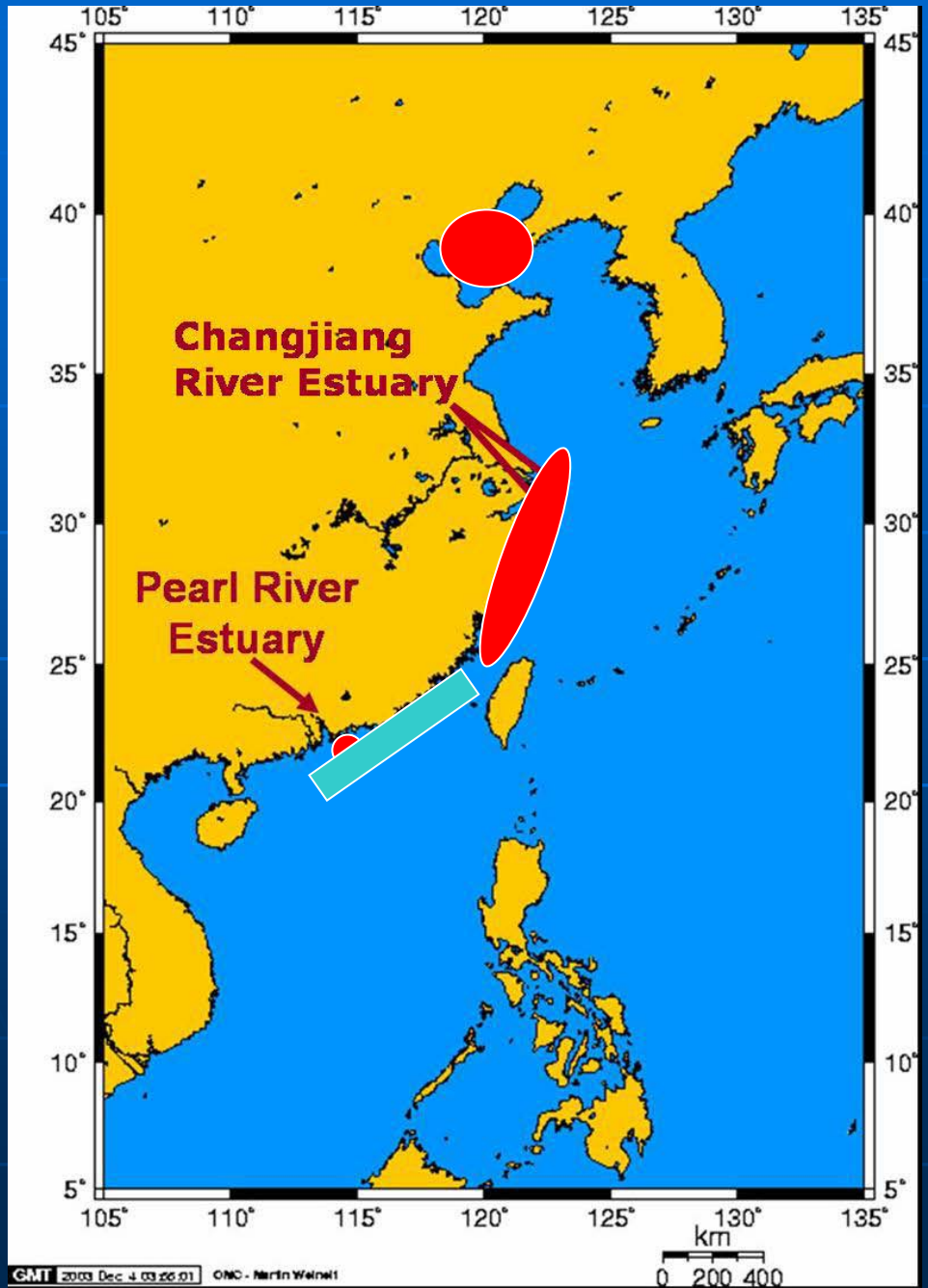
# *Alexandrium*

- Often coincide with the *prorocentrum* HABs, with maximum abundance *Of 100000 cell/L*



# *Karenia mikimotoi*




1995 HAB in Hongkong and caused great loss,

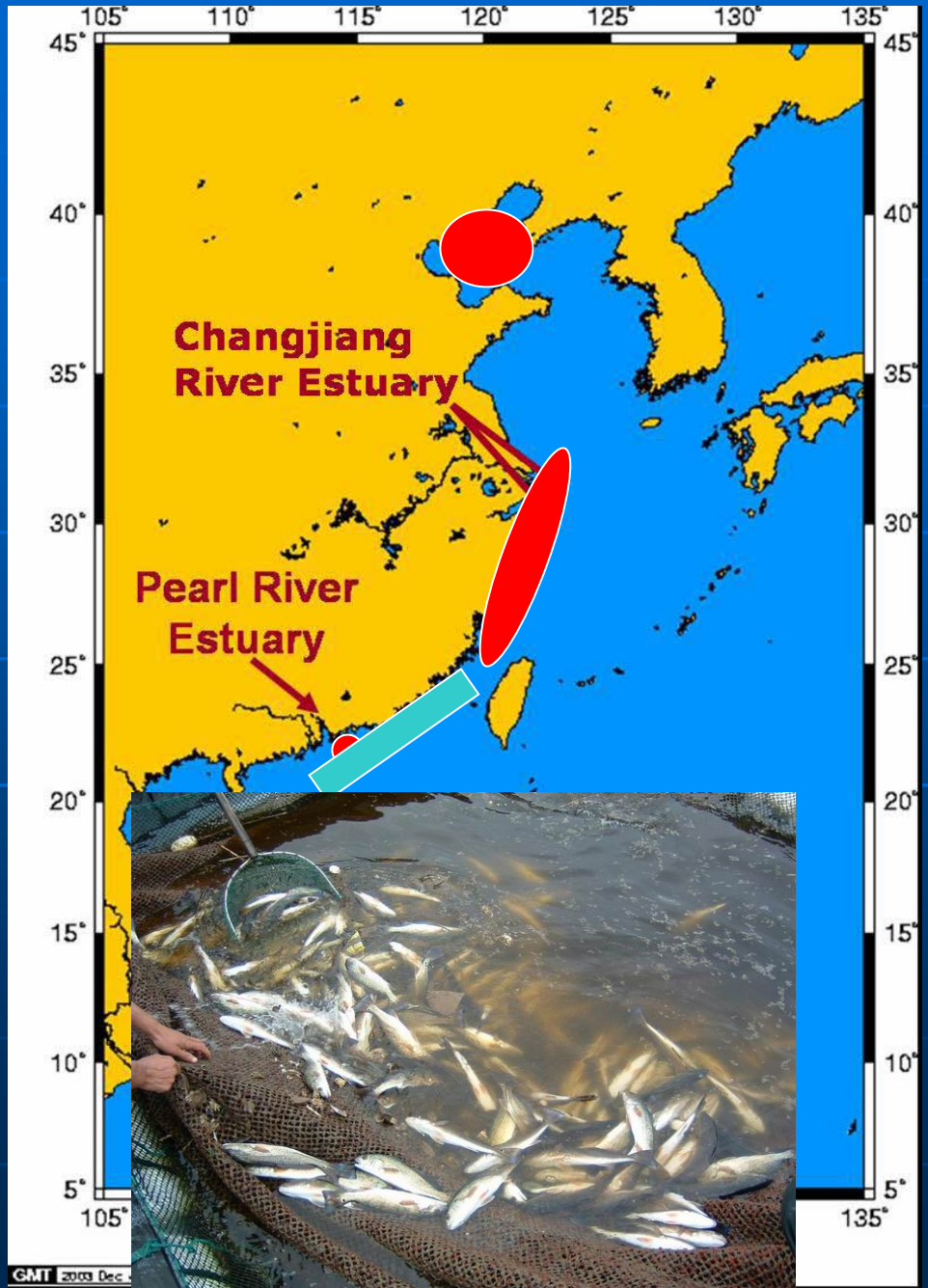
1998 HAB along the coast of the South China Sea

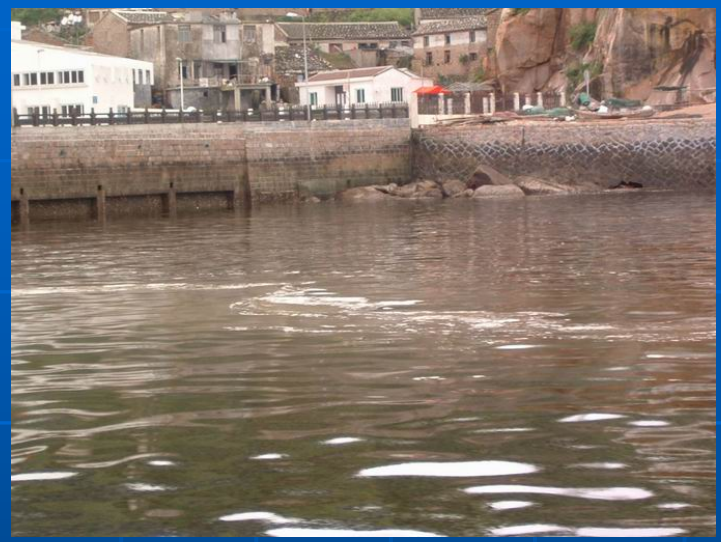
2001 small scale in east China sea and caused aquaculture fish dead

2004 large scale HAB (5000 $Km^2$) in Bohai sea, no dead fish。

2005 large scale HAB (7000 $Km^2$) in east China sea, caused lots of aquaculture fish dead, estimated loss of RMB 19.7 billion Yuan.

# *Karenia mikimotoi*



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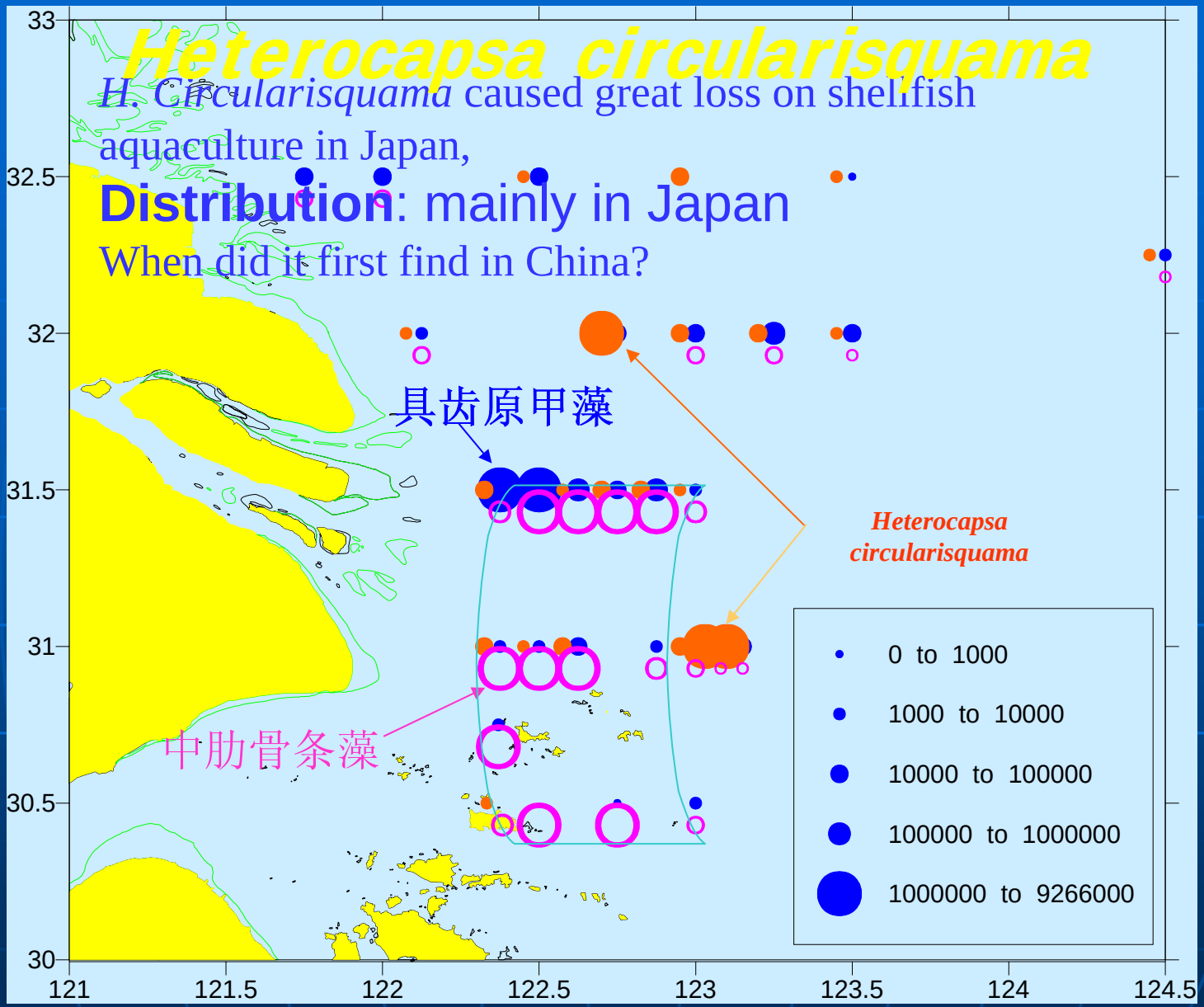
# *Heterocapsa circularisquama*

*H. Circularisquama* caused great loss on shelfish aquaculture in Japan,

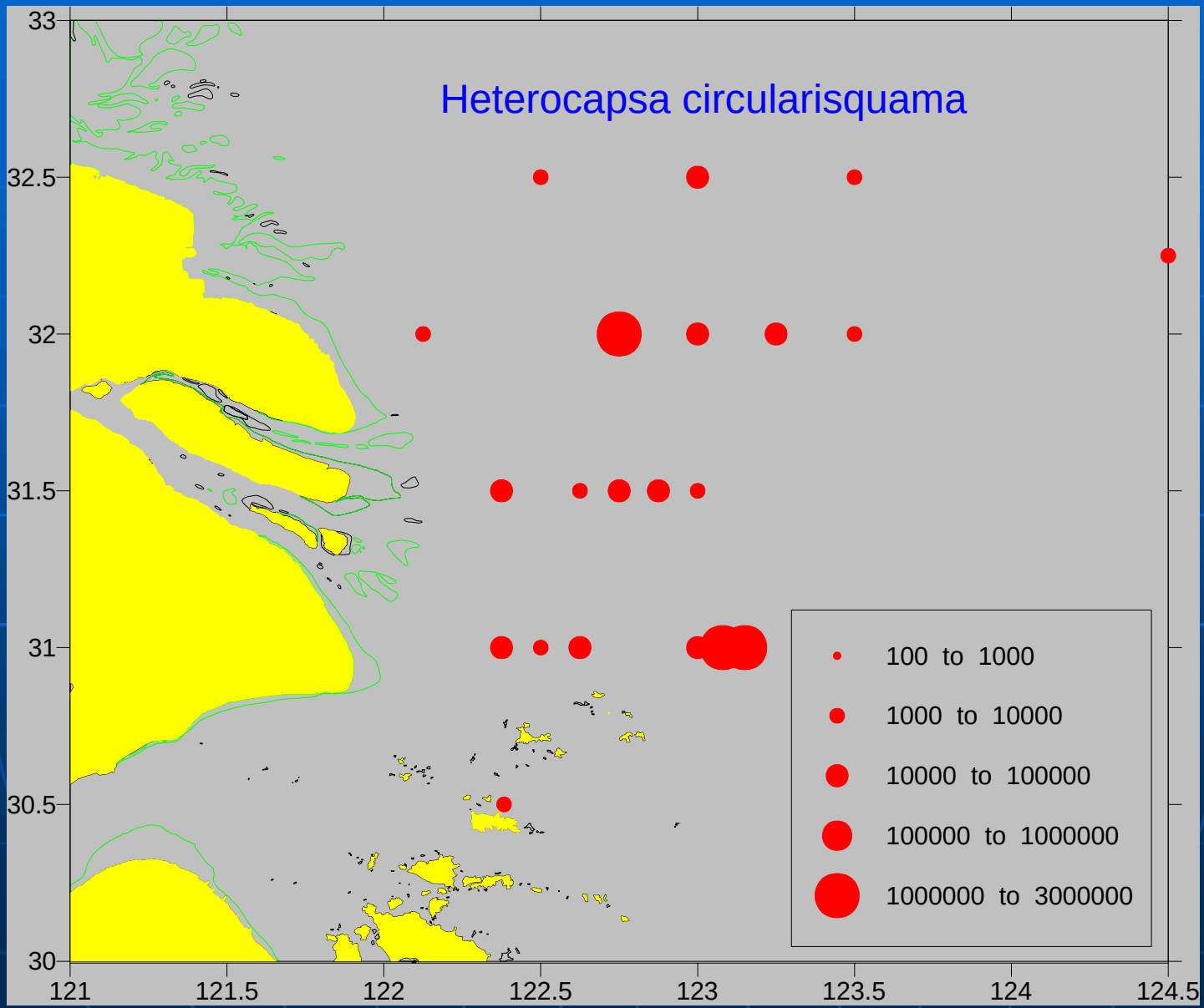
**Distribution**: mainly in Japan

When did it first find in China?




June 2003, HAB in Changjiang estuary, no harm found

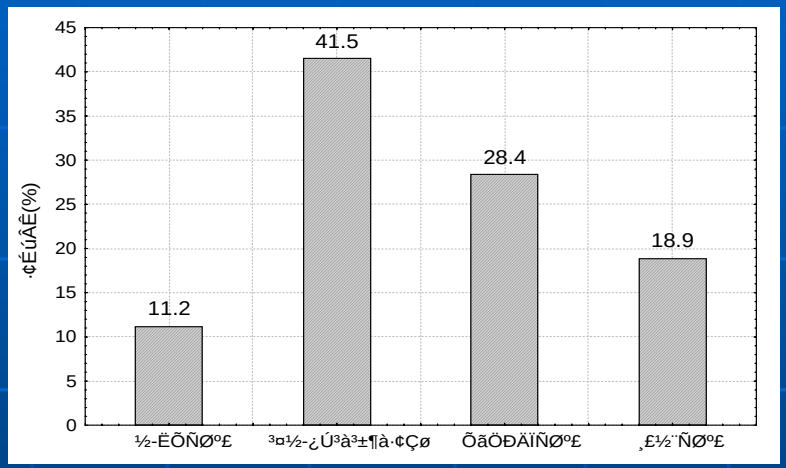
June 2005, HAB in Changjiang estuary, caused some cultured mussel dead

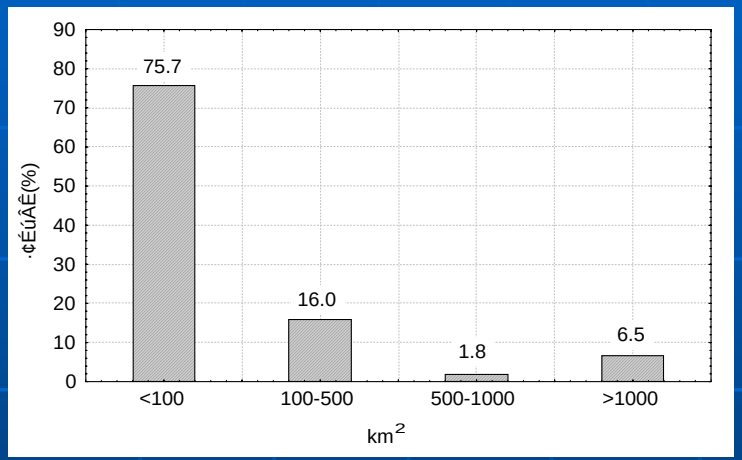

Heterocapsa circularisquama
33
32.5
32
31.5
31
30.5
30
121
121.5
122
122.5
123
123.5
124
124.5
100 to 1000
1000 to 10000
10000 to 100000
100000 to 1000000
1000000 to 3000000

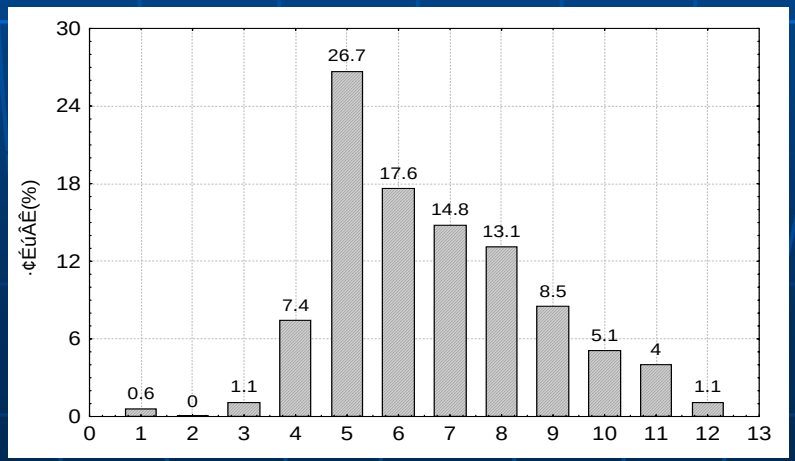
# *Pseudo-nitzschia spp*

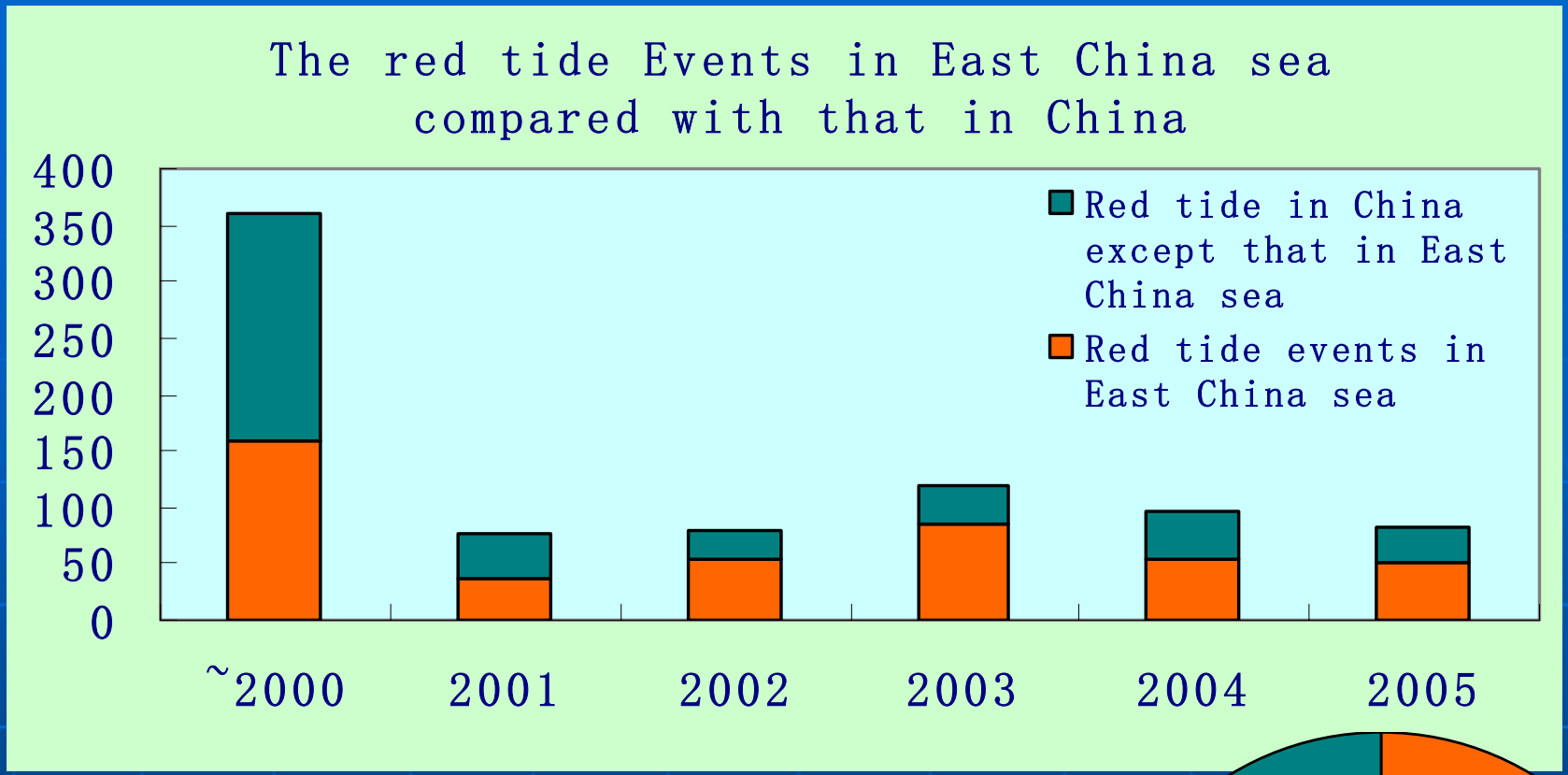
Among the 8 *Pseudo-nitzschia* species recorded to date on China coasts, namely *Pseudo-nitzschia cf. sinica* ,*P. pungens*, *P. delicatissima* ,*P. subpacific*, *P. Americana*, *P. multistriata*, *P. multiseries and P. pseudodelicatissima* (Qi Y 1994, Chen Jufan 2003, Zou, J.Z 1993, our research),the last four have been documented elsewhere in the world as DA producers, both in the field and in culture studies (Orsini L, 2002; Grethe R. Hasle, 2002)

# Red tide in East China sea

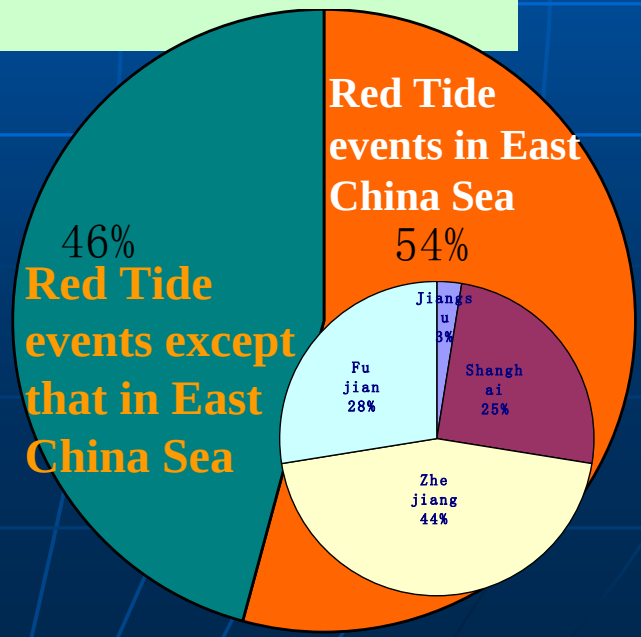


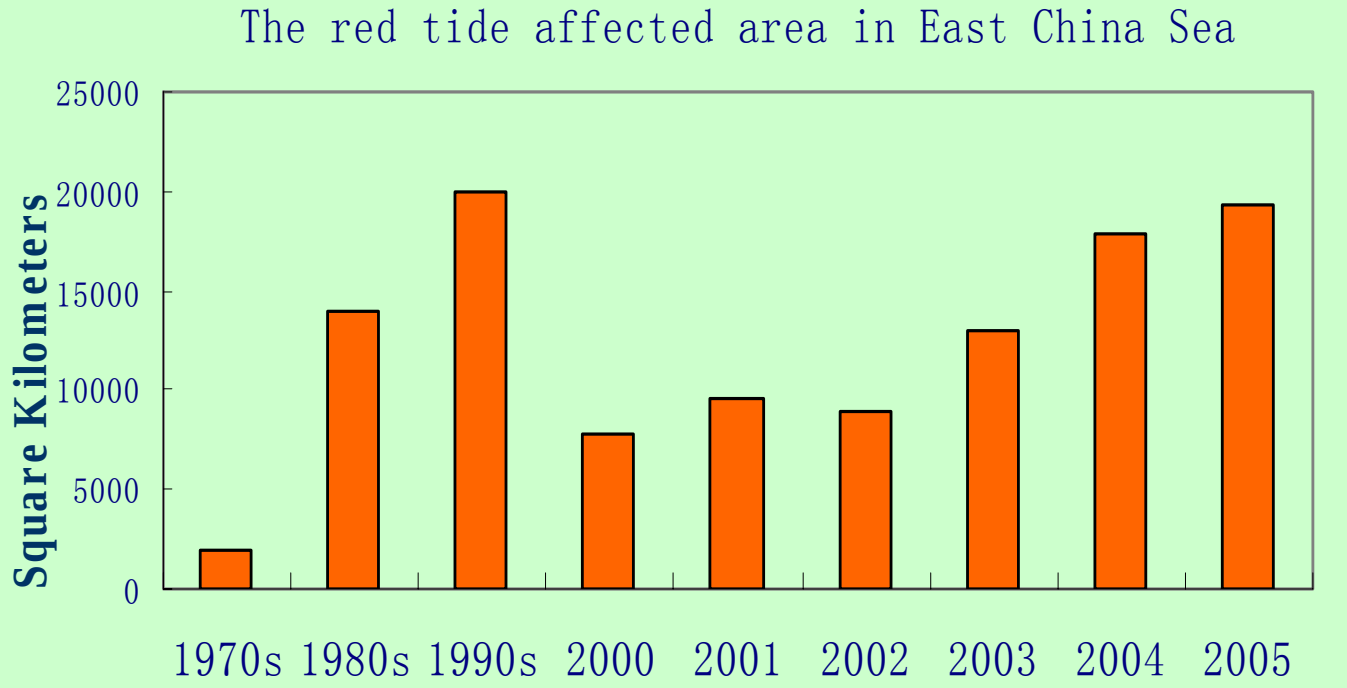



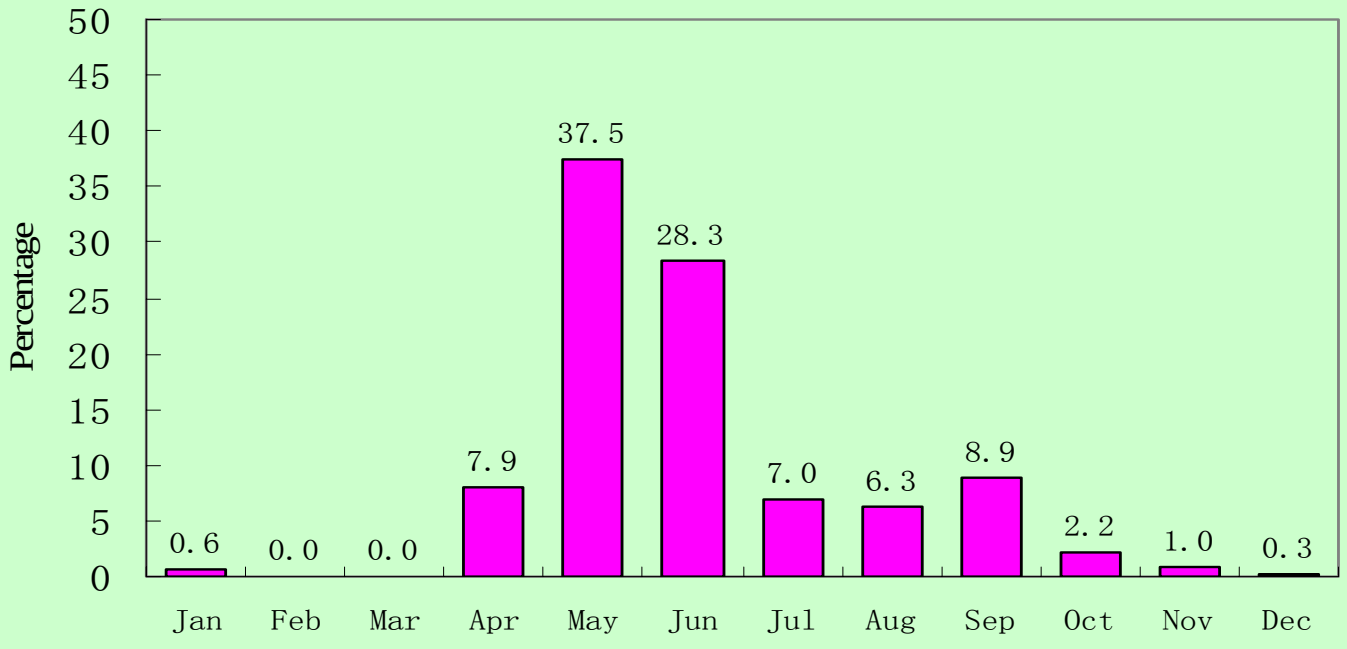






About 435 red tides are recorded in East China sea since 1930s,which occupied about 54% of total red tides in China..




The red tide affected area in East China Sea
Square Kilometers
25000
20000
15000
10000
5000
0
1970s
1980s
1990s
2000
2001
2002
2003
2004
2005


Percentage
50
45
40
35
30
25
20
15
10
5
0
0.6
0.0
0.0
7.9
37.5
28.3
7.0
6.3
8.9
2.2
1.0
0.3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

# Harmful Algal Bloom in East China Sea

43 HABs in East China sea were recorded which is about 10% of the red tides, the causing species include *Alexandrium tamarens*, *kerina mikimotoi*, *Heterocapsa circularisquama*, *Cochlodinium sp* and *kerina brevis* , in which *kerina mikimotoi* , *Heterocapsa circularisquama* had caused lots of harm to aquaculture recently. There are about 24 *kerina* (*Gymnodinium*) *sp*. bloom recorded in East China sea since 1980s, most of them have detrimental influence, the bloom of *kerina* sp. has the tendency of increase on frequency and spreading from south to north.

Other Toxic Algae

DSP


*kerina mikimotoi*


*Heterocapsa circularisquama*


*Heterosigma akashiwo*


*Gymnodinium sanguineum*

NSP

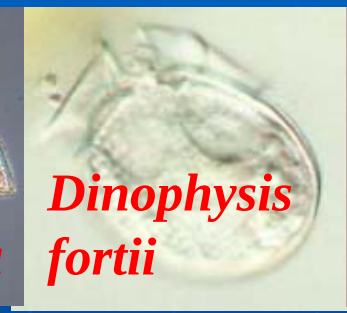

*Karinia brevis*

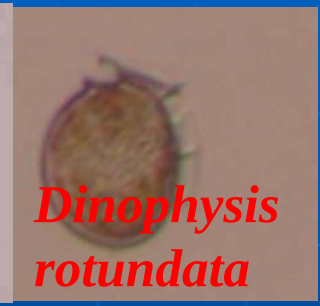
DSP

DSP


*Dinophysis acuminata*

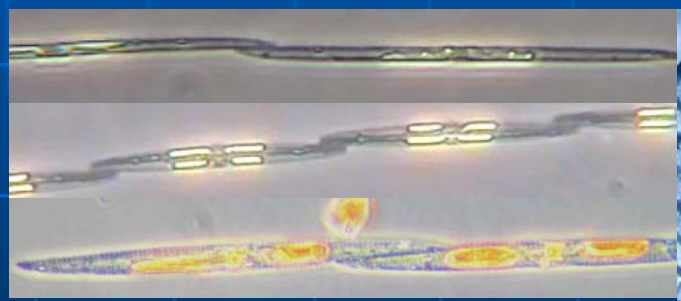

*Dinophysis caudata*

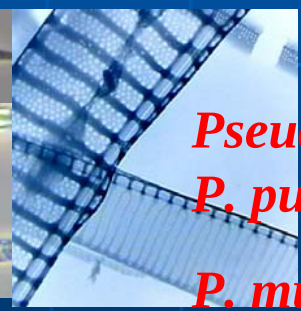

*Dinophysis fortii*


*Dinophysis rotundata*

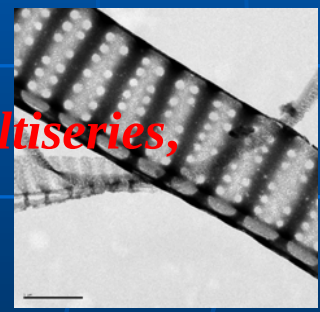
ASP

DSP



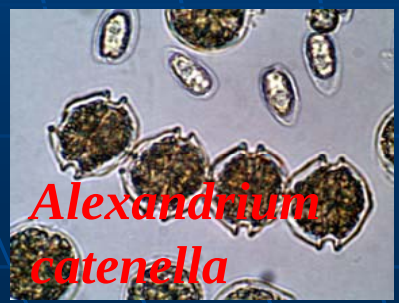


*Pseudo-nitzschia multiseries, P. pungens, P. multistriata,*



PSP

DSP

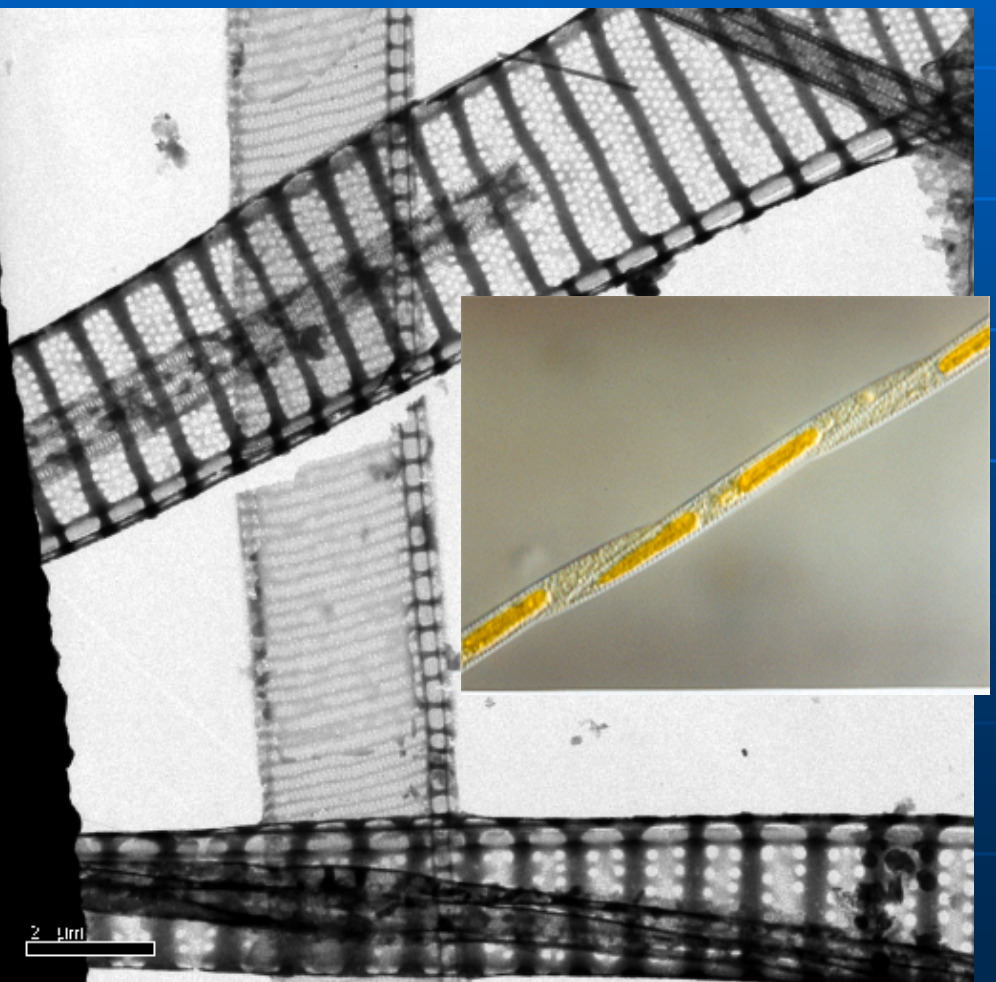

*Alexandrium catenella*

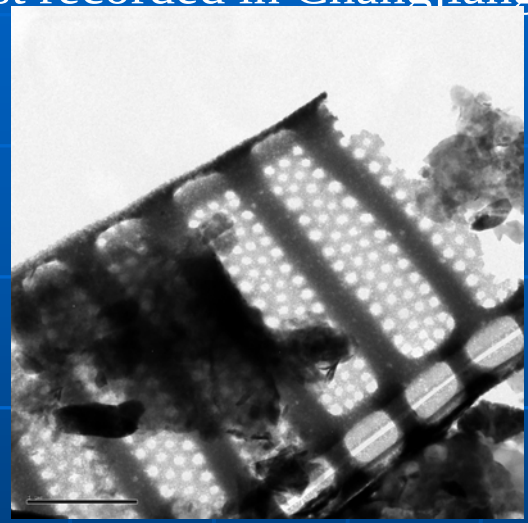

*Alexandrium minutum*


*Alexandrium tamarense*

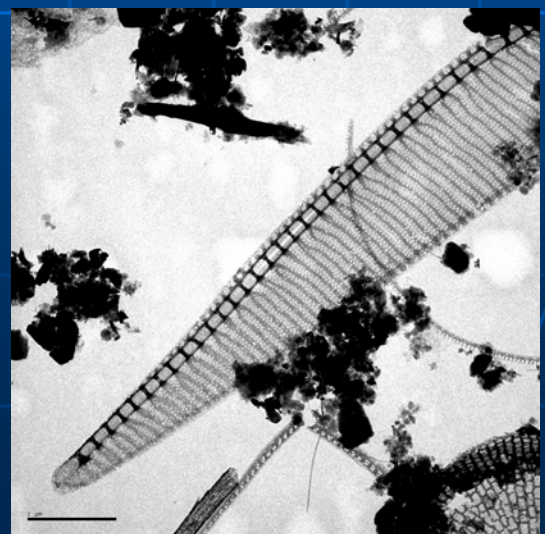
## *Pseudo-nitzschia spp*

5 species of *Pseudo-nitzschia* were identified during the monitoring: *Pseudo-nitzschia multiseries*, *P. pungens*, *P. multistriata*, *P. americana* and *P. delicatissima*, 3 species (*P. multiseries*, *P. americana* and *P. delicatissima*) are first recorded in China and the *P. multistriata* is first recorded in Changjiang estuary.





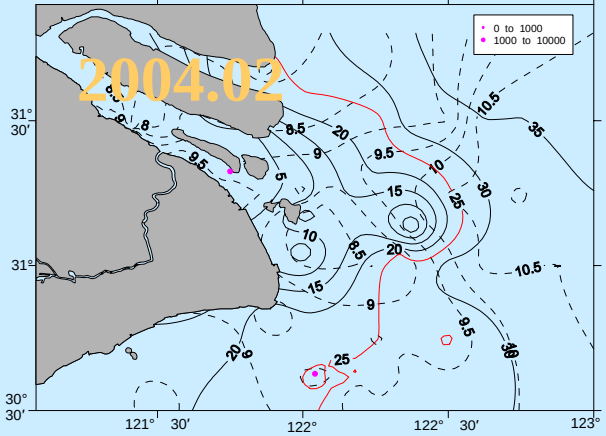
*P. multiseries*

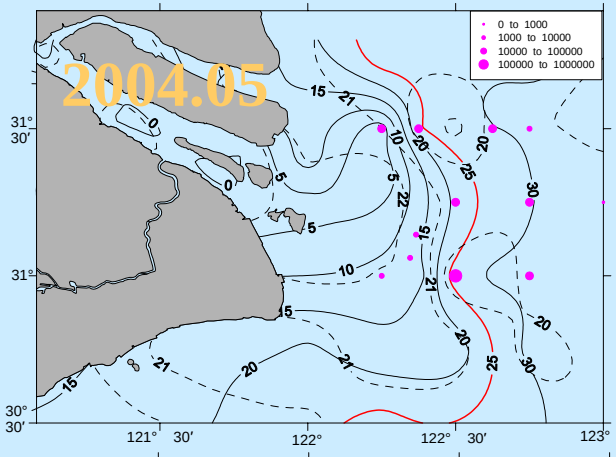


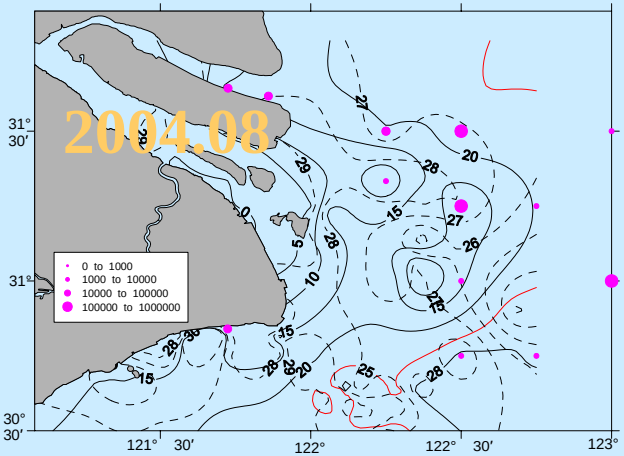
*P. multistriata*

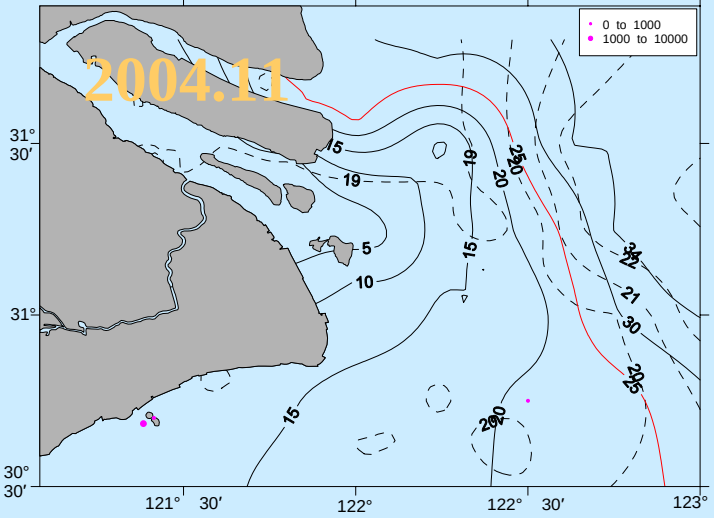
# The relative abundance (%) of *Psedudo-nitzschia sp*

| | Salinity | Turbidity | P. pungens | P. multiseries | P. americana | P. delicatissima | P. sp. | total |
|---|---|---|---|---|---|---|---|---|
| CH01 | | | 94 | 5 | 1 | 0 | 0 | 100 |
| CH04 | | | 89 | 8 | 2 | 1 | 0 | 100 |
| CH05 | | | 64 | 13 | 13 | 11 | 0 | 100 |
| CH07 | | | 76 | 24 | 0 | 0 | 0 | 100 |
| CH08 | | | 76 | 12 | 9 | 0 | 3 | 100 |



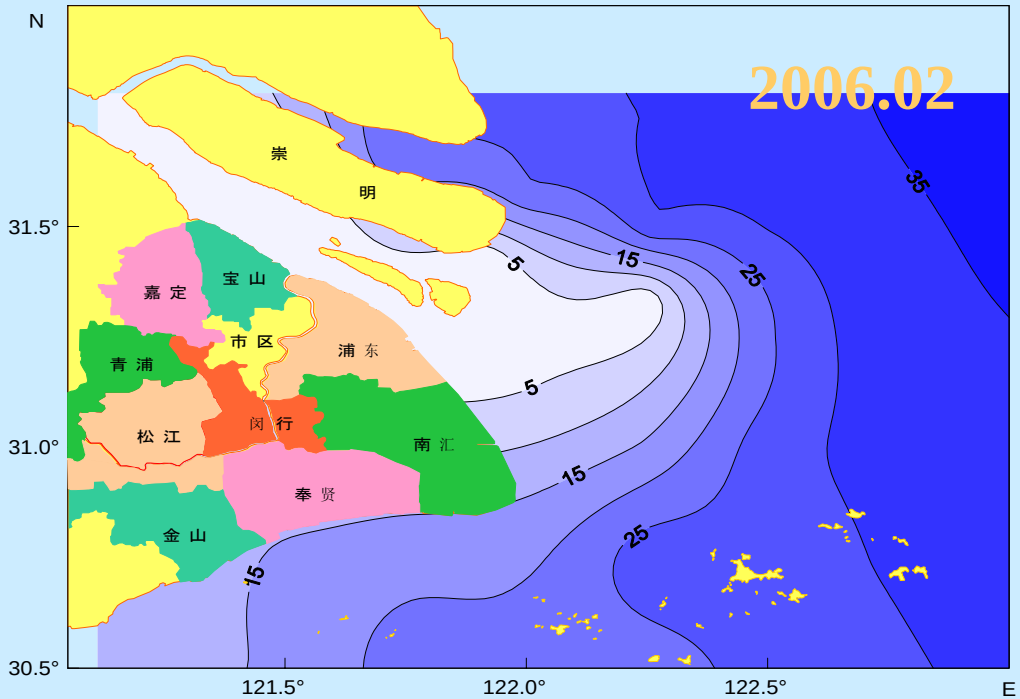
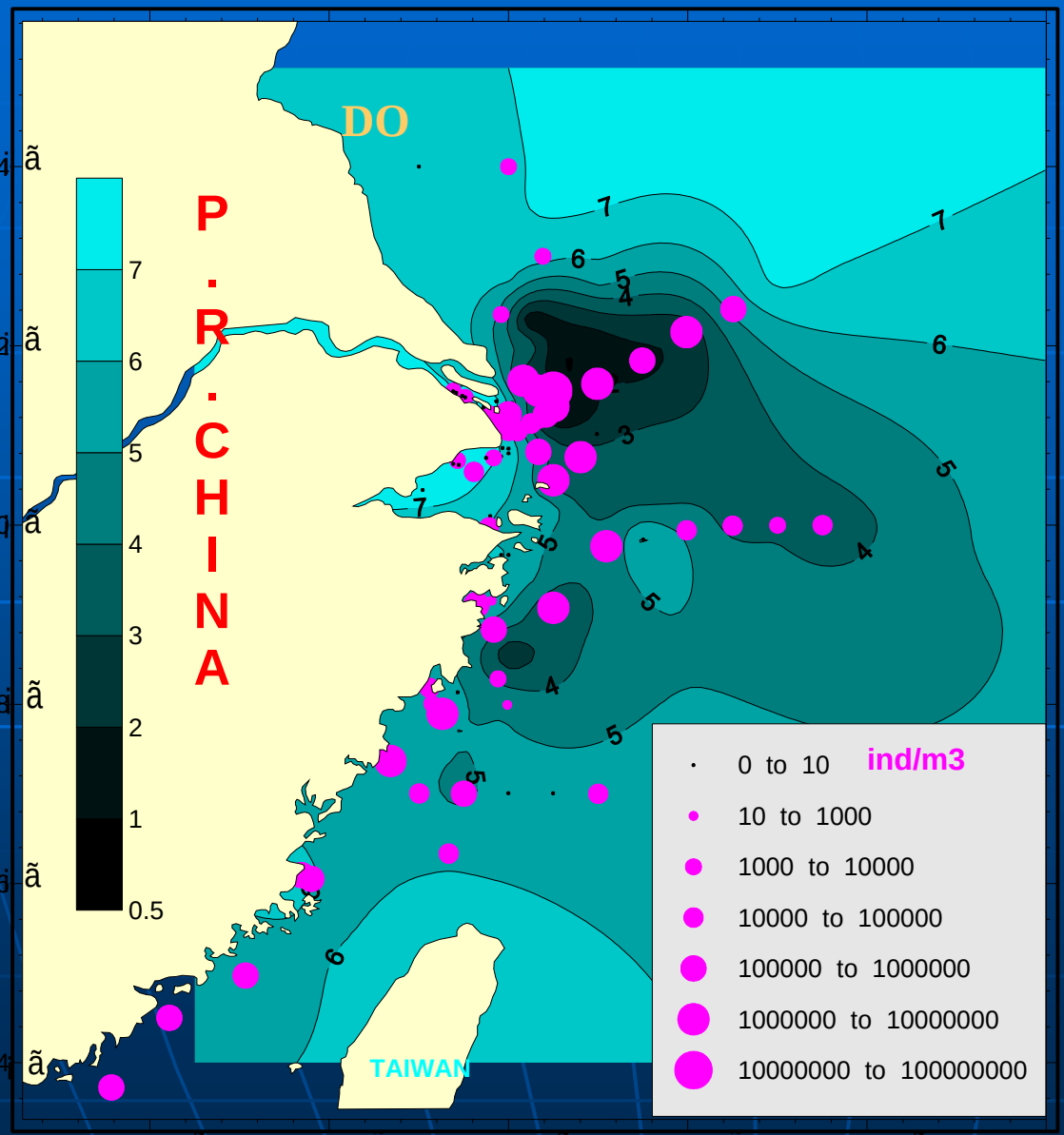
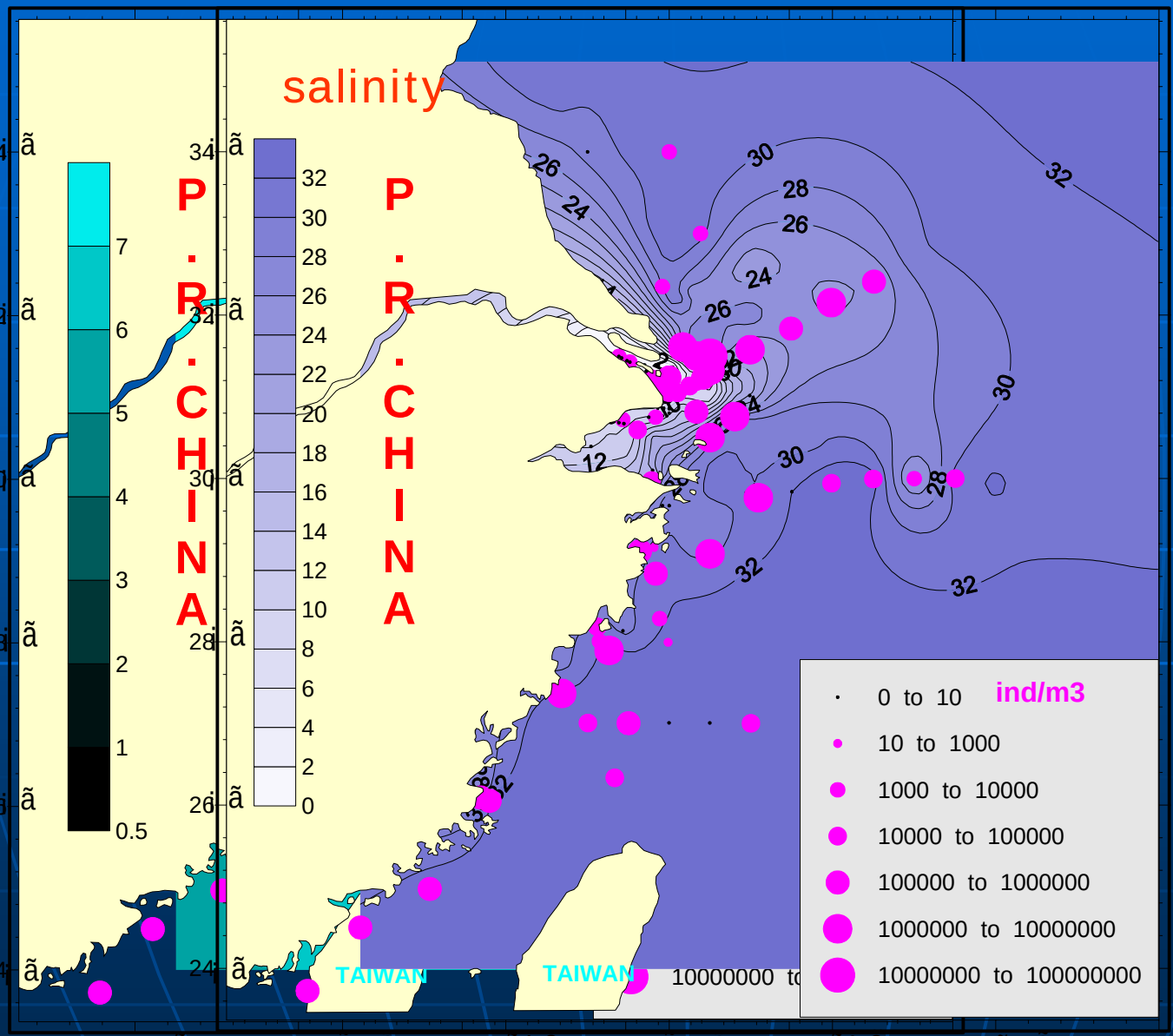
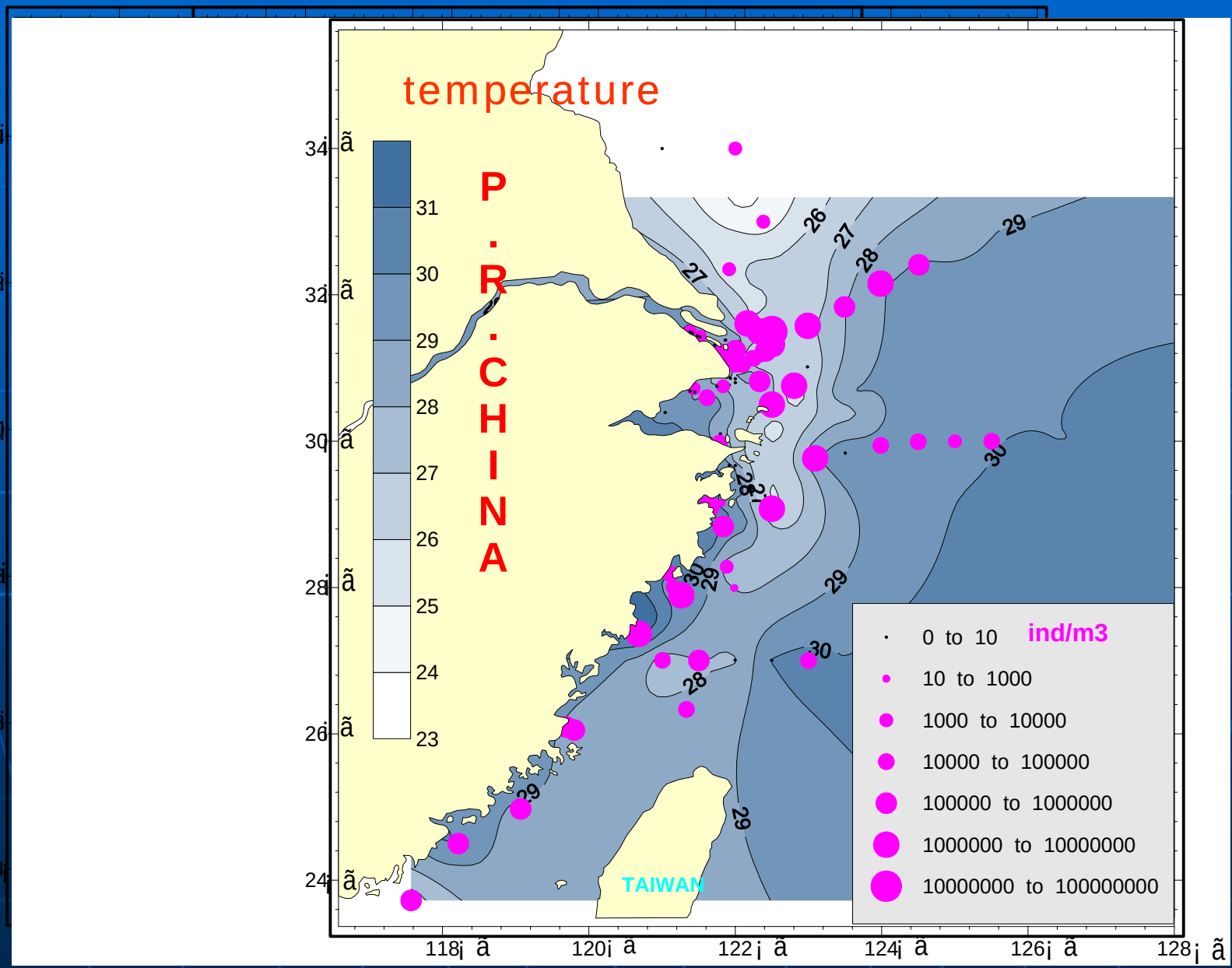
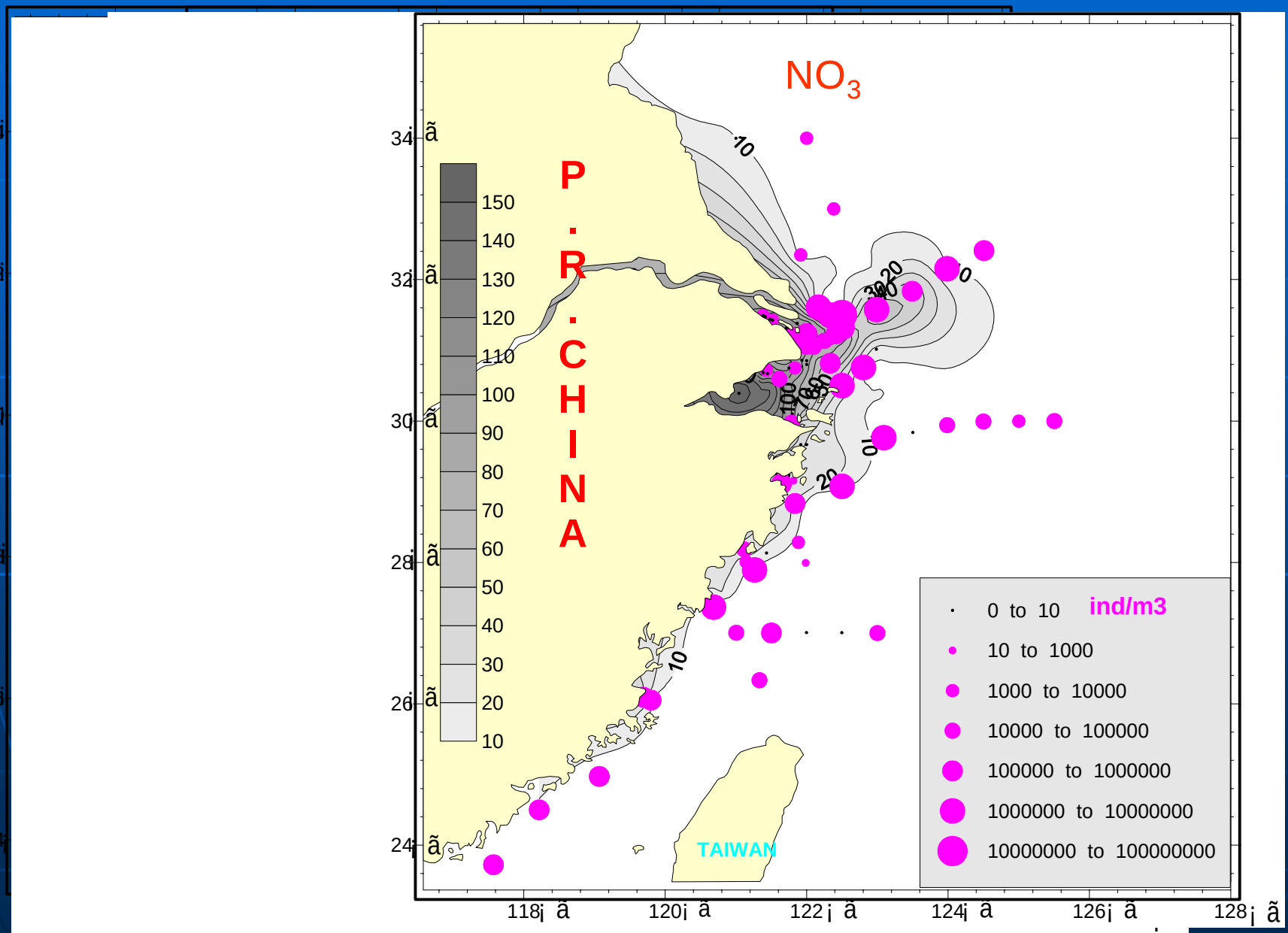




图3-2 上海海域表层盐度分布示意图


DO
P.R.CHINA
TAIWAN
7
6
5
4
3
2
1
0.5
0 to 10 ind/m3
10 to 1000
1000 to 10000
10000 to 100000
100000 to 1000000
1000000 to 10000000
10000000 to 100000000
34¡ ã
32¡ ã
30¡ ã
28¡ ã
26¡ ã
24¡ ã
118¡ ã
120¡ ã
122¡ ã
124¡ ã
126¡ ã
128¡ ã

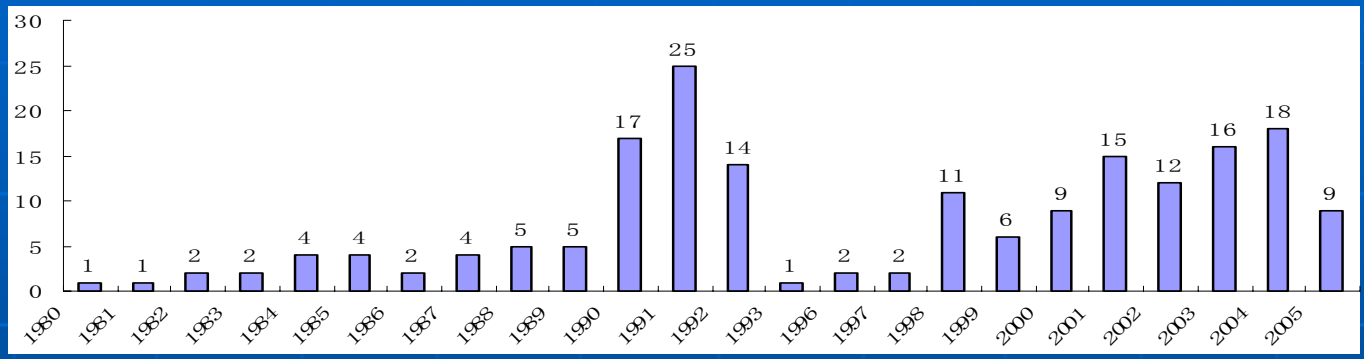

salinity
P.R.CHINA
P.R.CHINA
TAIWAN
TAIWAN
0 to 10 ind/m3
10 to 1000
1000 to 10000
10000 to 100000
100000 to 1000000
1000000 to 10000000
10000000 to 100000000


temperature
P.R.CHINA
TAIWAN
31
30
29
28
27
26
25
24
23
0 to 10 ind/m3
10 to 1000
1000 to 10000
10000 to 100000
100000 to 1000000
1000000 to 10000000
10000000 to 100000000
34¡ ã
32¡ ã
30¡ ã
28¡ ã
26¡ ã
24¡ ã
118¡ ã
120¡ ã
122¡ ã
124¡ ã
126¡ ã
128¡ ã

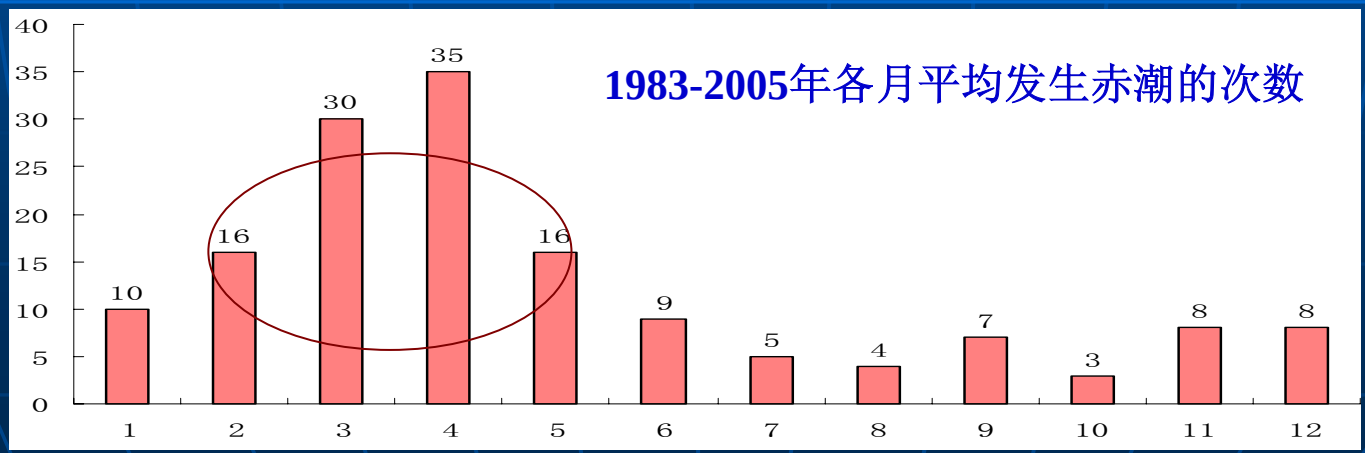

NO3
P.R.CHINA
TAIWAN
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 to 10 ind/m3
10 to 1000
1000 to 10000
10000 to 100000
100000 to 1000000
1000000 to 10000000
10000000 to 100000000
34
32
30
28
26
24
118
120
122
124
126
128

# Red tide in South China sea

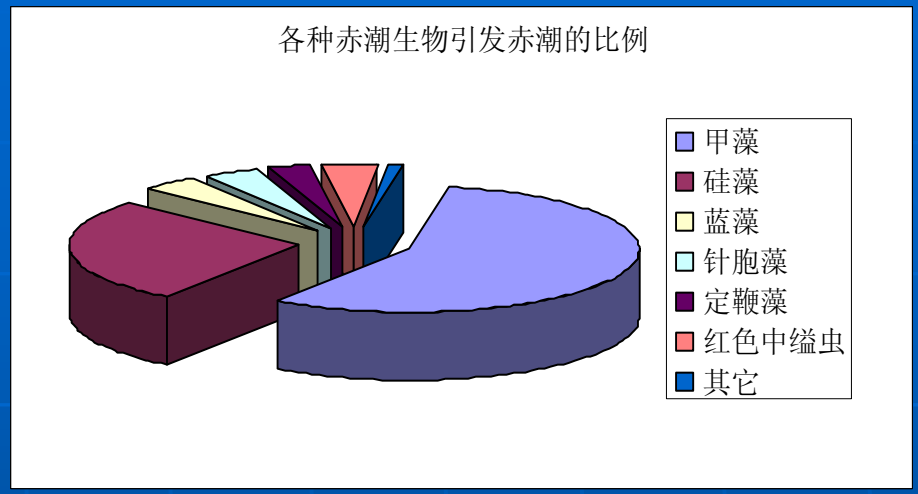
## 1）tendency of red tide events

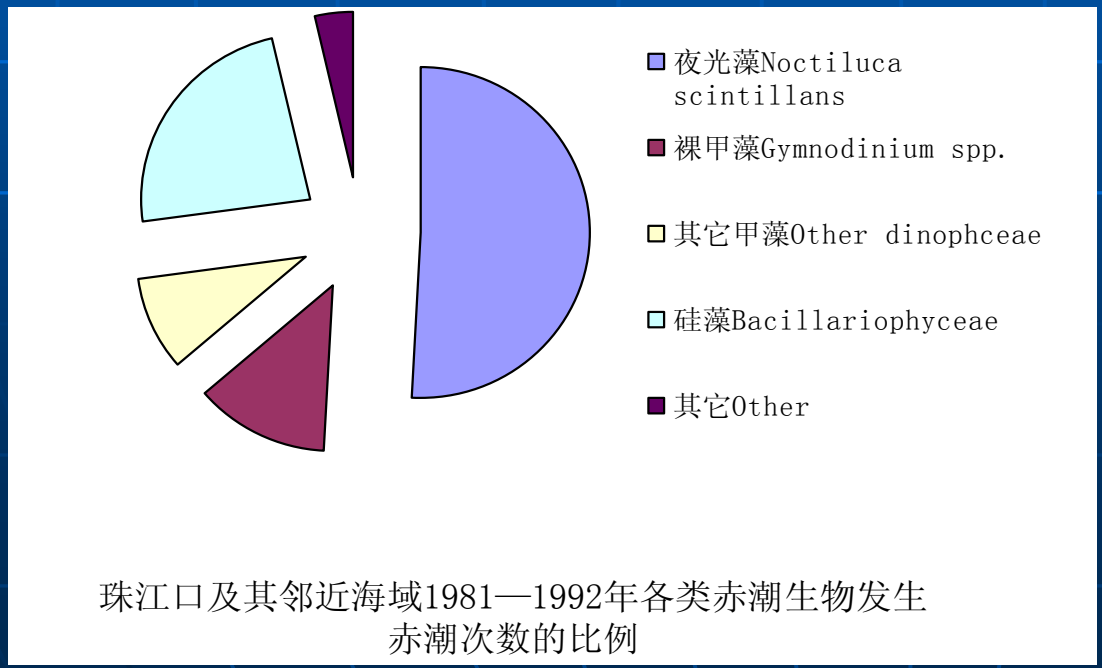



## 2）peak period: spring

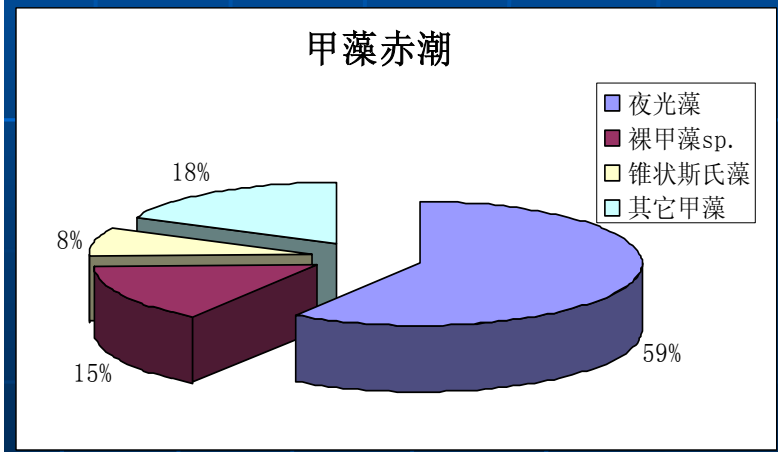


139 red tide species found in south China sea , mainly diatom and dinoflagellate。

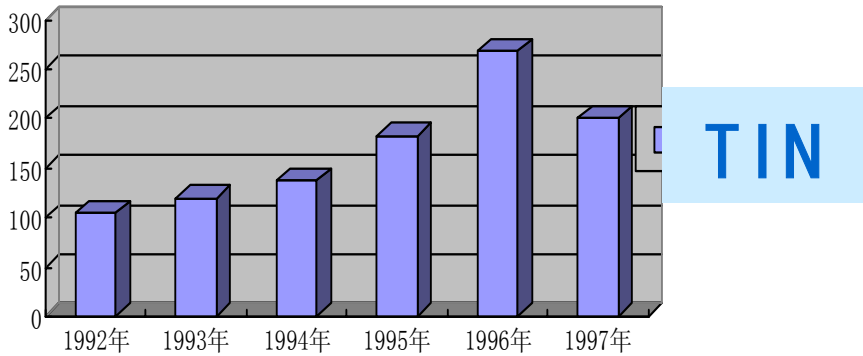


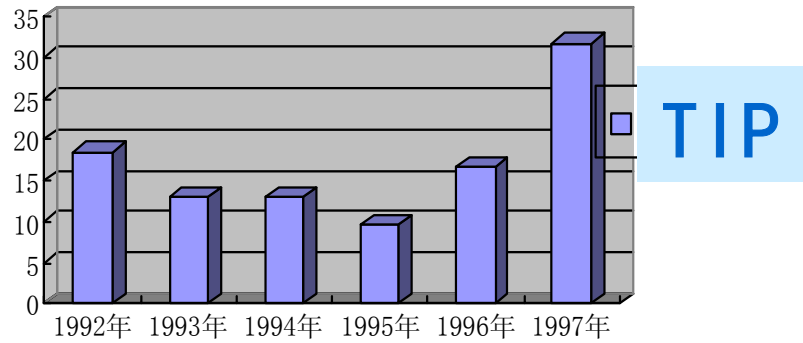



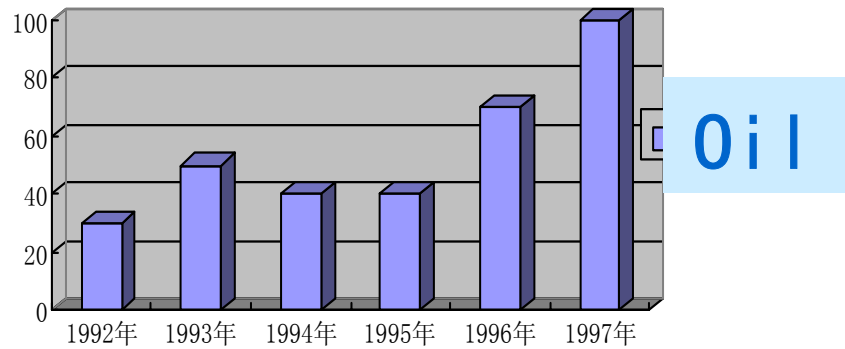

珠江口及其邻近海域1981—1992年各类赤潮生物发生赤潮次数的比例

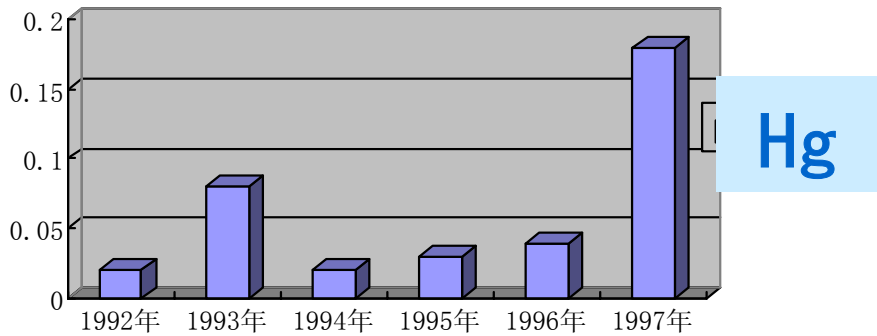


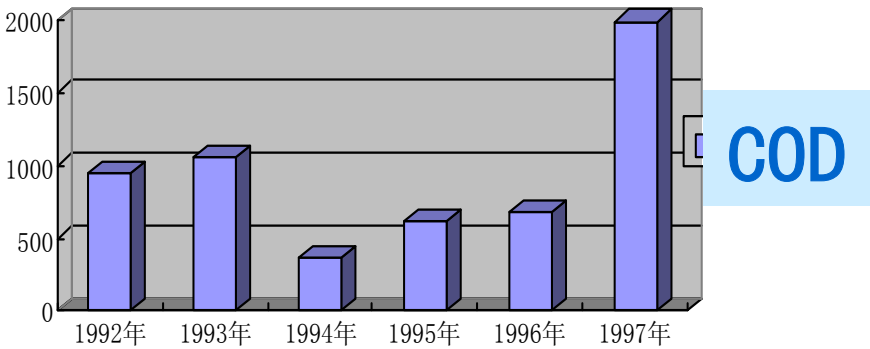
# Reason of HAB increase:increase of Pollution

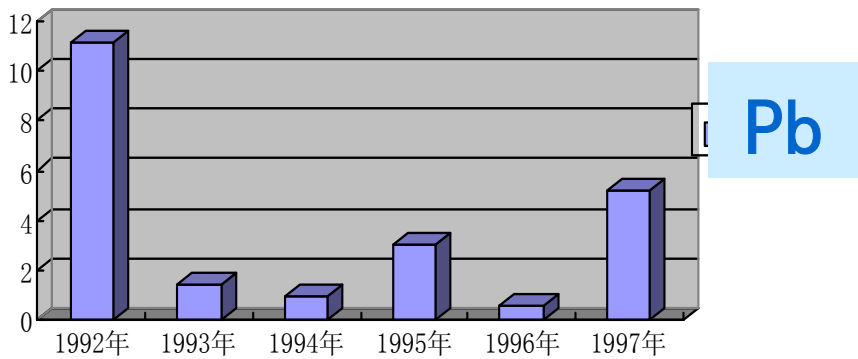


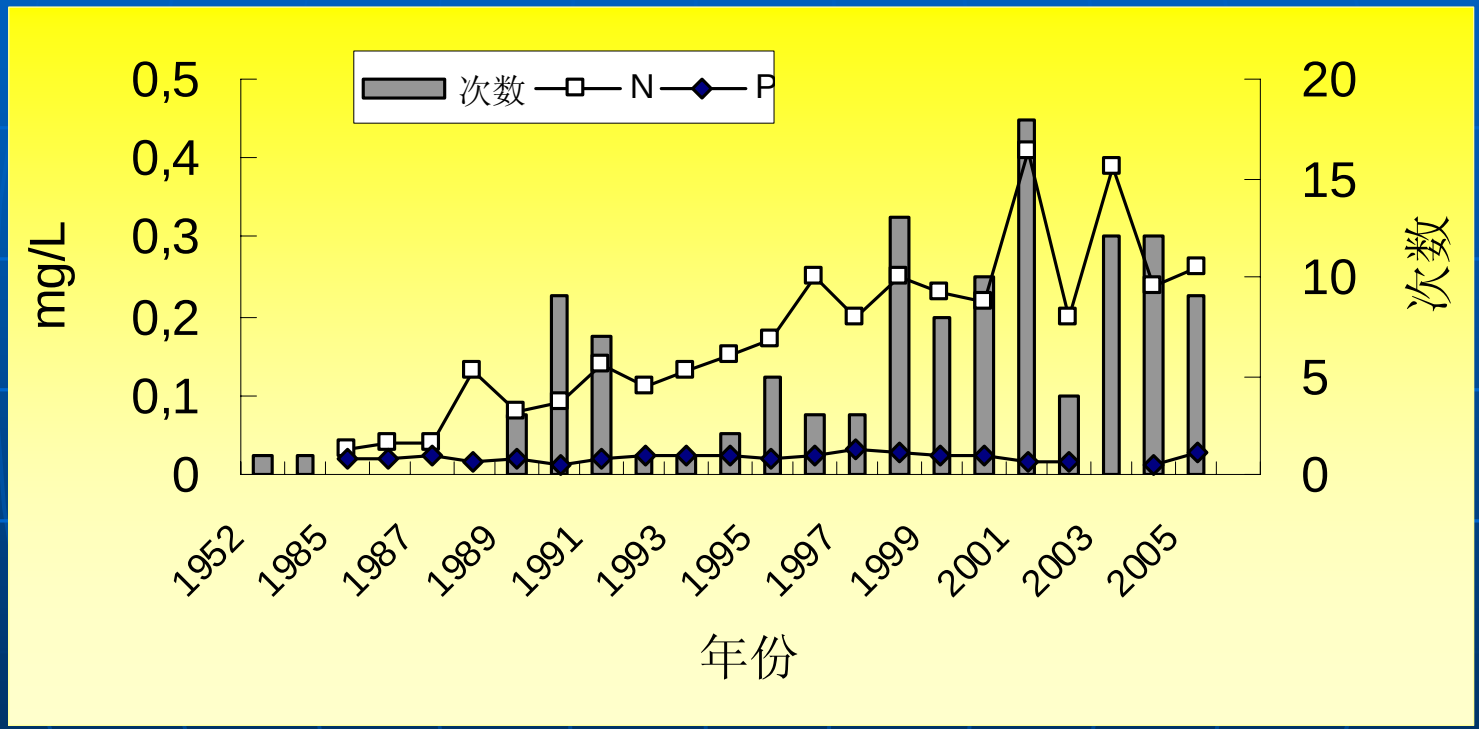



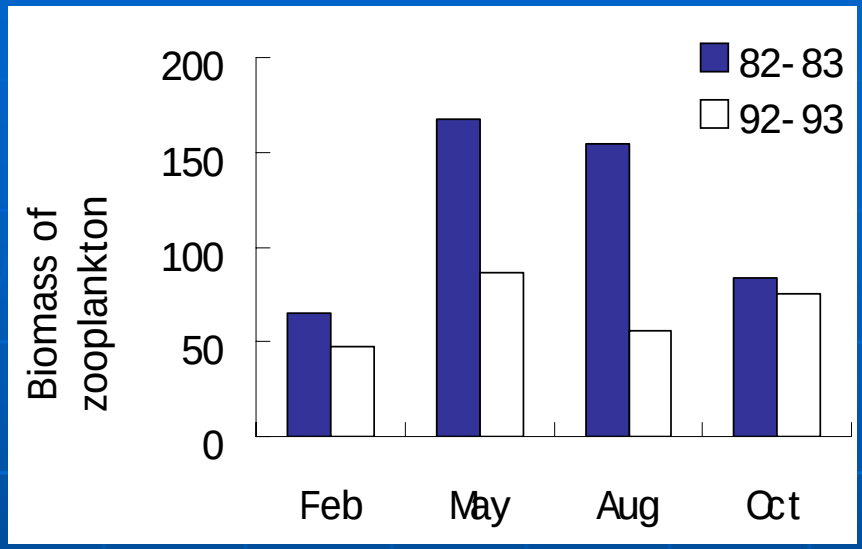



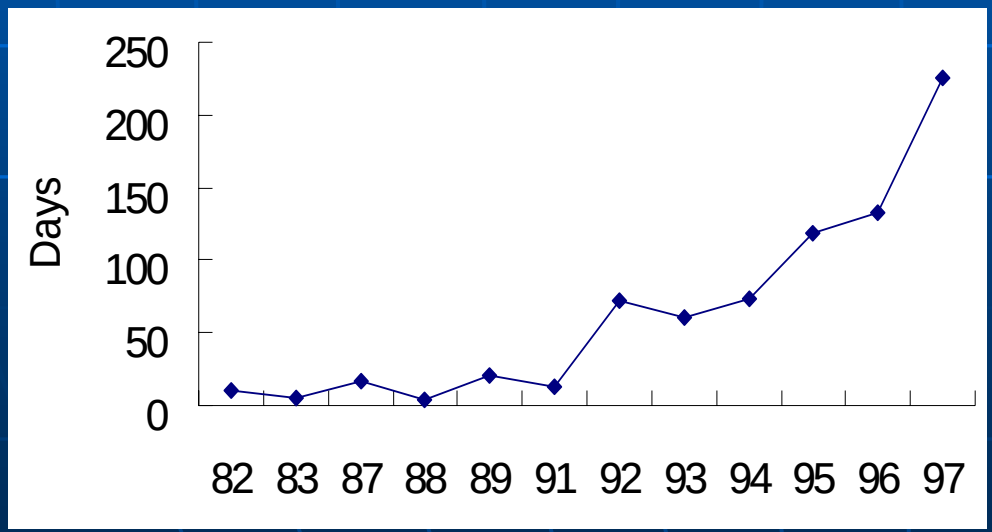



# Correlation of **Inorganic Nitrogen and HABs in Bohai sea**

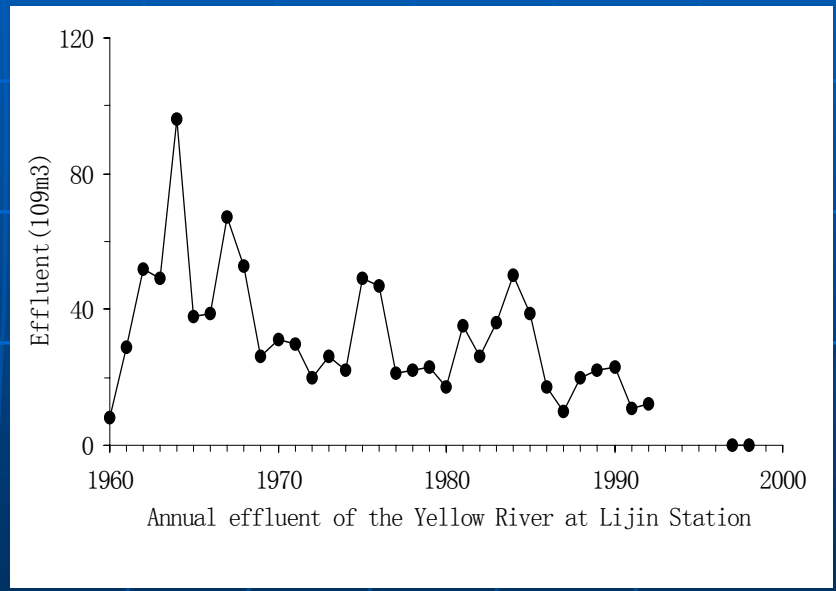


# Biomass of Predator decrease



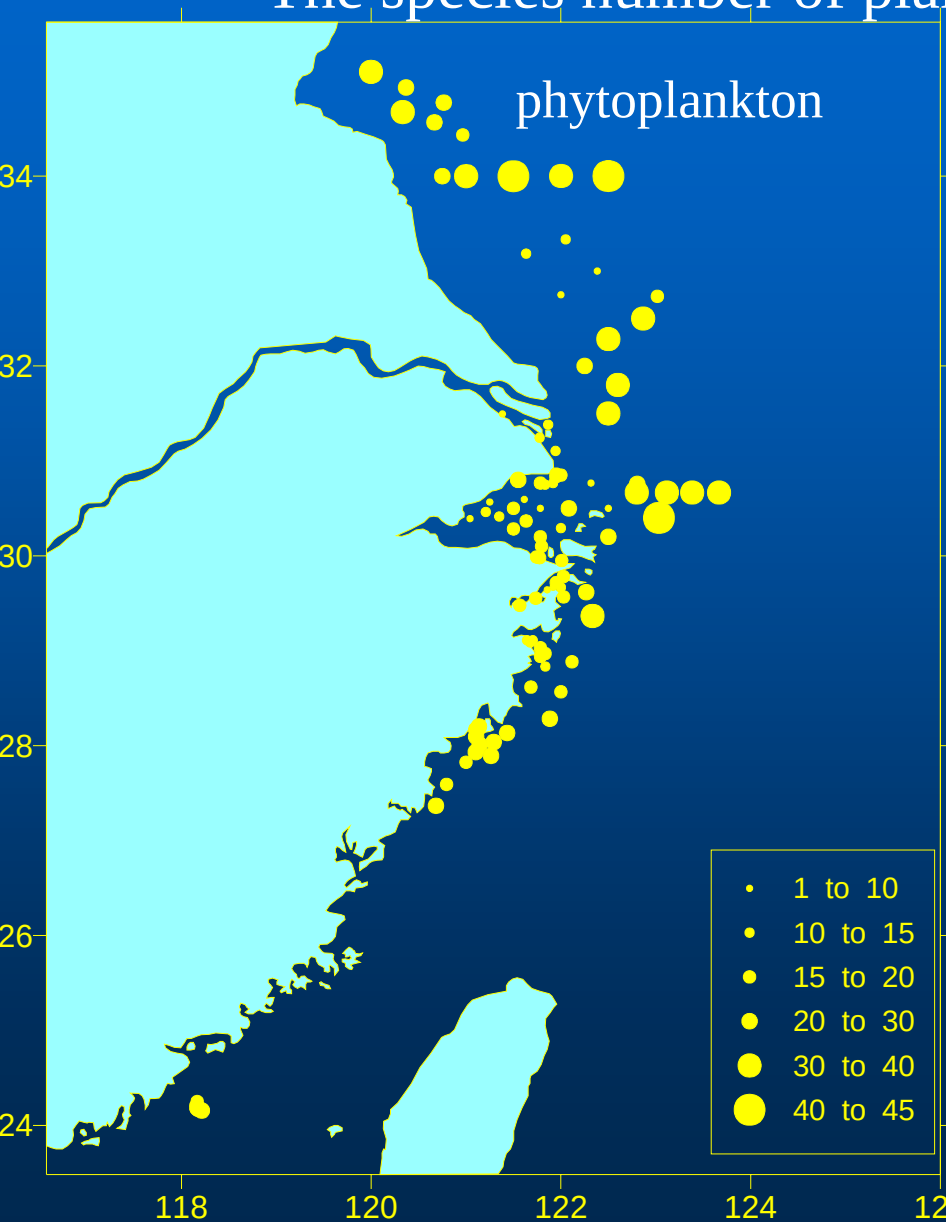



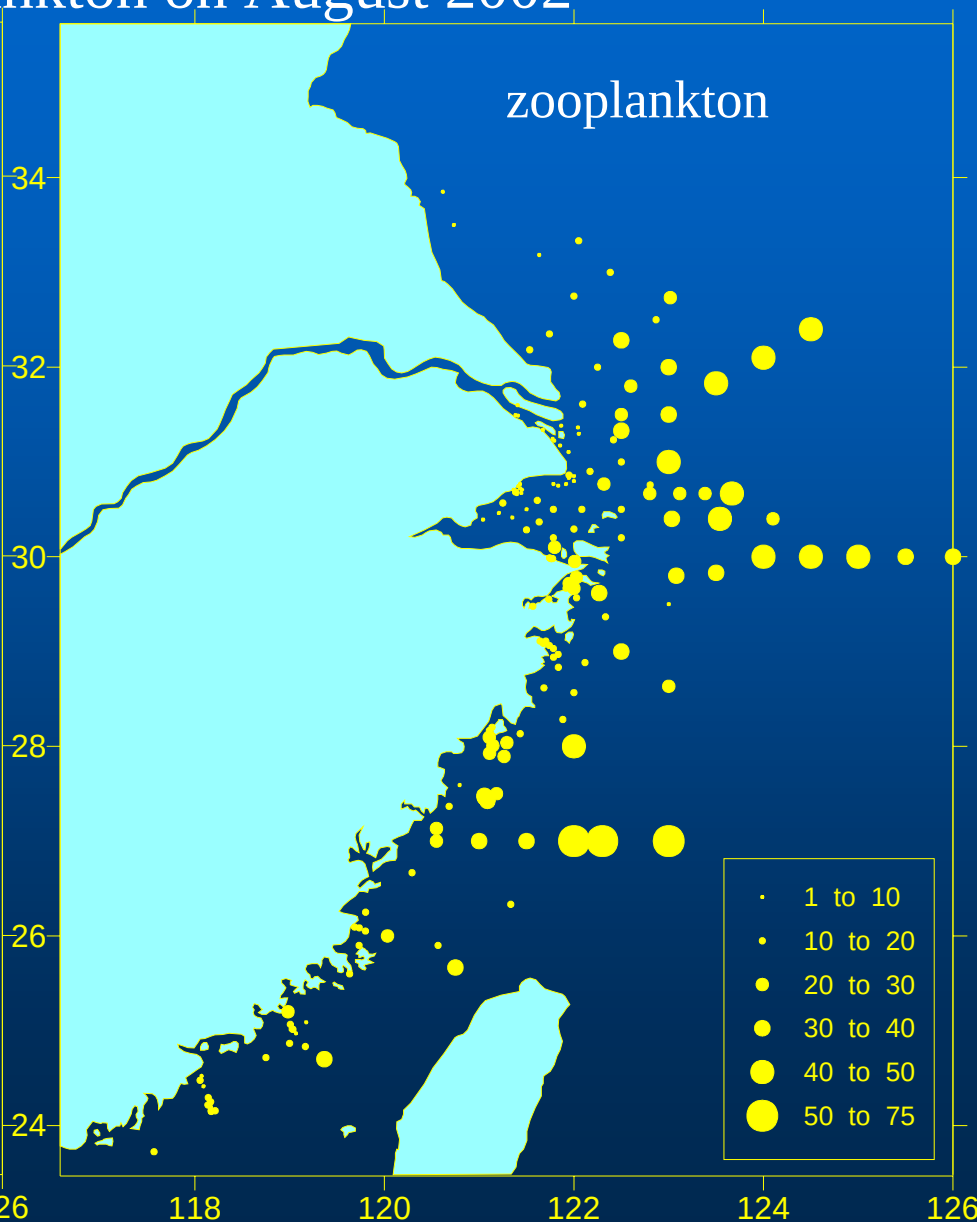

## decrease of runoff



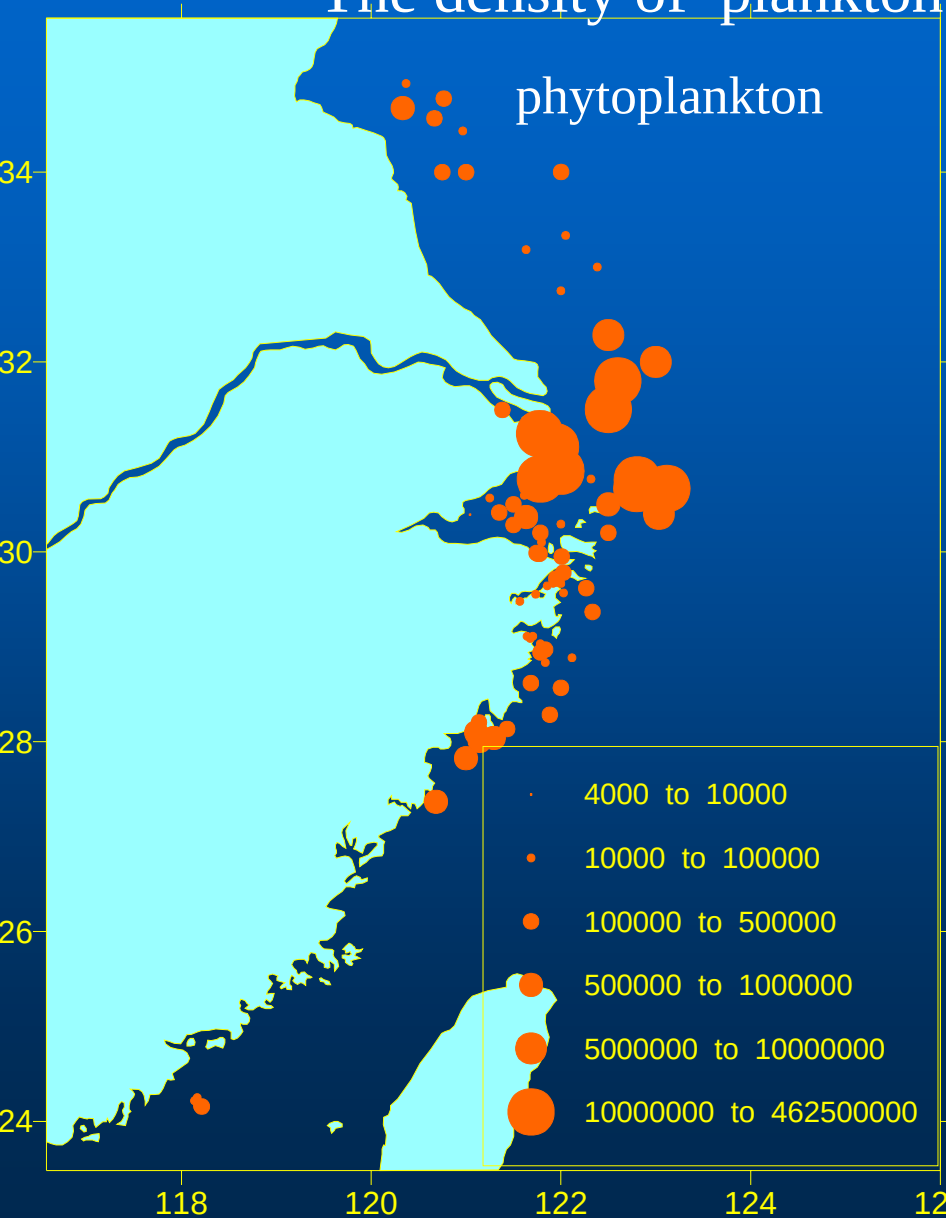

黄河断流天数的增加: 使得渤海盐度升高

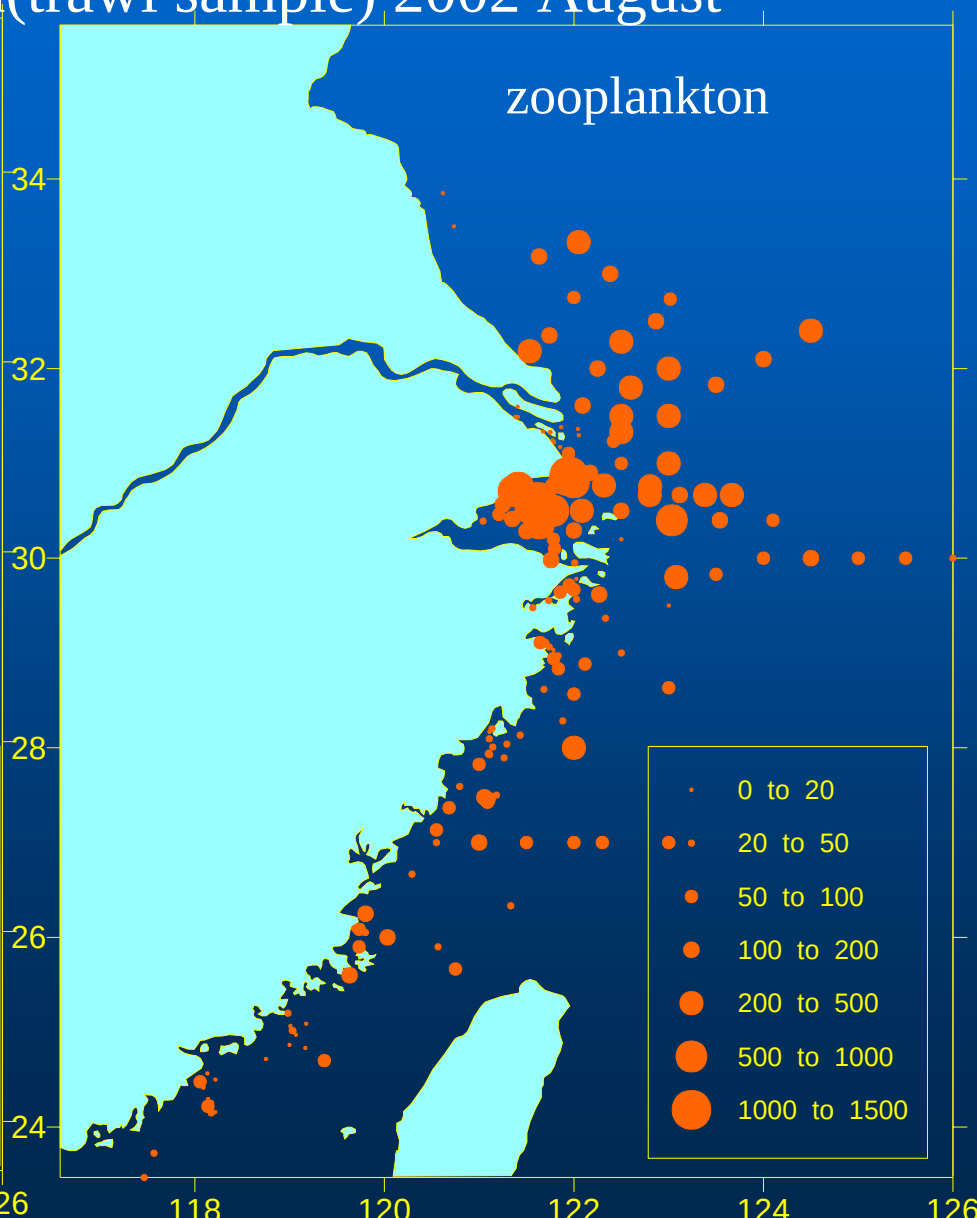
# The species number of plankton on August 2002



# The density of plankton(trawl sample) 2002 August

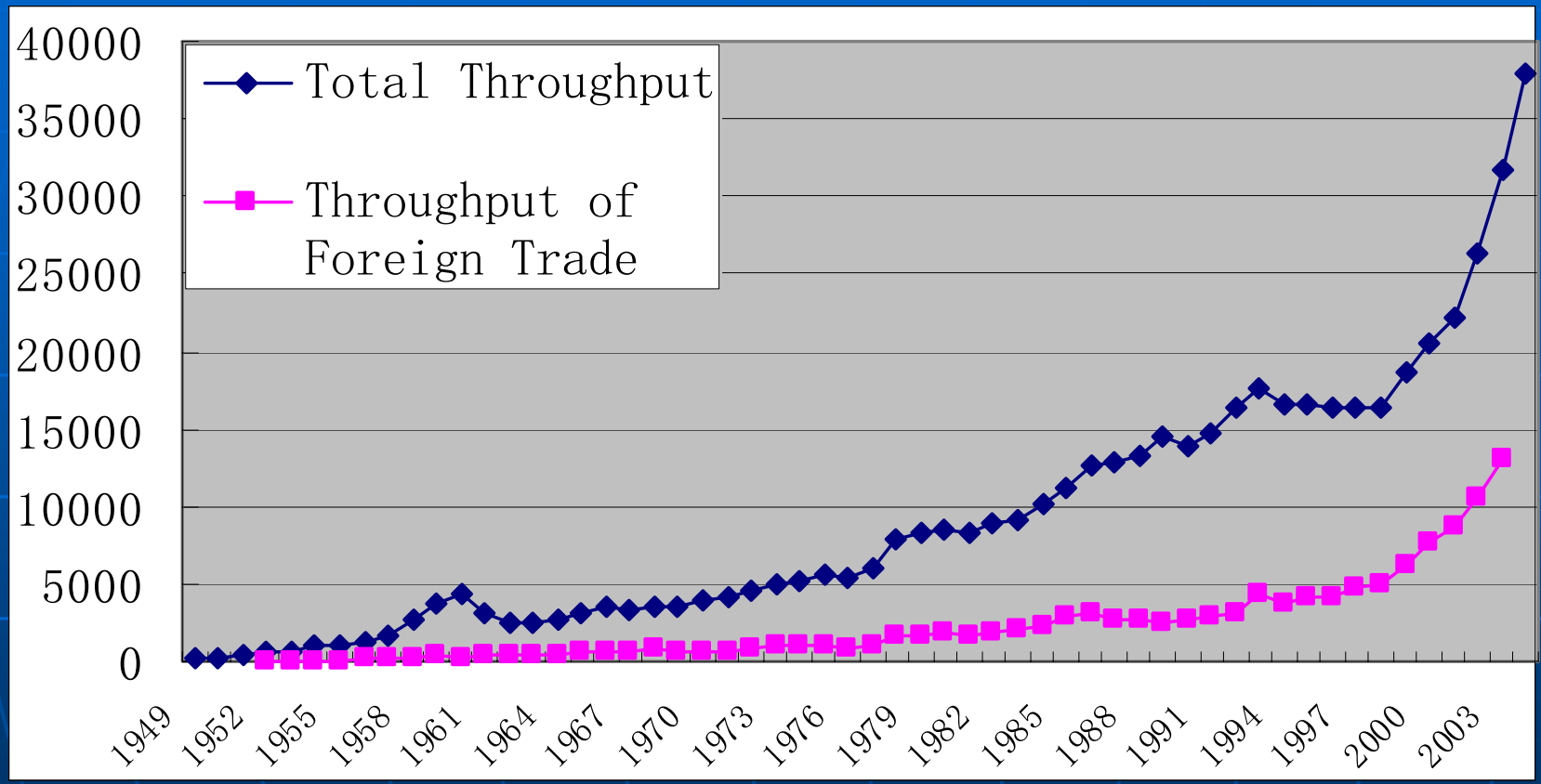


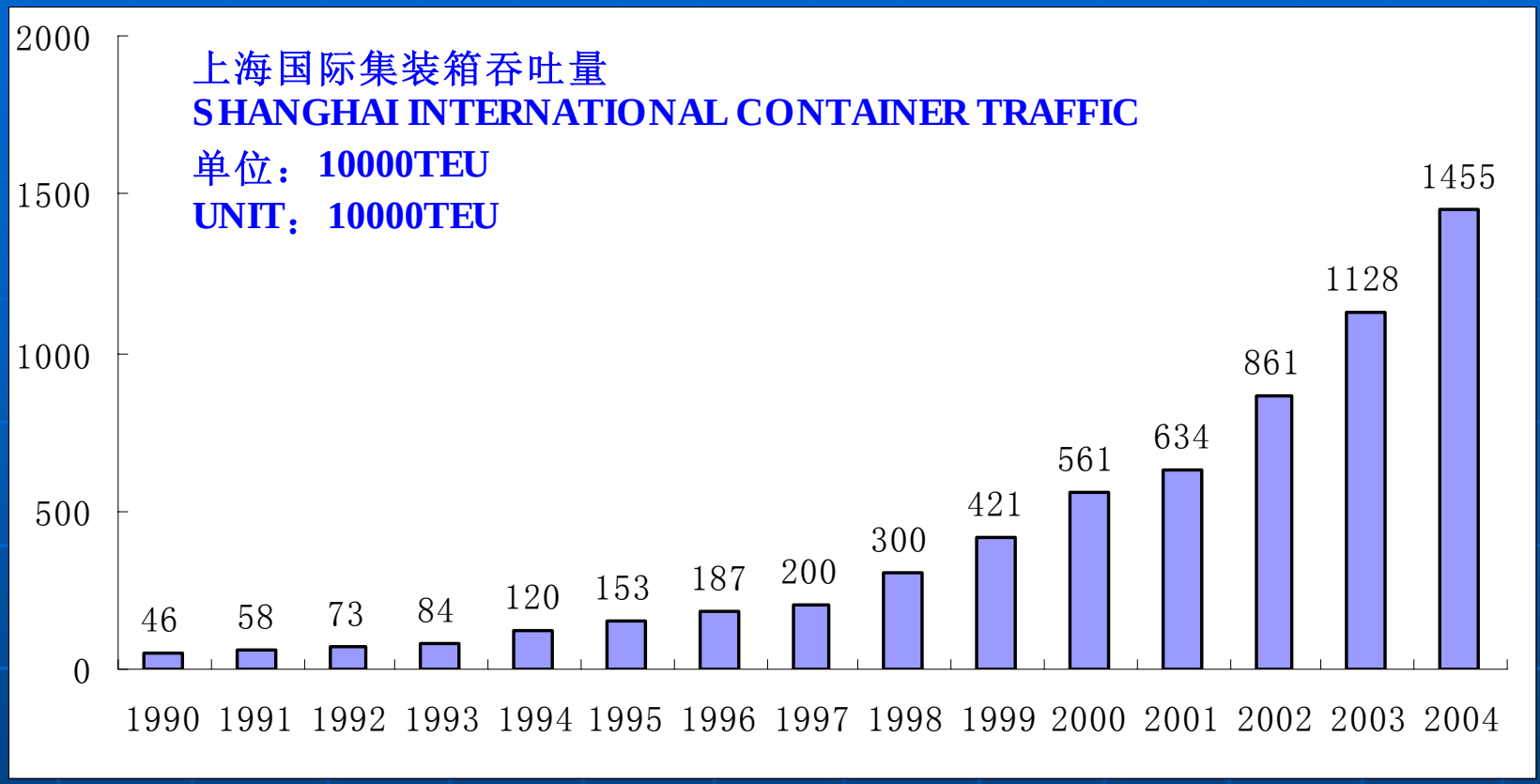
Reclamation for aquaculture

# Marine aquaculture

## The throughput of Shanghai Harbor (Unit: 10000 Ton)




The throughput of Shanghai Harbor in 2004 was 38 billion Ton which ranked first in the world; The container was 1.4551 billion TEU, which ranked third in the world。



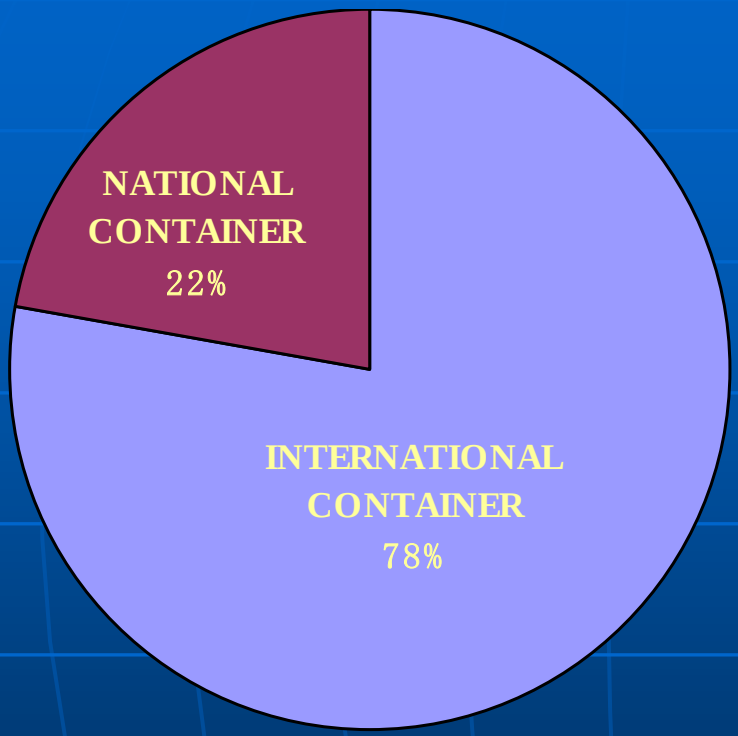

AMONG THEN EXPORT CONTAINER IS ABOUT 45% OF TOTAL,

There are 1716 container vessel every month in shanghai harbor,

1 TEU weighs 24000 kg, so about 1.57 billion ton ballast water was discharged in Changjiang estuary in 2004, which was about 1/59000 of the Total Changjiang freshwater in a year.

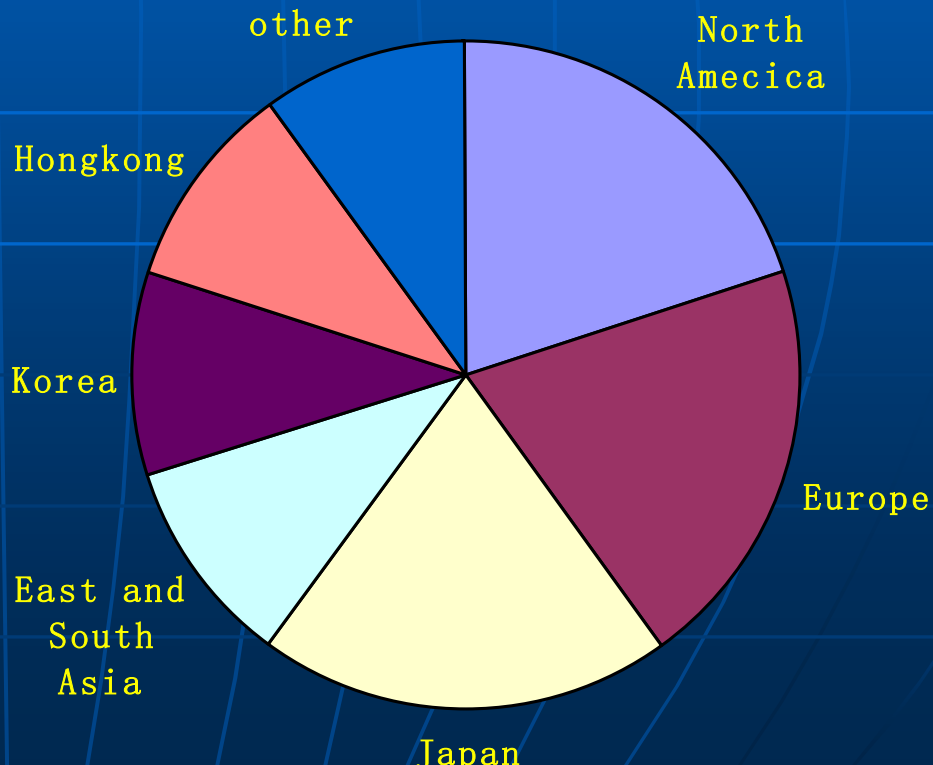
# THE CONTAINER TRAFFIC IN SHANGHAI HARBOR

## (2005.1~7)




7896000TEU

72% of the container trade with Korea, Japan, Singapore, America, Europe



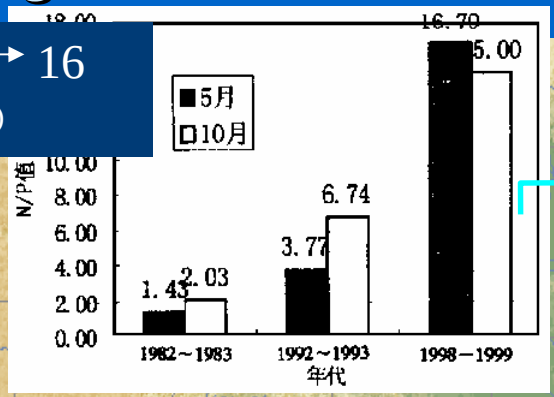
# Nutrient and N/P

| Sea | location | nutrient（mg/l） | | N/P |
|---|---|---|---|---|
| | | N | P | |
| South | 珠江口 | 0.713 | 0.021 | 77.6 |
| China | 大鹏湾 | 0.055 | 0.004 | 31.4 |
| Sea | 大亚湾 | 0.076 | 0.005 | 34.7 |
| | 柘林湾 | 0.353 | 0.083 | 9.7 |
| East | 长江口 | 1.49 | 0.029 | 117.4 |
| China | 舟山海域 | 0.594 | 0.021 | 64.7 |
| sea | 杭州湾 | 1.421 | 0.041 | 79.2 |
| | 渤海湾 | 0.365 | 0.032 | 26.1 |
| Bohai | 莱州湾 | 0.145 | 0.025 | 13.3 |
| | 大连湾 | 1.198 | 0.017 | 161.1 |

从环境富营养化程度看，东海赤潮高发区最严重，渤海次之，南海除珠江口外较轻。

# Increasing trend of N：P ratio in China's inshore waters

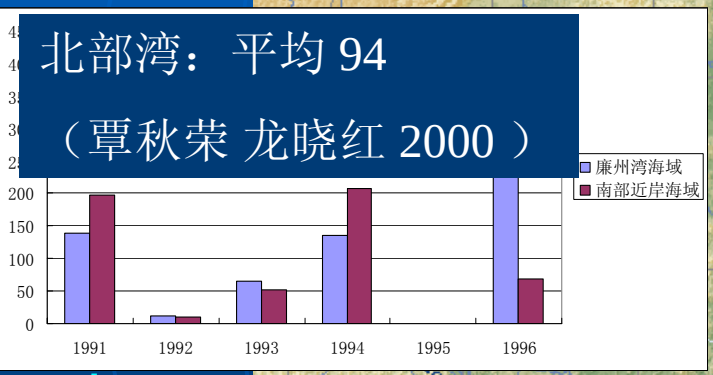
Bohai sea : 1.6→ 16
（ZG Yu 2001）




Bohai: 0.3 in1960 、 1.0 in1982 、 4.8in1992 、 >11.5 in1999、

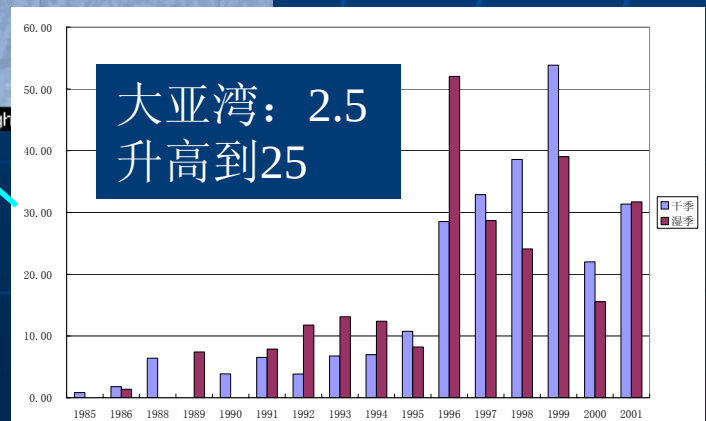
Jiaozhou Bay： 15.9 in 1960s：37.8 in 1990s（JX Zhang 1997， Shen 2001）

北部湾：平均 94
（覃秋荣 龙晓红 2000 ）




长江口: >22，平均 188, 最高> 900（Harrison *et al* 1990, 胡明辉等 1992, Justic *et al* 1995b, 蒲新明等 2000）

浙江沿海：平均 47 （金卫红 邵秀伟 2000）




大亚湾：2.5 升高到25

三亚湾：<5至>20
（王汉奎等 2002）

珠江口 ：>100，最高400 （Yin *et al* 2000, Yin *et al* 2001）

南沙海域：时常低至<1
（林洪瑛 韩舞鹰 2001）

1. Si:N比率, 与N:P比率一样, 是促进或压抑沿海HAB爆发的重要因素。 **Si:N ratios, in addition to N:P ratios, play a significant role in promoting or depressing HAB.**
2. Si:N比率之所以重要，因为它是硅藻 - 甲藻的天然营养竞争者 - 生长所必需。每当硅藻繁殖昌茂时，甲藻的生长便受压抑，赤潮现象便不明显。若硅藻因Si供应不足而受压抑，甲藻性赤潮爆发的机会便高。 **The influences of Si:N ratios might be attributed to their impacts to diatoms growth. When the growth of diatoms is promoted, dinoflagellate-related HAB is depressed. When diatoms growth is depressed by low silicates, dinoflagellate-caused HABs are promoted.**
3. Si:N比率之重要，反影不单纯是富营养化、生活污水(含大量N和P) 排放便是赤潮的成因，生态竞争其实也是重要因素。研究显示，近20年在中国沿海频繁的城市化建设、填海造地、河流断流、河道迁改活动等，也可能是引发大量赤潮的间接原因。 **The significance of Si:N (atomic) ratio implies that, other than discharges of domestic sewage and agricultural wastes, disturbance of Si input due to urbanization, soil erosion and river diversion can also be considered as a trigger for HABs dominated by dinoflagellates and micro-flagellates.**

The potential toxic algae and biotoxin were often detected in China sea recently, but few reports about the poisoning events caused by HAB biotoxin,.The death or loss of aquacultured and field fish /shellfish were often found recently during the red tide. The harmful algal bloom may affect the safety and economical development in the following paths in China sea: The advection of offshore toxic micro-algal blooms into growing areas and coast by current

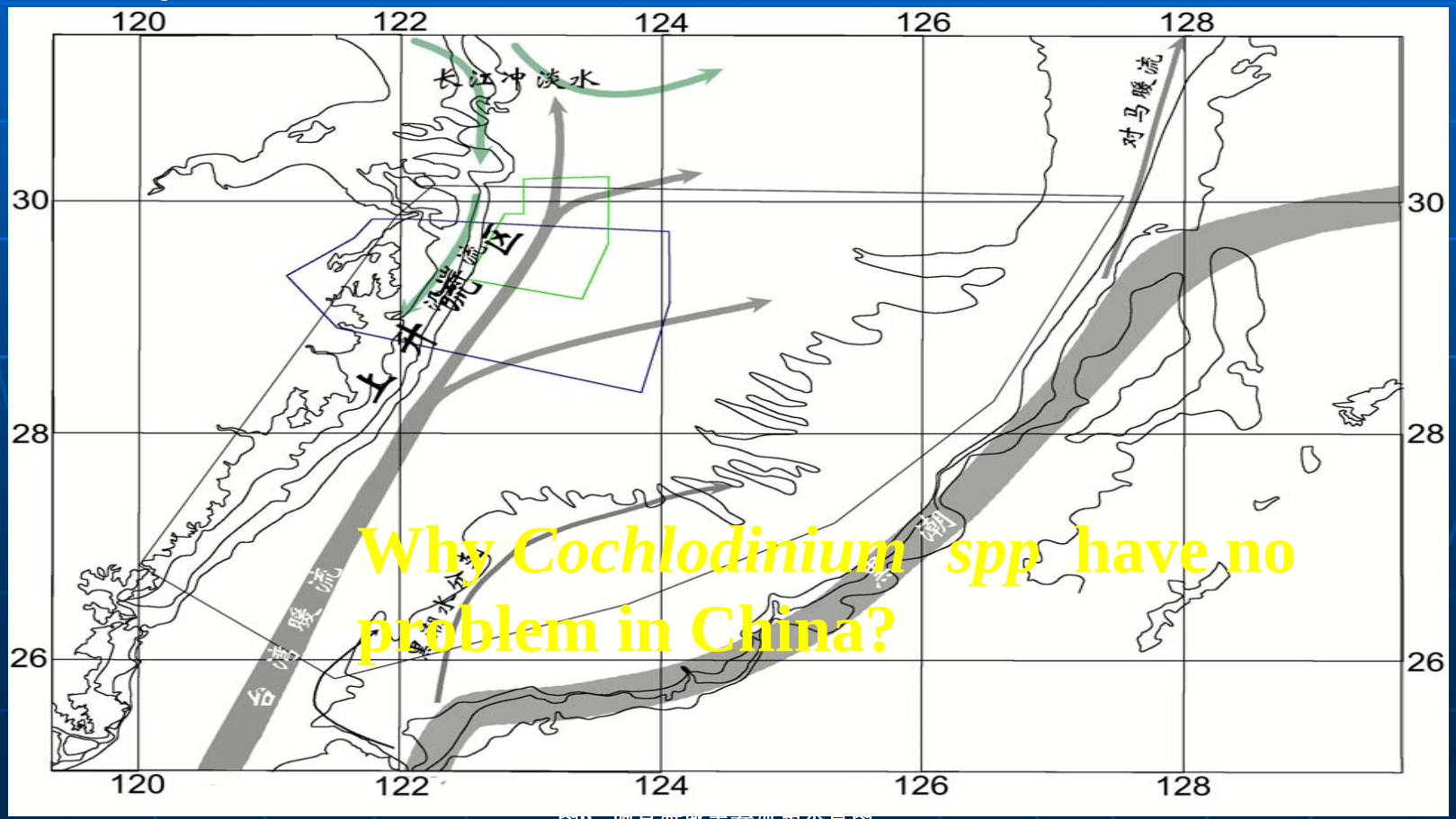
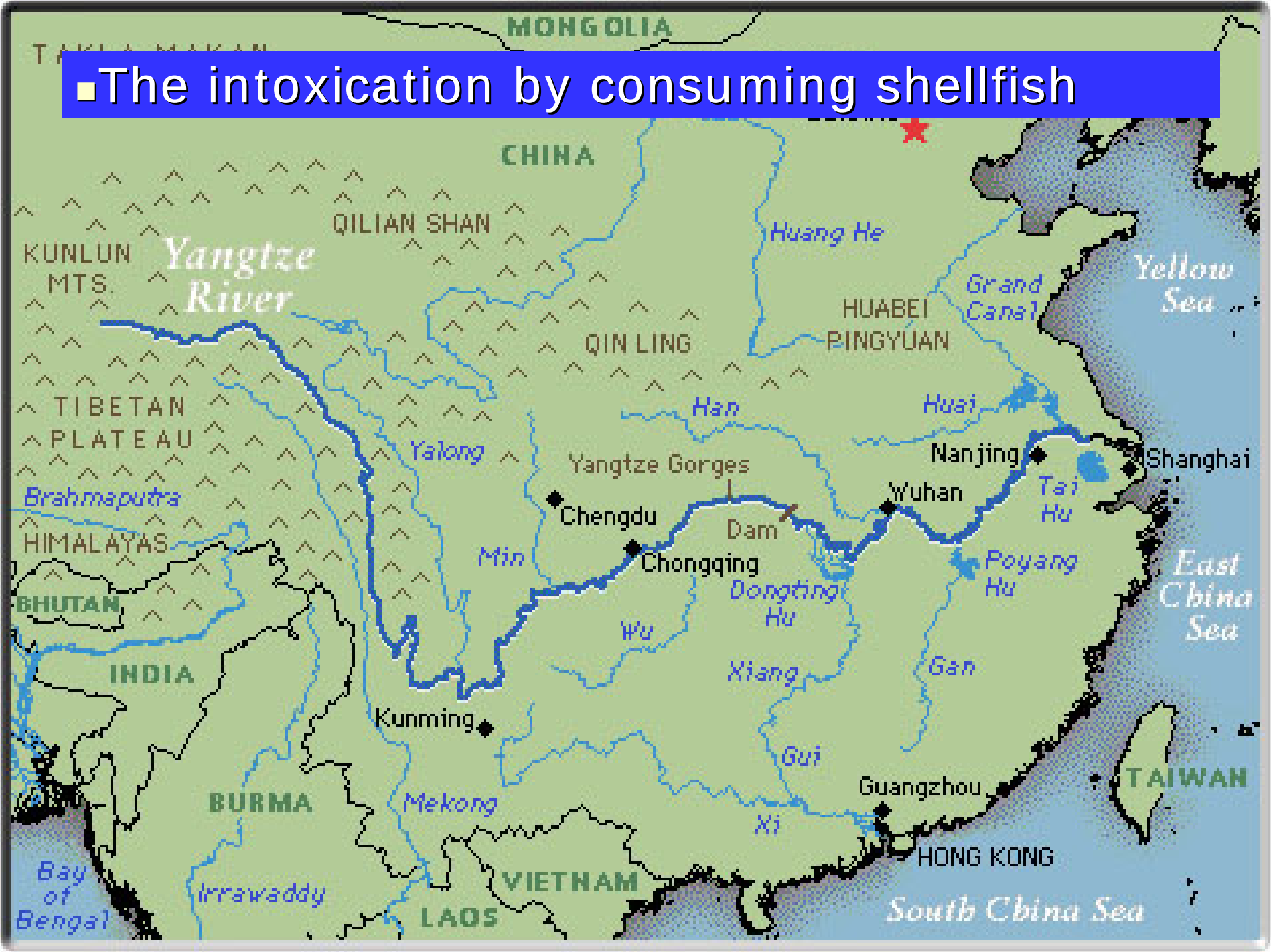



图6 渤黄海域主要流系示意图


The intoxication by consuming shellfish
MONGOLIA
CHINA
QILIAN SHAN
KUNLUN MTS.
Yangtze River
Huang He
Grand Canal
Yellow Sea
HUABEI PINGYUAN
QIN LING
TIBETAN PLATEAU
Han
Huai
Yalong
Yangtze Gorges
Nanjing
Shanghai
Brahmaputra
Chengdu
Wuhan
Tai Hu
HIMALAYAS
Dam
Min
Chongqing
Poyang Hu
East China Sea
Dongting Hu
BHUTAN
Wu
Xiang
Gan
INDIA
Kunming
Gui
TAIWAN
Guangzhou
BURMA
Mekong
Xi
HONG KONG
Bay of Bengal
Irrawaddy
VIETNAM
LAOS
South China Sea

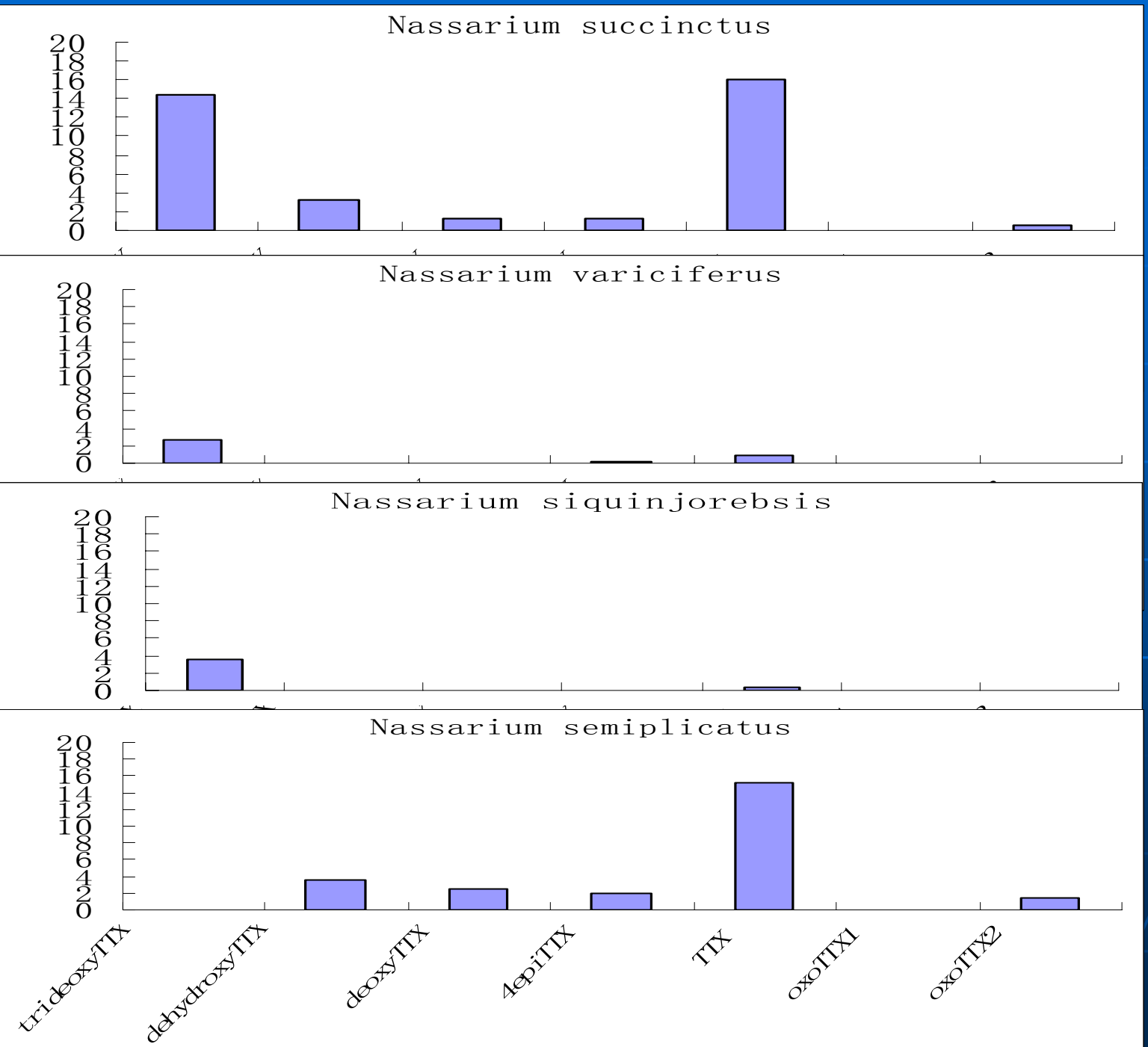
# Detect toxicity with **MIST Alert**


# Shellfish intoxication in Shangdong Province


3 cases of shellfish intoxication were reported, with total 121people intoxication, no dead.

# Shellfish intoxication in Jiangsu Province

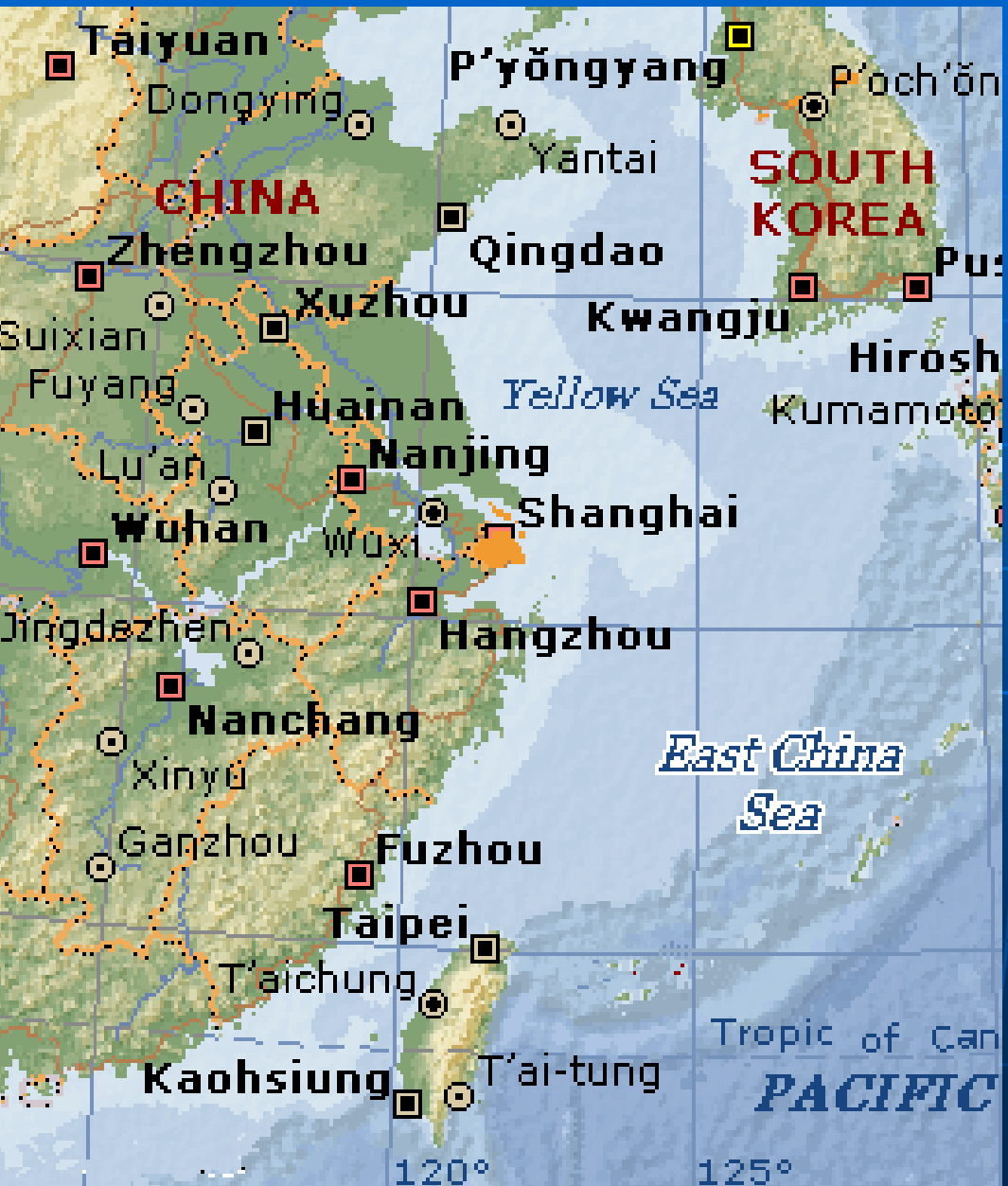

14 cases of shellfish intoxication were reported since 1991, with total 88 people intoxication, 11 dead.




These sample were analyzed with the help of Prof. Dr. Bernd Luckas in Friedrich-Schiller-University Jena

# *What cause Nassarius spp. Containing TTX?*

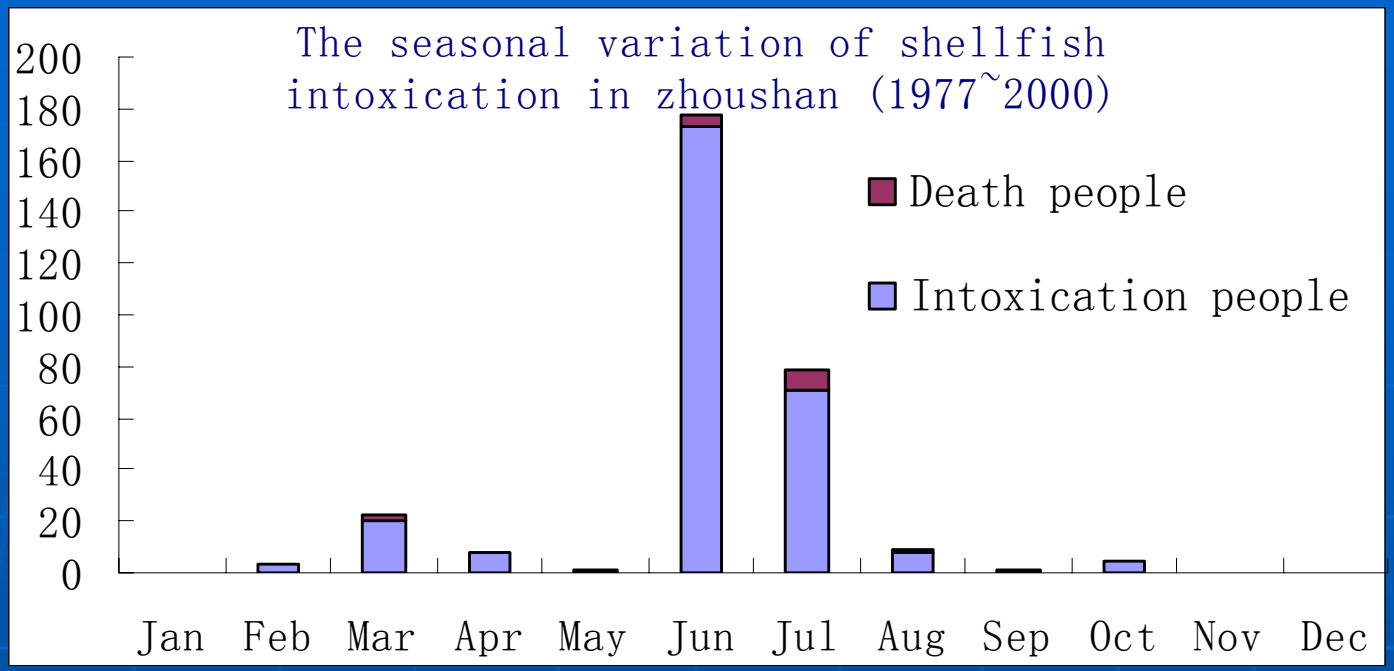
# Shellfish intoxication in Shanghai municiple

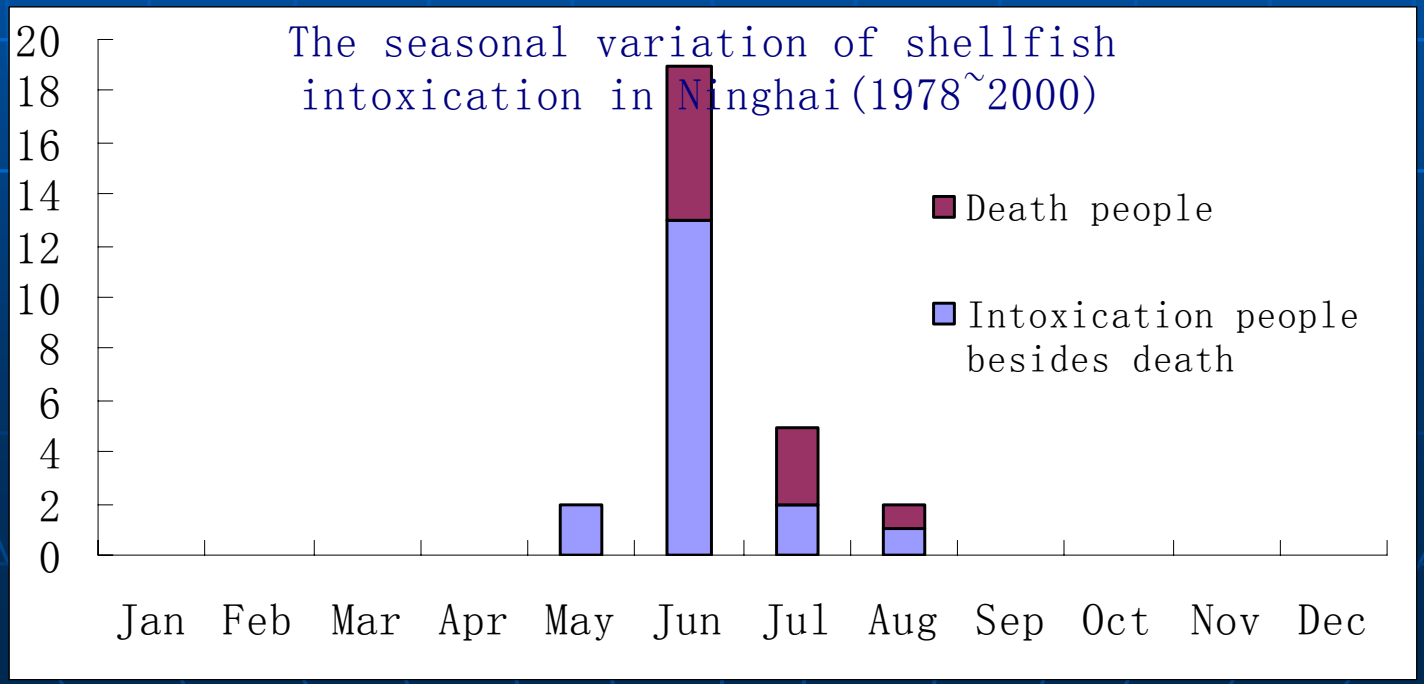



There is no shellfish intoxication reported, but several sea food intoxication is suspected as PSP intoxication.

# Shellfish intoxication in Zhejiang Province


More than 150 cases of shellfish intoxication were reported since 1967, with total 1200 people intoxication, 62 dead.


The seasonal variation of shellfish intoxication in zhoushan (1977~2000)
200
180
160
140
120
100
80
60
40
20
0
Death people
Intoxication people
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


The seasonal variation of shellfish intoxication in Ninghai(1978~2000)
20
18
16
14
12
10
8
6
4
2
0
Death people
Intoxication people besides death
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
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# Shellfish intoxication in Fujian Province


More than 40 cases of shellfish intoxication were reported since 1986, with total 324 people intoxication, 13 dead.

# Shellfish intoxication in Taiwan Province


About 4 cases of shellfish intoxication were reported since 1986, with total 89 people intoxication, 7 dead.

# Shellfish intoxication in Guangdong Province (Include Hainan)


About 16 cases of shellfish intoxication were reported since 1984, with total 246 people intoxication, 21 dead.

# Shellfish intoxication in other Province

About 5 cases of shellfish intoxication were reported in inland province include Heilongjiang,Anhui, Ningchuan, Sanxi, with total 140 people intoxication, 1 dead. The consumed shellfish include Scallop, oyster,snail and *Nassarius spp*

1 cases of shellfish intoxication were reported in Guangxi province in 2005, with total 1 people intoxication, 1 dead after consuming snail.

Several cases of shellfish intoxication were reported in Hong Kong Special Administrative Region since 1990s, but details on the number of patients affected and the clinical presentation are not available.

Since 1960s , poisoning incidents caused by the consumption of snail *Nassarius* spp. were reported in Coast of East China sea. After observation of the symptoms in the victims it was suspected that PSP toxins were involved, and the toxicity screening of the snail samples with mouse bioassay method for monitoring of PSP toxins gave numbers exceeding 10,000MU/100g tissue (wet weight).However, no PSP toxins were detected after analysis of snail samples usinghigh performance liquid chromatography (HPLC) with postcolumn derivatization. The toxins in *Nassarius* spp. were finally identified as tetrodotoxin (TTX), after re-analysis of the samples using HPLC coupled with a mass detector. The derivatives of TTX in toxic snail samples were also analyzed, using HPLC coupled with a triple quadrupole mass detector (API 4000), in the mode of precursor ion scan and product ion scan. Two isomers of trideoxyTTX, two isomers of TTX, two isomers of 11-oxoTTX,anhydroTTX and trace amounts of deoxyTTX were identified from the toxic snail samples.

## Advice for future HAB work in China

- the coordination and cooperation between various agencies make the HAB monitor network run favourably;
- the optimized monitor scheme should assure that most of the data collected are validated, but not rich data with poor information;
- the HAB monitor network and subsided monitor centers have quality assurance program to make data reliable and accurate;
- the selection of the variables, sites, techniques and periods should have explicit purpose to elucidate specific information of HAB, and objectives should be clearly stated as definite goals for monitoring.

Capability building:

1 algal identification and toxin detection training

many new unskilled crew, Comprehensive ecosystem

2 develop realtime techniques (monitoring\forecast\mitigation)

3 improve monitoring system

a large system but not high efficient

# Thank you

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**http://www.dhjczx.org/chichao/chichao.asp**