



The threat of potential alien species in the East China Sea

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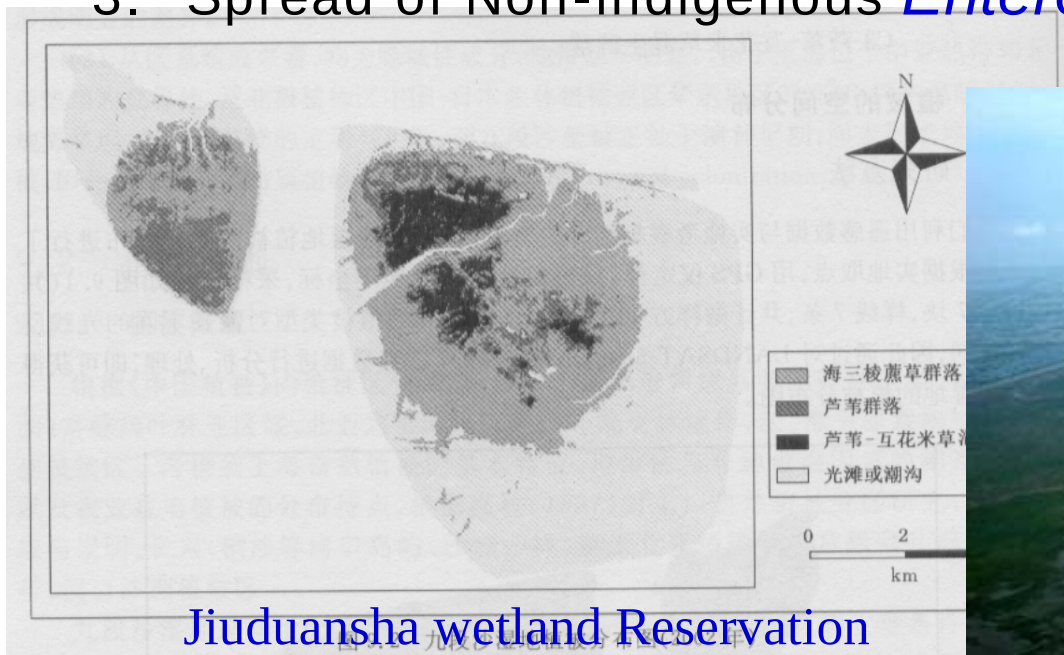
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2008.10.28 , Dalian,P.R.China

Outline

Major Invasive Species problem in ECS

1. The spread of *Spartina alterniflora* introduced intentionally for reclamation in wetland
2. The potential alien species and ballast discharge
3. Spread of Non-indigenous *Enteromorpha* bloom



Chongming wetland and bird Reservation

1990

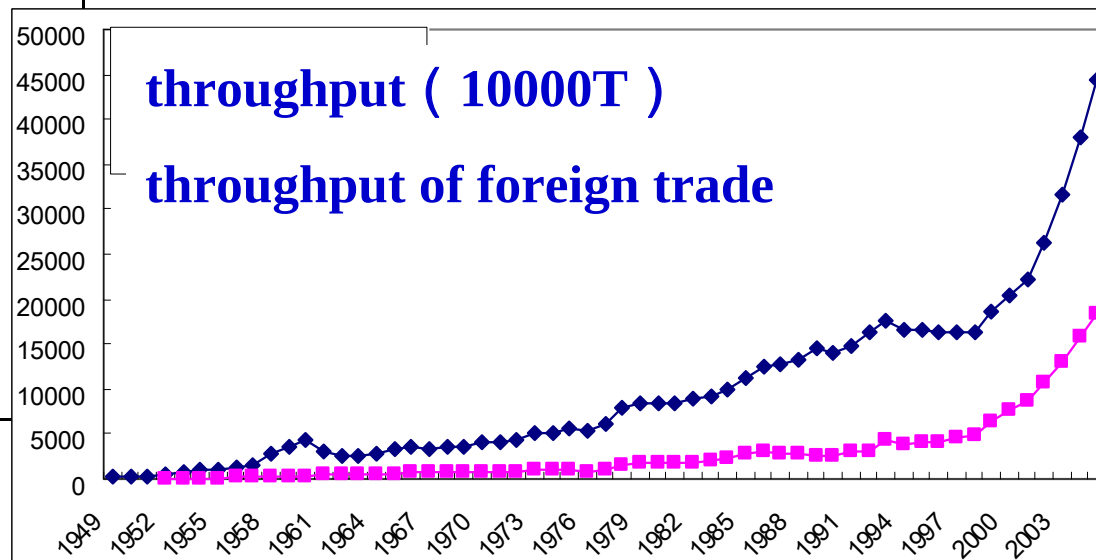
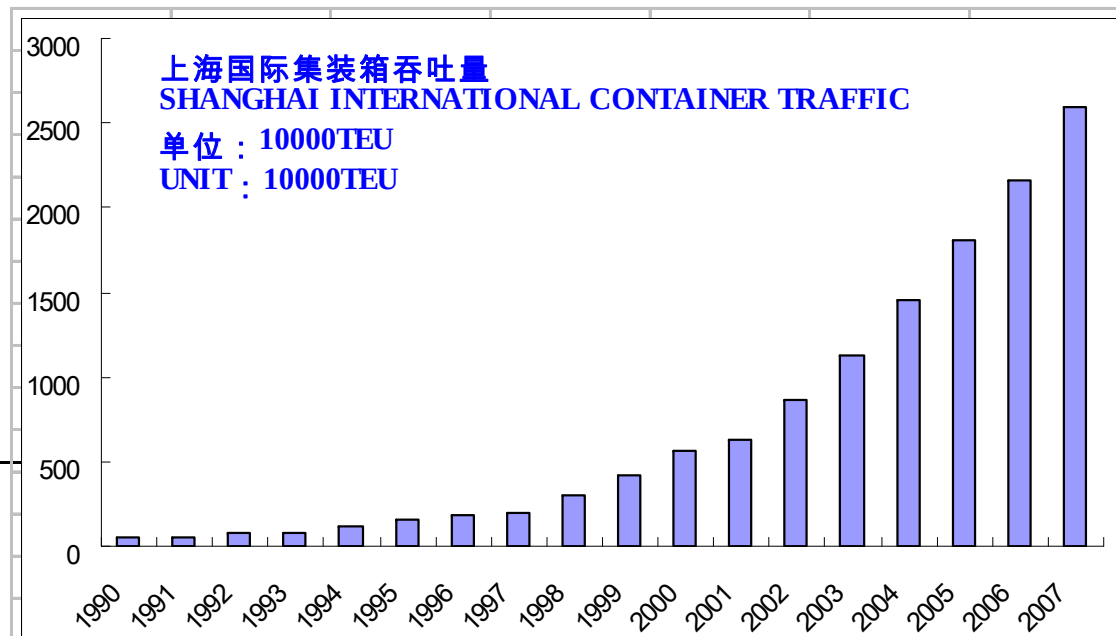
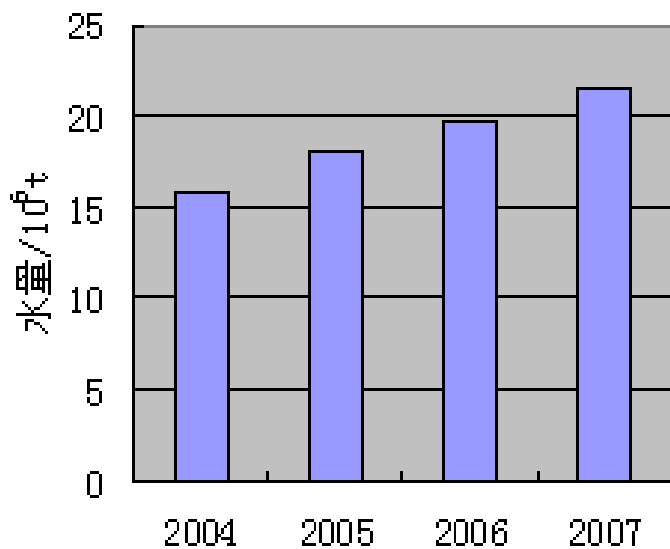


2004



Ballast water–Alien Algae source ?

About 82.4% of arrived vessel discharge no ballast water in shanghai. 17.8% discharge,so about 21.5×10^6 ton ballast water discharged in shanghai 2007

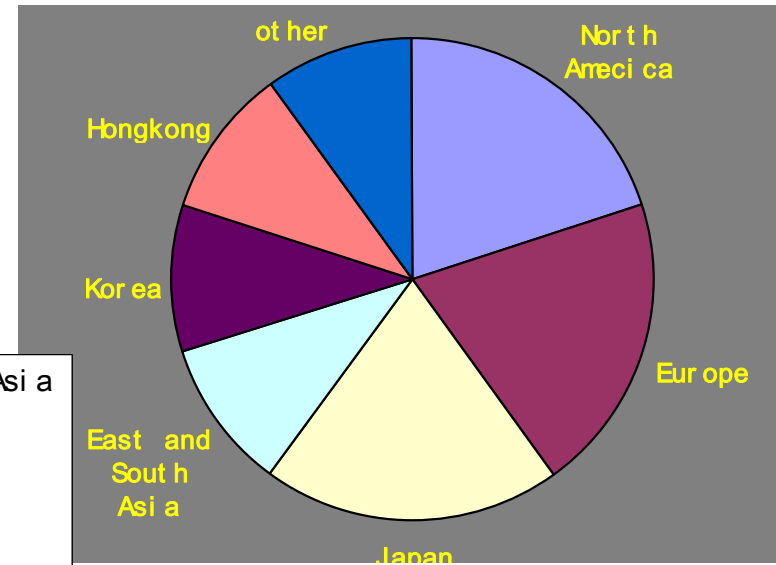
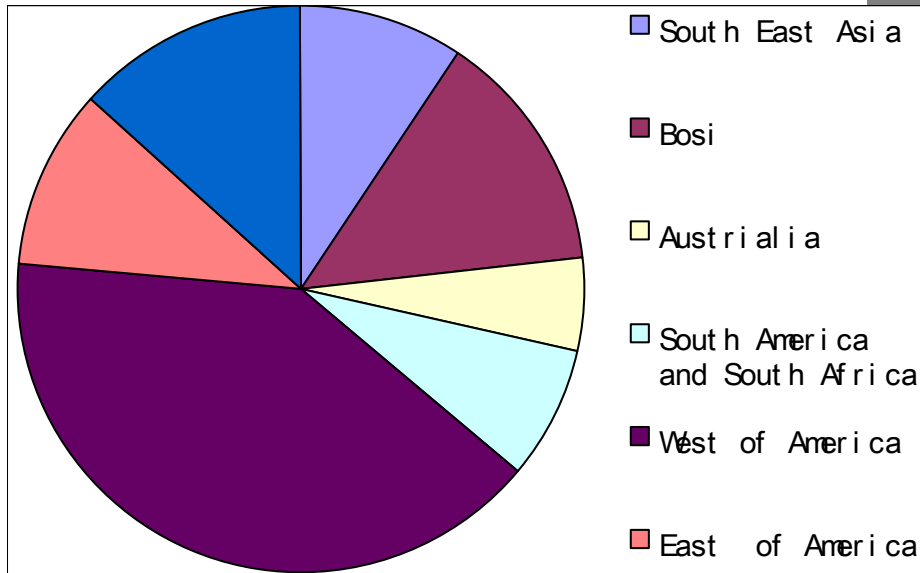


Where the ballast water come from?

Have connection with more than 500 harbor of 200 countries, most of the ballast water loaded from open sea

2005, 7896000TEU, 72% of the container trade with Korea, Japan, Singapore, America, Europe

2007, 50% trade with America, most of them with west of America



Ballast examination result (2002~2003)

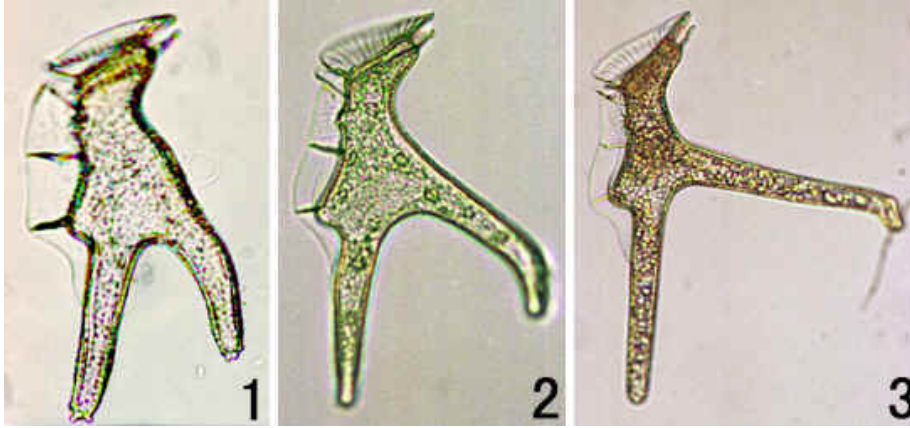
During August 2002 and July 2003, ballast water were sampled in Ningbo Harbor. The phytoplankton and zooplankton was examined in ballast water, there were 51 species of phytoplankton, including 38 diatoms, 5 dinoflaellate, the average abundance of phytoplankton is $3.5 \times 10^3 \text{ ind} / \text{dm}^3$ (among them, Zhenghai harbor $9.0 \times 10^3 \text{ ind} / \text{dm}^3$, ningbo harbor $1.0 \times 10^3 \text{ ind} / \text{dm}^3$, beilun harbor $0.6 \times 10^3 \text{ ind} / \text{dm}^3$).

There were 18 zooplankton identified in ballast water, including 10 Copepoda. The average abundance of zooplankton is 164 ind/100L (among them, Zhenghai harbor 150 ind/100L, ningbo harbor 282 ind/100L).

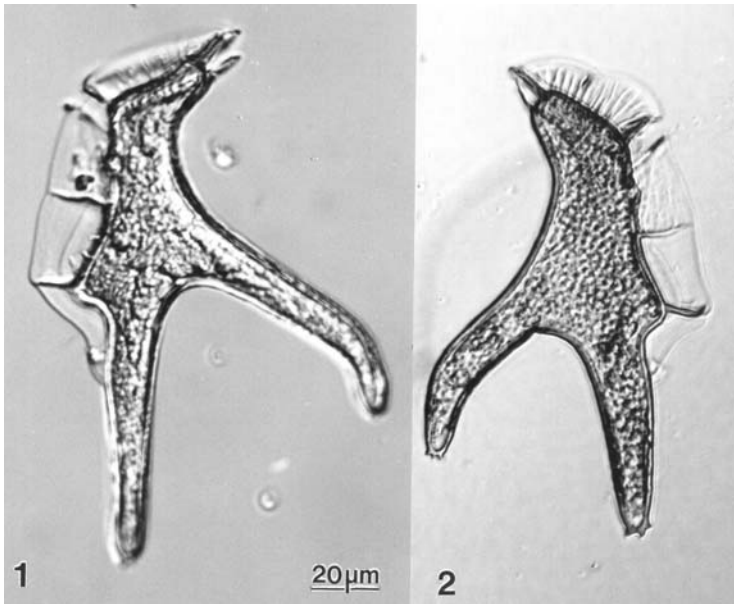
Phytoplankton identified in ballast water of ningbo port during 2003

<i>Bacteriastrum hyalinum</i>	<i>Nitzschia lorenziana</i>
<i>Bacteriastrum</i>	<i>Nitzschia pungens</i>
<i>Biddulphia mobiliensis</i>	<i>Nitzschia sp.</i>
<i>Biddulphia sinensis</i>	<i>Pleurosigma formosum</i>
<i>Chaetoceros affinis</i>	<i>Pleurosigma sp.</i>
<i>Chaetoceros castracanei</i>	<i>Rhizosolenia alata f.gracillima</i>
<i>Chaetoceros compressus</i>	<i>Rhizosolenia calcar-avis</i>
<i>Chaetoceros curvisetus</i>	<i>Rhizosolenia setigera</i>
<i>Chaetoceros decipiens</i>	<i>Rhizosolenia styliformis</i>
<i>Chaetoceros lorenzianus</i>	<i>Skeletonema costatum</i>
<i>Chaetoceros indicum</i>	<i>Stephanopyxis palmeriana</i>
<i>Chaetoceros diversus</i>	<i>Synedra sp.</i>
<i>Chaetoceros peruvianus</i>	<i>Thalassionema nitzschioides</i>
<i>Chaetoceros siamense</i>	<i>Dictyocha fibula</i>
<i>Coscinodiscus centralis</i>	<i>Gymnodinium sp.</i>
<i>Coscinodiscus jonesianus</i>	<i>Prorocentrum dentatum</i>
<i>Coscinodiscus sp.</i>	<i>Prorocentrum micans</i>
<i>Cyclotella sp.</i>	<i>Prorocentrum sp.</i>
<i>Cyclotella stlorum</i>	<i>Dinophysis miles</i>
<i>Ditylum brightwellii</i>	<i>Scenedesmus armatus</i>
<i>Leptocylindrus danicus</i>	<i>Pediastrum simplex</i>
<i>Eucampia zoodiacus</i>	<i>Gloeocapsa minima</i>
<i>Licmophora abbreviata</i>	<i>Spirulina princeps</i>
<i>Melosira sulcata</i>	<i>Microcystis aeruginosa</i>
<i>Nitzschia closterium</i>	<i>Mesodinium rubrum</i>
	<i>Holophrya sp.</i>

Dinophysis miles



- widely distributed in tropical waters
- toxicity demonstrated in cells from the Philippines



It is not found in natural sea water up till now.

Ballast examination result(2007~2008)

During August 2007 and September 2008, more than 60 ballast water were sampled in Shanghai Harbor, The phytoplankton was examined in ballast water, there were 127 species of plankton, including 94 diatoms , 21 dinoflagellate , 3 chrysophyta, 2 Protozoa and 7 other species.

压舱水检测报告

[illegible]

种名	
慈藻	DIATOM
长菱形藻	ELONGATED DIATOM
椭圆菱形藻	ELLIPSE DIATOM
圆藻	ROUNDED DIATOM
羽藻	FEATHER DIATOM
丝藻	STRAND DIATOM
丝藻(1种)	STRAND DIATOM
丝藻	STRAND DIATOM
丝藻(1种)	STRAND DIATOM
节肢动物门	ARTHROPODA
海鞘纲	THALIACEA
肉汁状藻	SLIMY ALGAE

[illegible]

采样日期: 2007 年 10 月
采样船舶: Raiju

种名	
硅藻	
日本星杆藻	<i>Aster</i>
黄蜡双壁藻	<i>Diplo</i>
华美双壁藻	<i>Diplo</i>
浮动弯角藻	<i>Eucan</i>
舟形藻 sp.	<i>Navic</i>
长菱形藻	<i>Nitzs</i>
螺旋菱形藻	<i>Nitzs</i>
尖刺拟菱形藻	<i>Pseud</i>
中肋骨条藻	<i>Skelet</i>
菱形海线藻	<i>Thala</i>
圆海链藻	<i>Thala</i>
甲藻	
螺旋环沟藻	<i>Gyrod</i>
黄藻	
赤潮异弯藻	<i>Heter</i>
浮游动物	
纤毛虫	
幼虫	

采样日期: 2008 年 1 月 14 日
采样船舶: FEDERAL KIVALINA

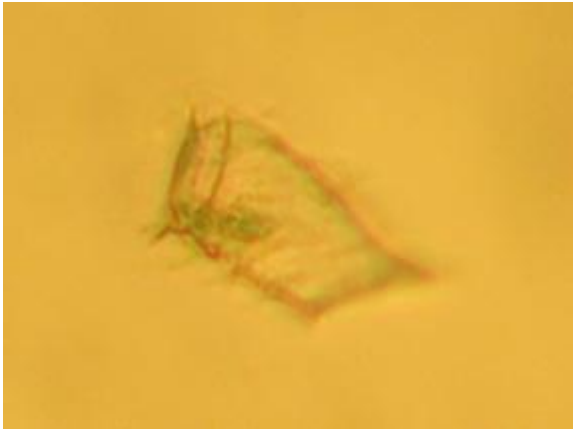
种名	拉丁文	密度	备注
		(个/L)	
硅藻	DIATOMOPHYTA		
偏心圆筛藻	<i>Coscinodiscus excentricus</i> ⁺	1320	
羽纹藻属	<i>Pinnularia</i> sp ⁺	80	
日本星杆藻	<i>Asterionella japonica</i> ⁺	1160	
菱形海链藻	<i>Thalassiosira nitzschoides</i> ⁺	3040	
乔氏圆筛藻	<i>Coscinodiscus thomii</i> ⁺	560	
丹麦细杆藻	<i>Leptocylindrus danicus</i> ⁺	280	
圆海链藻	<i>Thalassiosira rotula</i> ⁺	2240	
脆根直藻	<i>Rhizosolenia fragilissima</i> ⁺	320	
中肋直条藻	<i>Skeletonema costatum</i> ⁺	1160	
菱形藻属	<i>Nitzschia</i> sp ⁺	440	
布氏双尾藻	<i>Ditylum brightwellii</i> ⁺	80	
长菱形藻	<i>Nitzschia longissima</i> ⁺	160	+
颗粒直链藻	<i>Melosira granulata</i> ⁺	360	+
海洋斜纹藻	<i>Pleurosigma pelagicum</i> ⁺	80	+
近缘斜纹藻	<i>Pleurosigma affine</i> ⁺	280	+
菱角毛藻	<i>Chaetoceros gibberii</i> ⁺	80	+
条纹小环藻	<i>Cyclotella striata</i> ⁺	80	+
刚毛根直藻	<i>Rhizosolenia setigera</i> ⁺	40	+
旋链角毛藻	<i>Chaetoceros curvisetus</i> ⁺	880	+
中型幼直盾氏藻		40	+
尖刺拟菱形藻	<i>Pseudo-nitzschia pungens</i> ⁺	240	+
虹彩圆筛藻	<i>Coscinodiscus oculus-indis</i> ⁺	80	+
掌状冠盖藻	<i>Stephanopyxis palmeriana</i> ⁺	80	+
全环直链藻	<i>Melosira moniformis</i> ⁺	120	+
巨圆筛藻	<i>Coscinodiscus gigas</i> ⁺	80	+
金藻门	CHRYSOPHYTA		

Plankton identified in ballast water of Shanghai Port during 2007-2008

Diatomophyta	<i>Coscinodiscus ornatus</i>	<i>Melosira granulata</i>	<i>Rhizosolenia styliformis</i>	<i>Gymnodinium</i> sp.
<i>Actinopterychus trilingulatus</i>	<i>Coscinodiscus oculus-iridis</i>	<i>Melosira moniiformis</i>	<i>Skeletonema costatum</i>	<i>Gyrodinium spirale</i>
<i>Amphiprora alata</i>	<i>Coscinodiscus gigas</i>	<i>Navicula membranacea</i>	<i>Skeletonema</i> sp	<i>Oxytoxum</i> sp
<i>Asterionella japonica</i>	<i>Coscinodiscus</i> sp	<i>Navicula</i> sp.	<i>Stephanopyxis palmeriana</i>	<i>Prorocentrum dentatum</i>
<i>Asteromphalus cleveanus</i>	<i>Cyclotella</i> sp.	<i>Nitzschia punctata</i>	<i>Stephanopyxis turris</i>	<i>Prorocentrum micans</i>
<i>Bacteriastrum hyalinum</i>	<i>Cyclotella striata</i>	<i>Nitzschia longissima</i>	<i>Synedra</i> sp.	<i>Prorocentrum</i> sp
<i>Biddulphia aurita</i>	<i>Cymbella</i> sp	<i>Nitzschia longissima</i> var. <i>reversa</i>	<i>Thalassionema nitzschioides</i>	<i>Protoperidinium pyriforme</i>
<i>Biddulphia mobiliensis</i>	<i>Cymbella tumida</i>	<i>Nitzschia lorenziana</i>	<i>Thalassiosira rotula</i>	<i>Protoperidinium conicum</i>
<i>Biddulphia regia</i>	<i>Dacthliosolen mediterraneus</i>	<i>Nitzschia sigma</i>	<i>Thalassiosira</i> sp	<i>Protoperidinium crassipes</i>
<i>Cerataulina bergonii</i>	<i>Diploneis bombus</i>	<i>Nitzschia</i> sp	<i>Thalassiosira</i> sp1	<i>Protoperidinium divergens</i>
<i>Ceratium fusus</i>	<i>Diploneis crabro</i>	<i>Nitzschia</i> sp1.	<i>Thalassiosira</i> sp2	<i>Protoperidinium pallidum</i>
<i>Chaetoceros affinis</i>	<i>Diploneis splendica</i>	<i>Nitzschia</i> sp2.	<i>Thalassiosira subtilis</i>	<i>Scrippsiella trochoidea</i>
<i>Chaetoceros compressus</i>	<i>Ditylum brightwellii</i>	<i>Pinnularia</i> sp	<i>Thalassiothrix frauenfeldii</i>	<i>Karenia mikimotoi</i>
<i>Chaetoceros curvisetus</i>	<i>Donkinia recta</i> var. <i>intermedia</i>	<i>Pleurosigma affine</i>	<i>Thalassiothrix longissima</i>	<i>Euglena</i> sp
<i>Chaetoceros debilis</i>	<i>Donkinia</i> sp	<i>Pleurosigma pelagicum</i>	CHRYSTOPHYTA	Protozoa
<i>Chaetoceros didymus</i>	<i>Eucampia zodiacus</i>	<i>Pleurosigma</i> sp.	<i>Dictyocha fibula</i>	<i>Tintinnopsis</i> sp
<i>Chaetoceros eibenii</i>	<i>Guinardia flaccida</i>	<i>Pseudo-nitzschia delicatissima</i>	<i>Mesocena polymorpha</i> var. <i>bioconaria</i>	<i>Codonellopsis mobilis</i>
<i>Chaetoceros lorenzianus</i>	<i>Gyrodinium spirale</i>	<i>Pseudo-nitzschia pungens</i>	<i>Distephanus speculum</i>	Nematoda
<i>Chaetoceros pseudocurvisetus</i>	<i>Gyrosigma acuminatum</i>	<i>Rhizosolenia alata</i>	DINOPHYTA	Other
<i>Chaetoceros</i> sp	<i>Hemiaulus hauckii</i>	<i>Rhizosolenia alata</i> f. <i>gracillima</i>	<i>Ceratium bohmi</i>	<i>Unidentified species1</i>
<i>Chaetoceros</i> sp	<i>Hemiaulus sinensis</i>	<i>Rhizosolenia</i> sp	<i>Ceratium</i> f.	<i>Unidentified species2</i>

Some Non-indigenous species

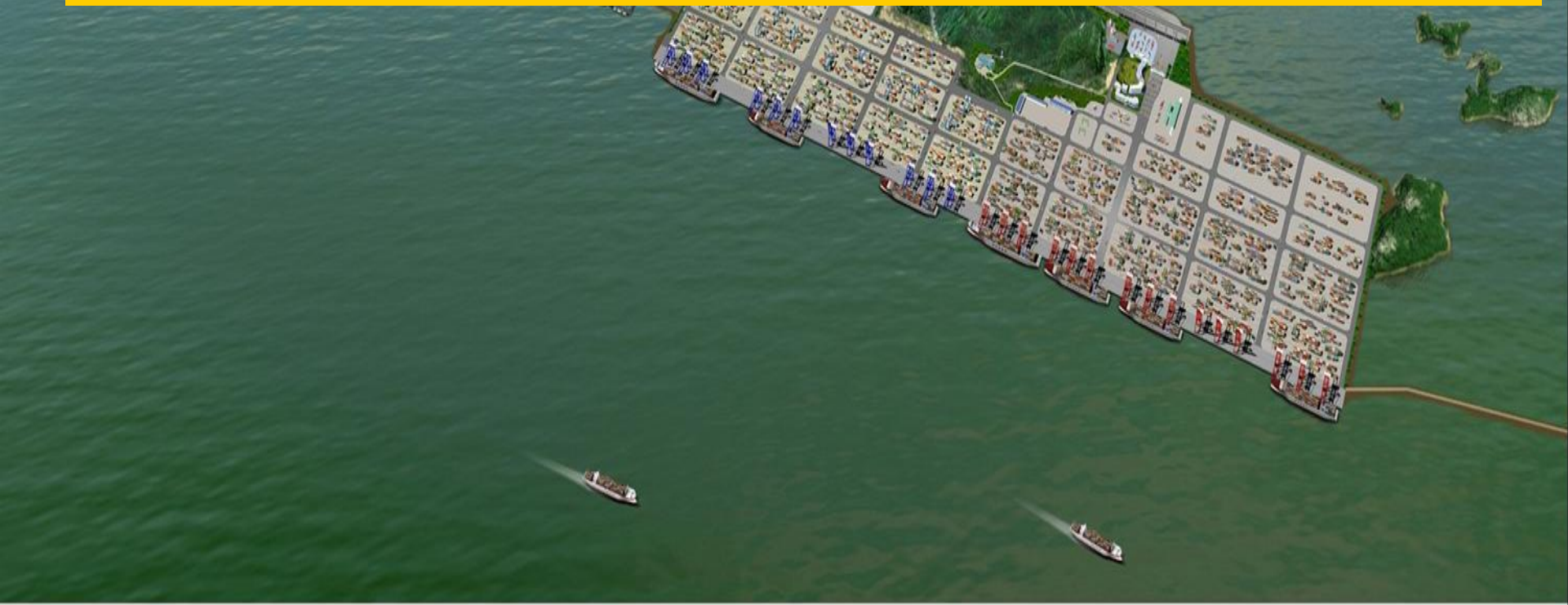
- *Dinophysis* sp 密度:40ind/L 41*20um



The forecast Throughput in Yangshan Harbor

Unit : 10000TEU

Year	2005	2010	2015	2020
Throughput	230-240	520-570	950-1000	1400-1500
Transfer	80	200	300	500



sampling in Yangshan Port

- Since 2002, plankton sample and environmental parameters in Yangshan port were analyzed in four season by quantity.
- During 2007.9.1~2008.8.31. plankton were sampled in trawl net (20 μ m) 2 times one week, total 130 sample.138 species of phytoplankton including 89 diatom and 40 dinoflagellate.

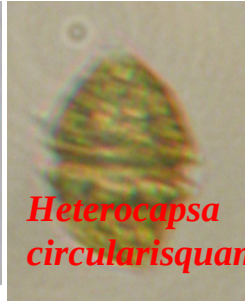


Harmful algae in China

Other Harm Algae



Karina mikimotoi



Heterocapsa circularisquama



Heterosigma akashiwo



Gymnodinium sanguineum

NSP



Karina brevis

DSP



Dinophysis acuminata



Dinophysis caudata

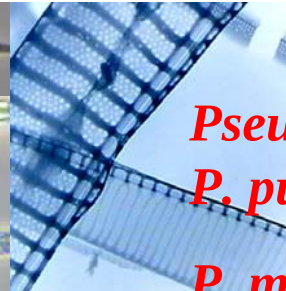
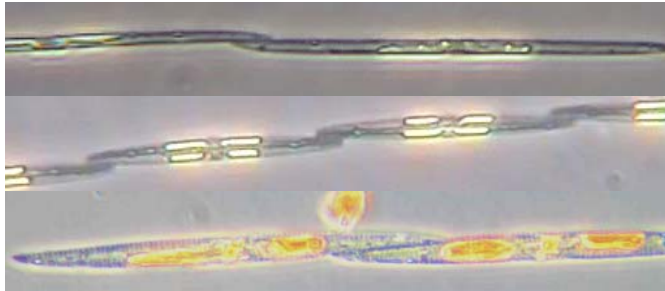


Dinophysis fortii

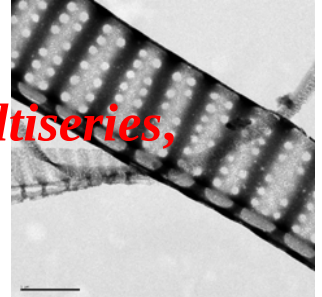


Dinophysis rotundata

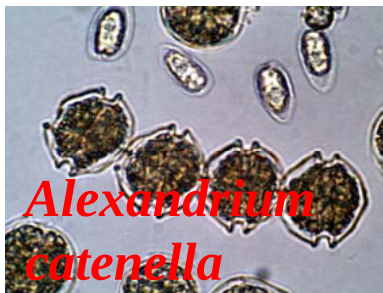
ASP



Pseudo-nitzschia multiseriata,
P. pungens,
P. multistriata,



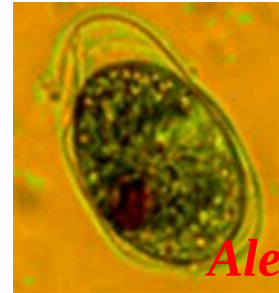
PSP



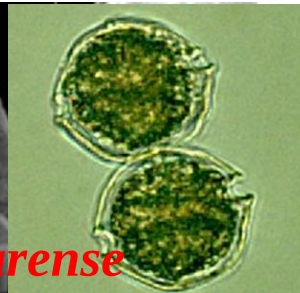
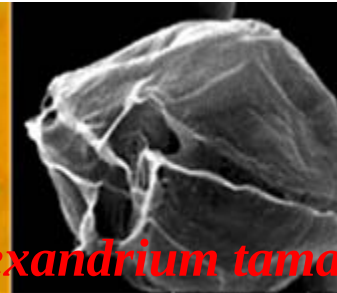
Alexandrium catenella



Alexandrium minutum



Alexandrium tamarense



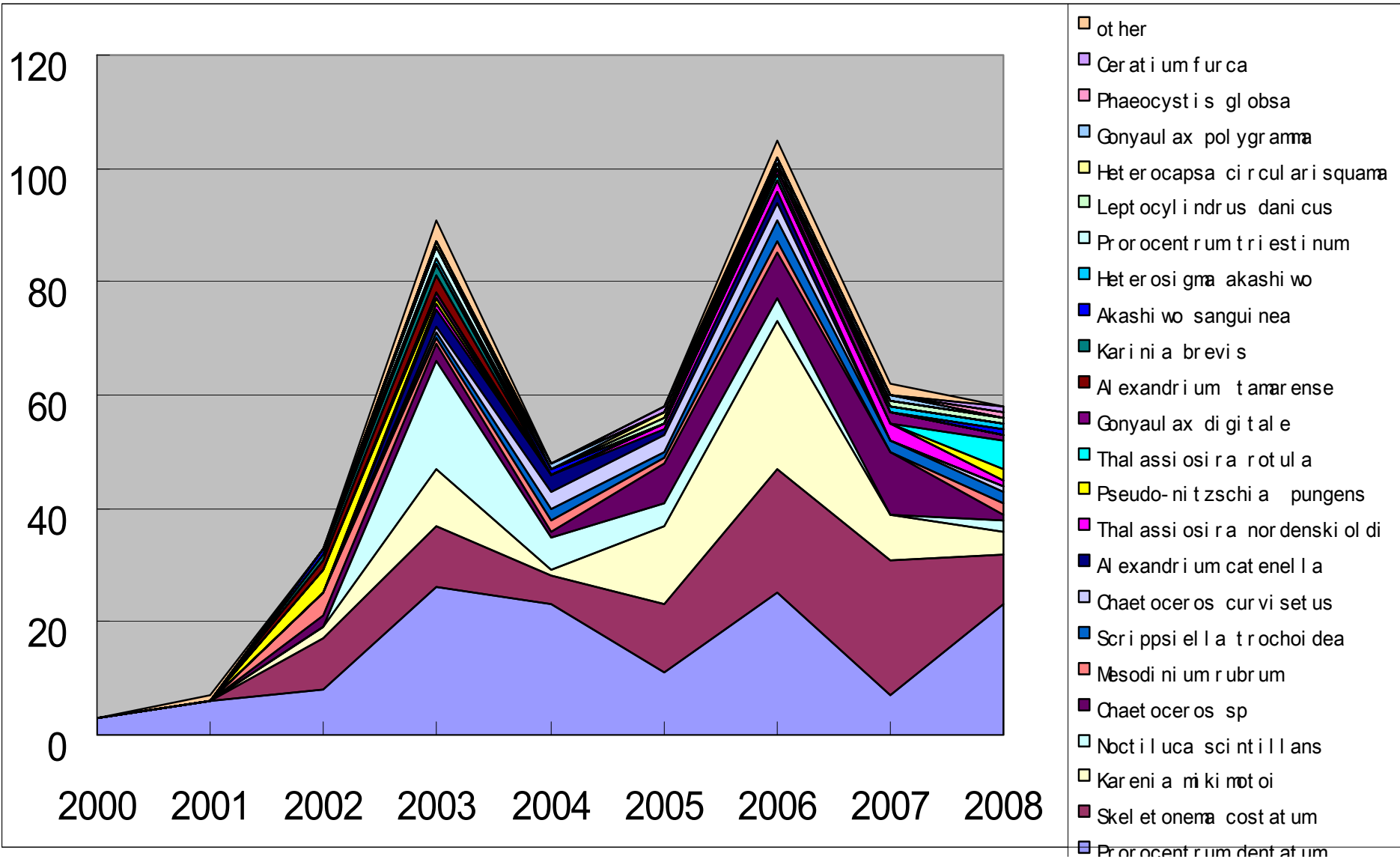
Chronology of red tide species

1933	<i>Noctiluca scintillans</i>	<i>Skeletonema costatum</i>			
1952	<i>Trichodesmium thiebautii</i>				
1972	<i>Prorocentrum mininum</i>	<i>Trichodesmium erthraeum</i>			
1980	<i>Heterosigma akashiwo</i>	<i>Karenia mikimotoi</i>			
1982	<i>Ceratium tripos</i>				
1983	<i>Rhizosolenia alata f. gracillima</i>				
1984	<i>Cocholeodinium spp.</i>				
1986	<i>Dactyliosolen mediterraneus</i>	<i>Gymnodinium sp</i>	<i>Teleaulax acuta</i>		
1987	<i>Chaetoceros socialis</i>	<i>Eucampia cornuta</i>			
1988	<i>Alexandrium sp.</i>	<i>Nitzschia sp</i>			
1989	<i>Thalassiosira weissflogii</i>	卵甲藻			
1990	<i>Euglena sp</i>	<i>Mesodinium rubrum</i>			
1991	<i>Chattonella marina</i>	<i>Gonyaulax polygramma</i>	<i>Peridinium bipes</i>	<i>Prorocentrum micans</i>	<i>Prorocentrum triestinum</i>
1993	<i>Dictyocha fibula</i>	<i>Pseudonitzschia Pungens</i>			
1994	<i>Scrippsiella trochoidea</i>				
1995	<i>Ceratium furca</i>				
1996	<i>Prorocentrum dentatum</i>				
1997	<i>Phaeocystis globosa</i>	微型蓝藻			

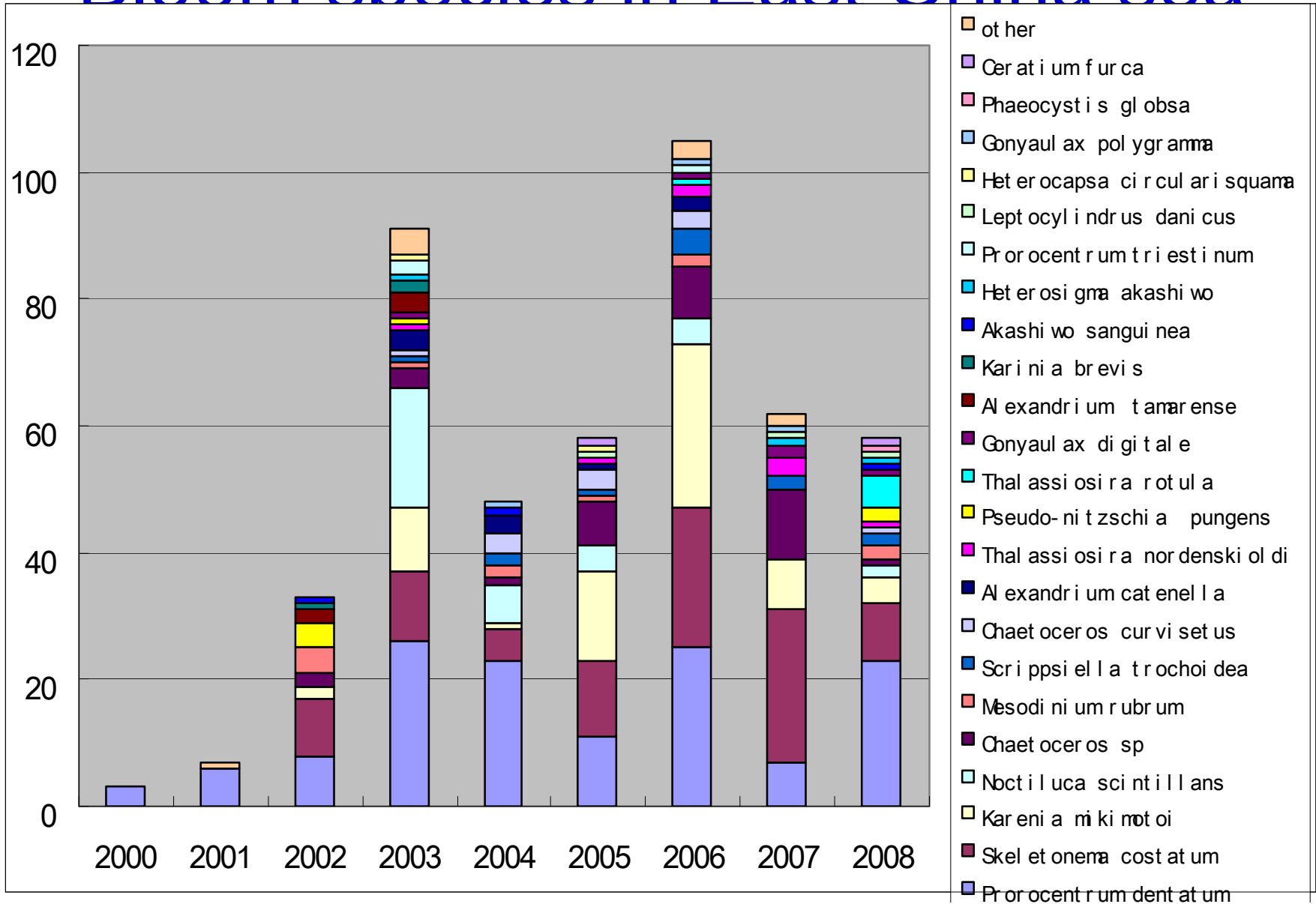
Chronology of red tide species

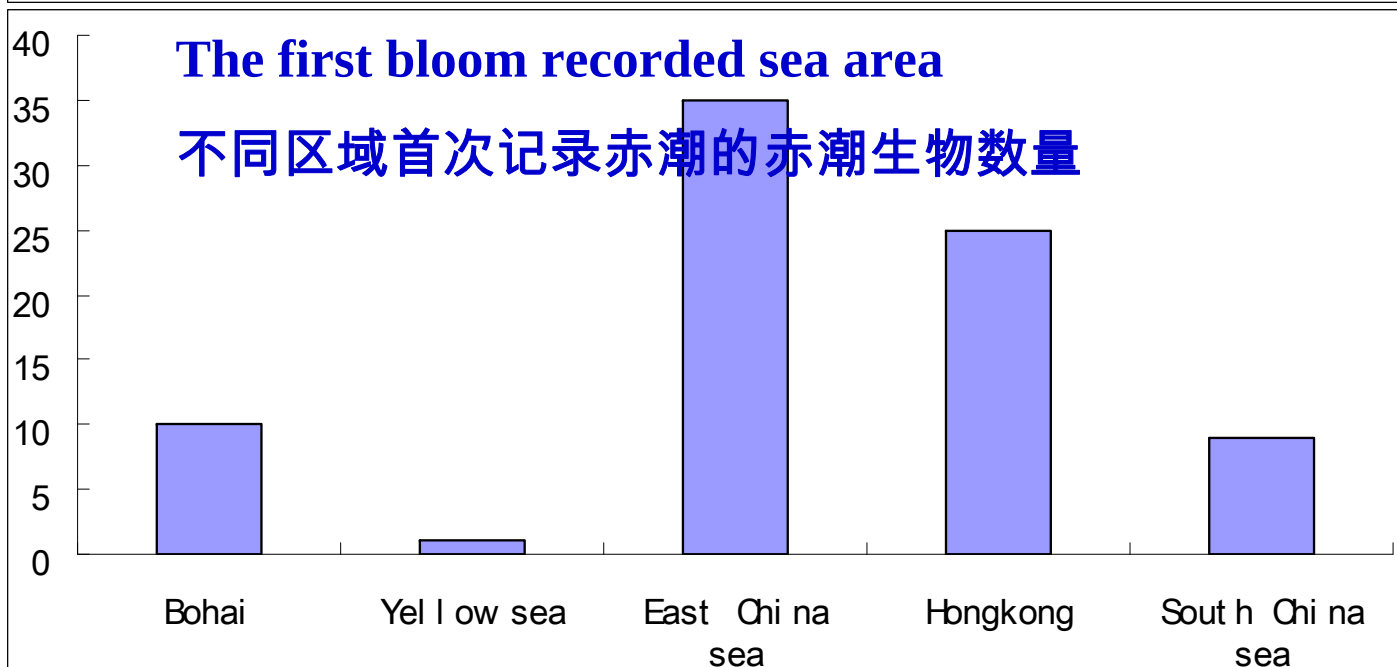
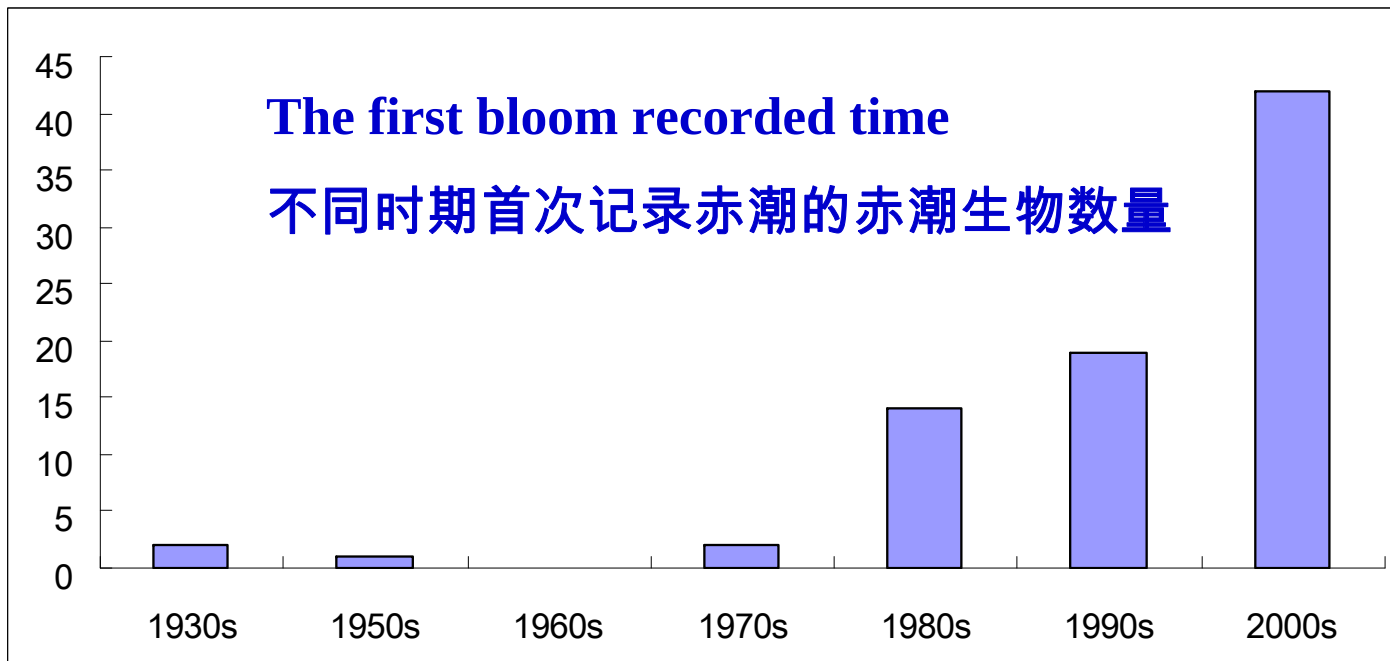
1998	<i>Gyrodinium instriatum</i>	<i>Karenia digitata</i>	<i>Karenia longican ales</i>						
1999	<i>Cochlodinium polykrikoides</i>								
2000	<i>Hermesinum adriaticum</i>	<i>Plagioselmis prolonga</i>	红 球 藻 科	<i>Akashiwo sanguinea</i>					
2001	<i>Akashiwo sanguinea</i>	<i>Thalassiosira nordenskioldi</i>	<i>Chattonella globosa</i>	<i>Chattonella ovata</i>	<i>Distephanus speculum</i>	<i>Eucampia zodiacus</i>	<i>Leptocylindrus danicus</i>	<i>Navicula sp.</i>	<i>Biddulphia aurita</i>
2002	<i>Chaetoceros pseudocurvisetus</i>	<i>Heterocapsa circularisquama</i>	<i>Gymnodinium brevis</i>	<i>Gymnodinium catenella</i>	<i>Gyrodinium sp</i>				
2003	<i>Chaetoceros curvisetus</i>	<i>Thalassiosira subtilis</i>	<i>Cyclotella caspia</i>	<i>Gonyaulax sp</i>	<i>Karlodinium micrum</i>	<i>Nitzschia closterium</i>	<i>Prorocentrum balticum</i>	<i>Chaetoceros debilis</i>	
2004	<i>Chroomonas sp.</i>	<i>Haematococcus pluvialis</i>	<i>Cylindrotheca closterium</i>	<i>Thalassiosira mala</i>					
2005	<i>Cerataulina pelagica</i>	<i>Heterocapsa rotundata</i>	<i>Thalassiosira rotula</i>						
2006	<i>Chaetoceros subsecundus</i>	<i>Melosira sulcata</i>	<i>Rhizosolenia delicatula</i>						
2007	<i>Asterionella japonica</i>	<i>Chaetoceros lorezianus</i>	<i>Chaetoceros Compressus</i>	<i>Chaetoceros tortissimus</i>	<i>Ditylum brightwellii</i>	<i>Gonyaula x digitale</i>	h		

Bloom species in East China sea



Bloom species in East China sea





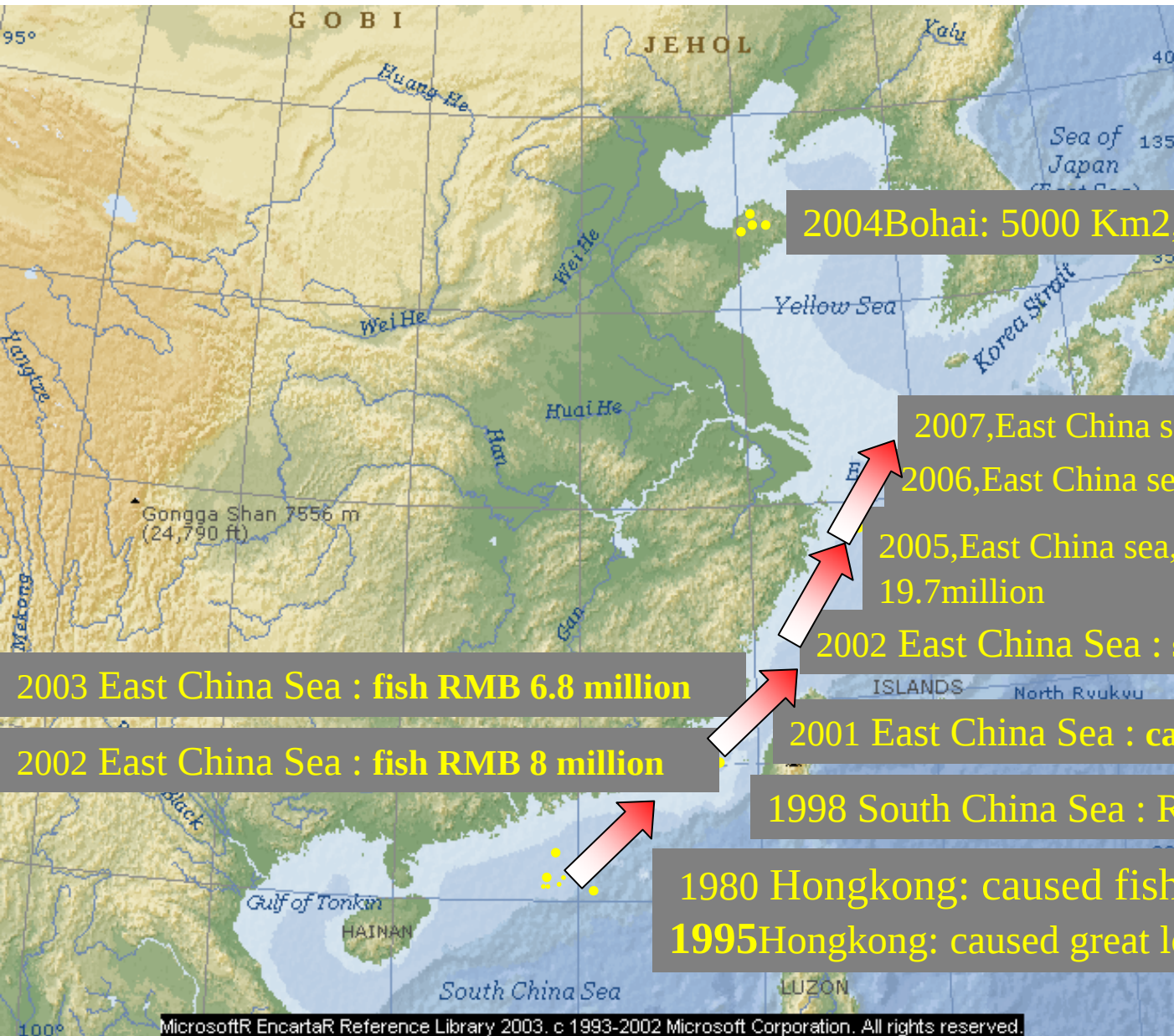
Harmful algae recorded	time	Affected area	FRE
<i>Trichodesmium thiebautii</i>	1952	bohai(1952,1962),East China sea(1959,1960,1961,1962,1972),Hongkong(2003)	Q+
<i>Trichodesmium erthraeum</i>	1972	East China sea(1972,1979),south China sea(1984),Hongkong(2003,2004,2007)	++
<i>Prorocentrum mininum</i>	1972	Bohai(1972),East China sea(fujian2006,2007),Hongkong(2000,2001 , 2002 , 2003,2004)	+
<i>Heterosigma akashiwo</i>	1980	Bohai(1985,1986,1987,2003),Yellow sea(2007), South China sea (1980,1997,1999,2001,2005,2007) ,Hongkong(2000,2001,2007)	+++
<i>Karenia mikimotoi</i>	1980	Hongkong(1980,1995),South China sea(1998),East China sea(2001~2007),Bohai(2004)	+
<i>Cocholodinium spp.</i>	1984	Quanzhou Bay,East China sea(1990),south China sea(1984),Hongkong(2002)	+
<i>Alexandrium spp.</i>	1988	Hongkong、 Changjiang estuary (2002 , 2004) ; South China sea	+
<i>Chattonella marina</i>	1991	South China sea (1991,2001,2003) Hongkong(2001,2003,2004), Yellow sea(1993,1995),Bohai(2002.2003)	+++
<i>Ps Pungens</i>		South China sea	+
<i>Karenia mikimotoi</i>	1995	Hongkong(1995),south China sea(1998)East China sea(2001~2007)	++++
<i>Phaeocystis globosa</i>	1997	East China sea(1997) South China sea(1998,2003),Bohai sea (2004) ,Hongkong(2002,2006,2008)	+
<i>Karenia digitata</i>	1998	South China sea, Hongkong(1998)	+
<i>Karenia longicanales</i>	1998	South China sea, Hongkong(1998)	+
<i>Chattonella globosa</i>	2001	Hongkong(2001)	+
<i>Chattonella ovata</i>	2001	Hongkong(2001)	+
<i>Heterocapsa circularisquama</i>	2002	Changjiang estuary(2003,2005),Hongkong (2002)	+

	1950s	1960s	1970s	1980s	1990s	2000s
<i>Trichodesmium thiebautii</i> 铁氏束毛藻						
<i>Trichodesmium erthraeum</i>						
<i>Prorocentrum mininum</i>						
<i>Heterosigma akashiwo</i>						
<i>Karenia mikimotoi</i>						

Trichodesmium thiebautii in 1950~70s, no bloom records then on *Heterosigma akashiwo*、*Karenia mikimotoi* \ *Cocholodinium* sp. Record bloom since 1980s
Alexandrium 、*Chattonella marina* record bloom since 1990
Chattonella ovata in 2000

<i>Phaeocystis globosa</i>
<i>Karenia digitata</i>
<i>Karenia longicanales</i>
<i>Chattonella globosa</i>

Blooms of *Karenia mikimotoi* in China



2004 Bohai: 5000 Km², no direct loss

2007, East China sea, 7 events, 平潭 RMB 5 million

2006, East China sea, 25 events,

2005, East China sea, 25 events, 7000 Km², RMB 19.7 million

2002 East China Sea : shrimp RMB 1.50 million

2003 East China Sea : fish RMB 6.8 million

2002 East China Sea : fish RMB 8 million

2001 East China Sea : caused albino and fish dead

1998 South China Sea : RMB 0.35 billion loss

1980 Hongkong: caused fish dead

1995 Hongkong: caused great loss

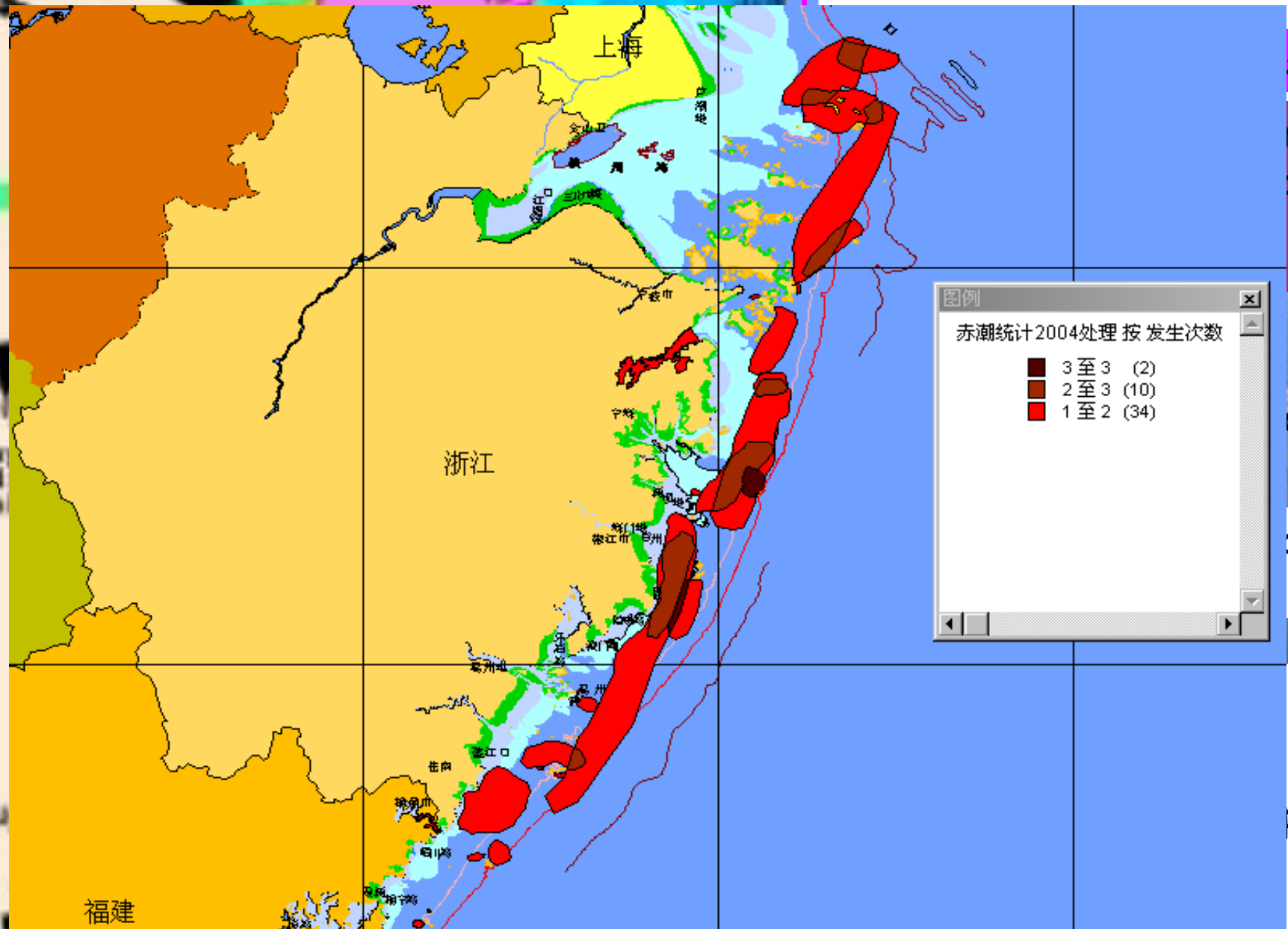
Blooms of *Prorocentrum dentatum*



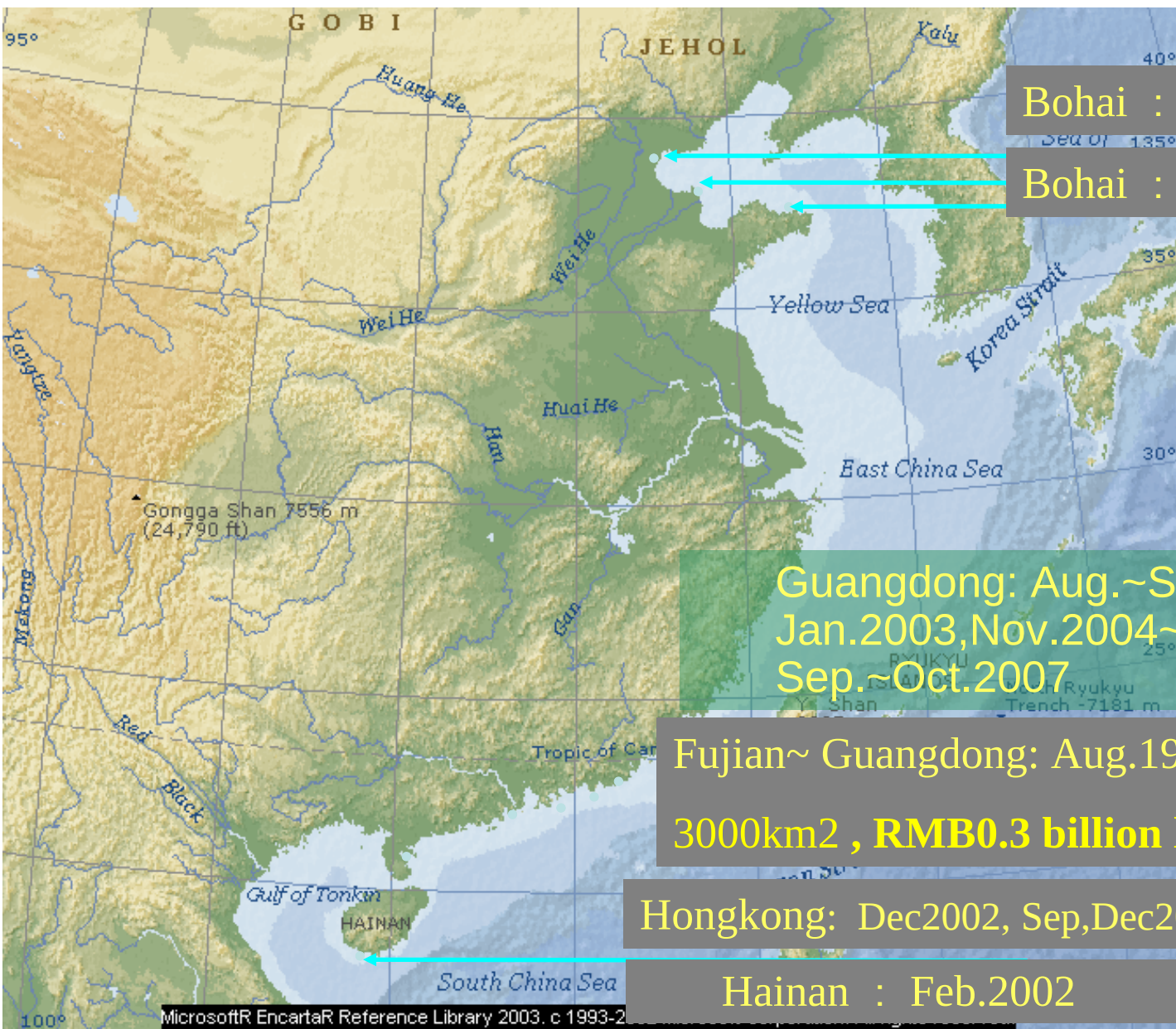
East China sea:

1996	1	events
1997	1	events
2000	2	events
2001	6	events
2002	8	events
2003	27	events
2004	23	events
2005	10	events
2006	43	events

Prorocentrum dentatum



Blooms of *Phaeocystis* reported in China



Bohai : 2004 June, 1850km²

Bohai : 2006 Sep.~Oct, 300km²

Guangdong: Aug.~Sep.1999,
Jan.2003,Nov.2004~Jan.2005,
Sep.~Oct.2007

Fujian~ Guangdong: Aug.1997~Feb. 1998
3000km² , **RMB0.3 billion loss**

Hongkong: Dec2002, Sep,Dec2005,Jan.Feb2006,Jan 2008

Hainan : Feb.2002

Blooms of *Heterosigma akashiwo* in China



- Blooms of *Heterosigma akashiwo* are not frequently recorded in China, first recorded in 1985 (Dalian, Bohai sea)

Dalian Bay : Jun~Aug in 1985,1986,1987,2003, lasting 7d days (YJ Guo1985 , HQ Wang 1989)

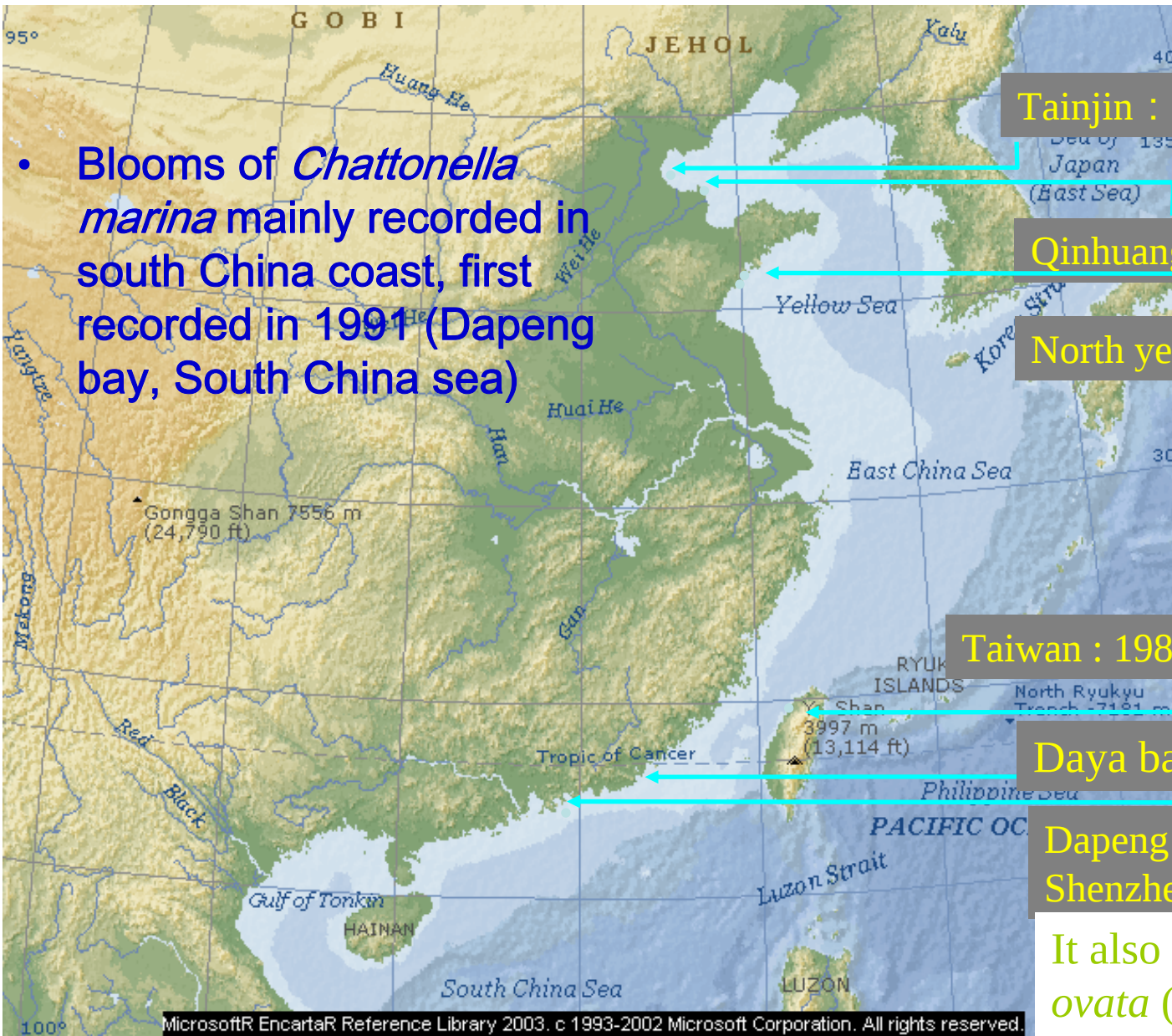
Haizhou Bay : May 2007, 14km²



Dapeng Bay : Apr 2001, lasting 6d days, 5km²

Tulu Harbor, Hongkong : 9 events during 1980-1997, Jul1999, Mar2001, Feb2005, Apr2005, May2005, Feb 2007

9 Blooms of *Chattonella marina*



Tainjin : 2003, 100km²

Qinhuangdao bay: Jul 2002

North yellow sea: Aug 1993, 1995

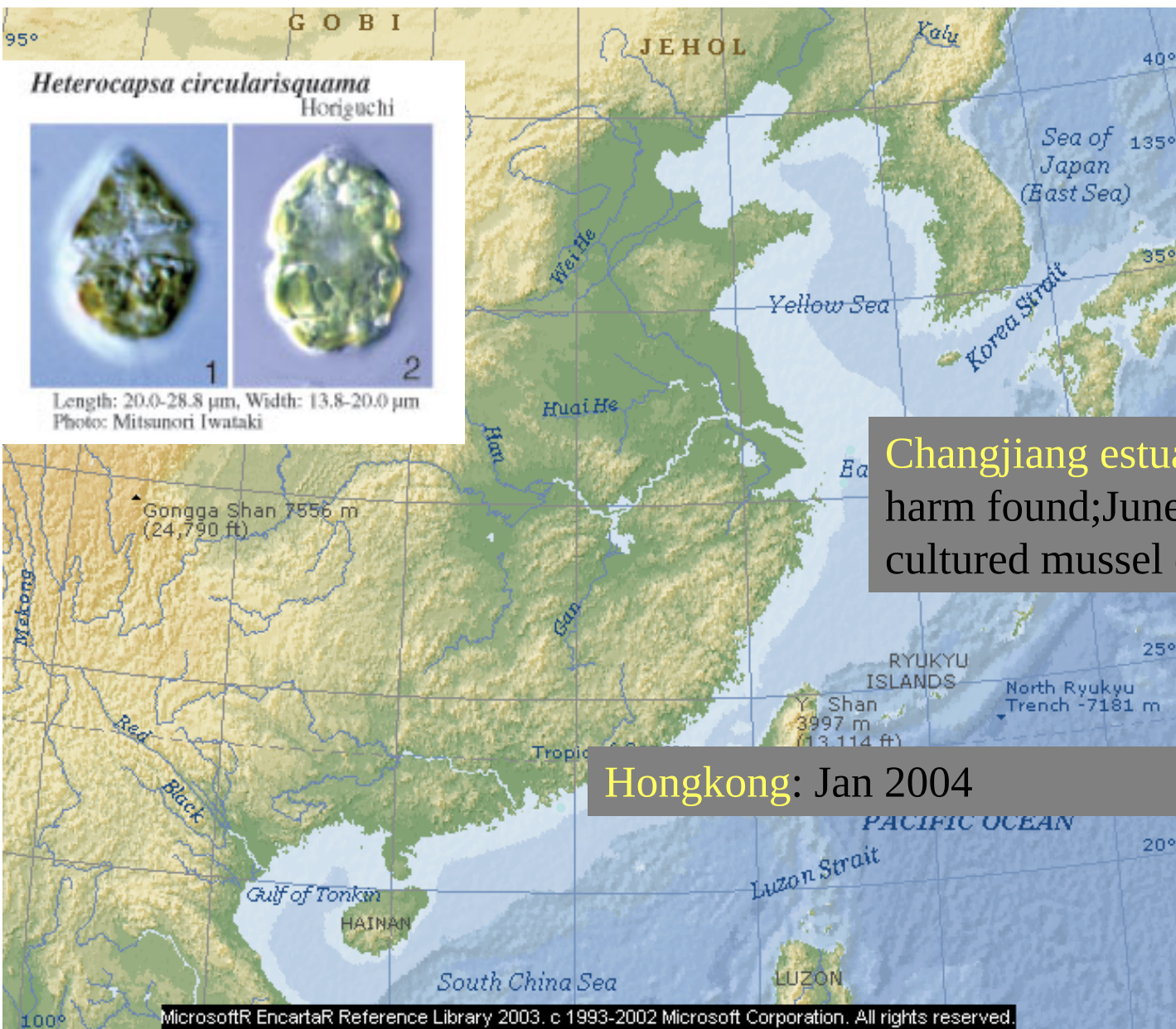
Taiwan : 1980s, cause loss 30% shrimp

Daya bay: Aug 2003, Oct 2005

Dapeng Bay : Mar 1991, Apr 2001
Shenzhen Beiguan: Apr 2001

It also reported as bloom of *C. ovata* (Lu and Hodgkiss, 2001)

Blooms of *Heterocapsa circularisquama* in China



Blooms of *Cocholodinium*



1990 East China sea 泉州湾 : lots field fish dead,
culture clam loss RMB 2 million

1991 South China sea 大鹏湾 : lots field fish dead,
culture clam loss RMB 2 million

Hongkong : Dec. 2002

Guangdong : Jan. 2003

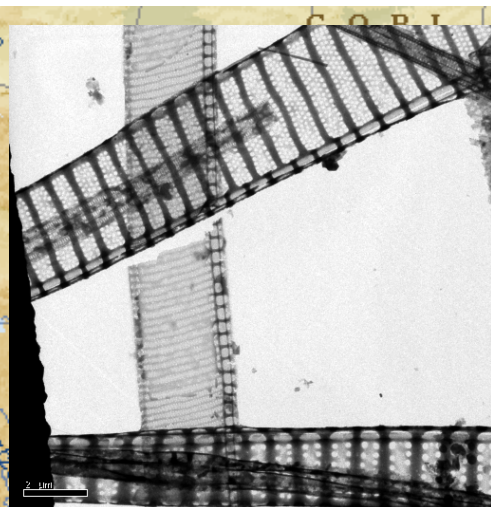
Guangdong: Nov. 2004~Jan. 2005

Guangdong: Sep.~Oct. 2007

Blooms of *Trichodesmium erthraeum*



Pseudo-nitzschia



Pseudo-nitzschia pungens
bloom only recorded in
South China sea

<i>Ps. delicatissima</i>	Changjiang Estuary 2002
<i>Ps. multiseriata</i>	Changjiang Estuary 2002
<i>Ps. multistriata</i>	Changjiang Estuary 2003
<i>Ps. subfraudulenta</i>	Changjiang Estuary 2002
<i>Ps. pseudodelitissima</i>	Changjiang Estuary 2002
<i>Ps. pungens</i>	all coast
<i>Ps. americana</i>	Xiamen,Hongkong2004
<i>Ps. brasiliiana</i>	Xiamen,Hongkong2004

<i>Ps. caciaantha</i>	Hongkong2004
<i>Ps. calliantha</i>	Hongkong2004
<i>Ps. cuspidata</i>	Hongkong2004,Daya bay2005
<i>Ps. heimii</i>	Hongkong2005
<i>Ps. linea</i>	Hongkong2004

Cite from: Liyang 2005

Potential alien algae in China

Species	vector	distribution	T/harm	bloom
Dinoflagellates				
<i>Cochlodinium polykrikoides</i>	--	SCS	T	N
<i>Peridinium perardiforme</i>	Ballast	All	PSP	N
<i>Prorocentrum micans</i>	Ballast/Current	B\ECS\SCS		Y
<i>Dinophysis caudata</i>	Ballast	SCS	DSP	13
<i>Prorocentrum lima</i>	Ballast/Current	TAIWAN/SCS	DSP	N
<i>Gymnodinium catenatum</i>	Ballast/Current	Estuary	PSP	N
<i>Alexandrium tamarense</i>	Ballast/Current	SCS/ECS	PSP	Y
<i>Alexandrium minutum</i>	Ballast/Current/ Float	集中在港口、河口 和泻湖	PSP	N
<i>Noctiluca scintillans</i>	--	All	H	Y
<i>Scrippsiella trochoidea</i>	Ballast	广泛分布于近岸和 河口	H	N

Potential alien algae in China

Species	vector	distribution	T/harm	bloom
硅藻 Diatom				
<i>Thalassiosira punctigera</i>	Ballast/Current	TAIWAN/ECS	H	N
<i>Rhizosolenia styliformis</i>	Ballast	ECS/JIAOZHOU RAY	H	Y
<i>Bacteriastrum comosum</i>	Ballast	SCS	H	N
<i>Chaetoceros concavicornis</i>	Ballast	SCS	H	N
<i>Pseudo-nitzschia delicatissima</i>	Ballast	CHANGJIANG/HO NGKONG	DA	Y
<i>Coscinodiscus wailesii</i>	Ballast/Sed	All	H	N
<i>Pinnularia viridis</i>	Ballast/Sed	ECS	H	N
<i>Cyclindrotheca closterium</i>	Ballast/Sed	ECS	H	N
<i>Biddulphia sinensis</i>	--	Y/ECS/SCS	H	N
<i>Skeletonema costatum</i>	--	沿岸广布种	N	Y
针胞藻 Raphidophyta				
<i>Heterosigma akashiwo</i>	--	世界近岸海域广布	H	N
蓝藻 Cyanophyceae				
<i>Trichodesmium erythraeum</i>	--	ECS SCS	H	Y

Alien species to invasive species?

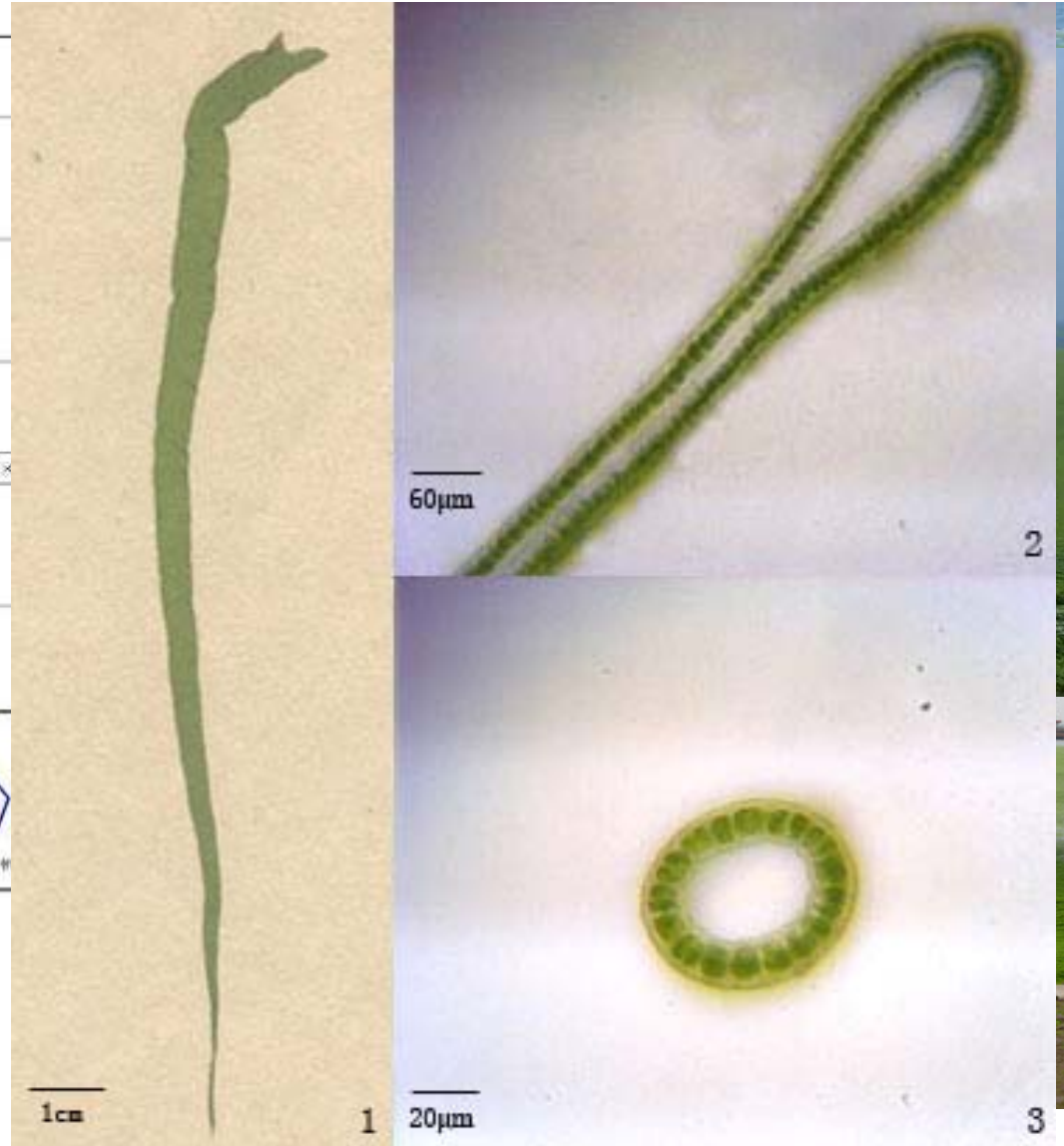
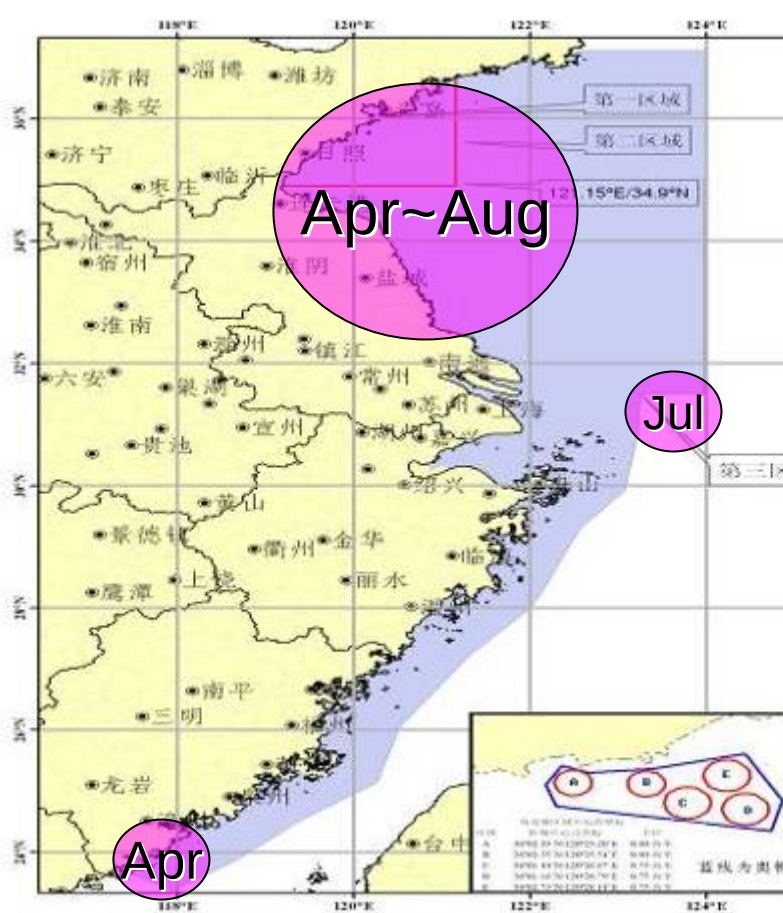
- The history of all above species in the China Sea is not long. The appearance of these Harmful *species* has become questionable whether they belong to exotic or indigenous species in the China waters. Because some are so small, fragile and difficult to preserve, they might be overlooked if cell density is low. On the other hand, *Prorocentrum dentatum*, *Alexandrium spp*, *Heterocapsa circularisquama* and *kerina mikimoto* were never found in such high cell concentrations and formed massive blooms in this area before mid 1990s. It seems that they have established their niche and potentiality of recurrence to form spring blooms in other part of China Sea.

Further work

- DNA Barcoding to ID organisms in ship's ballast water
- ID organisms 'hitchhiking' on ship's hull
- Harbour monitoring



Bloom of *Enteromorpha* sp

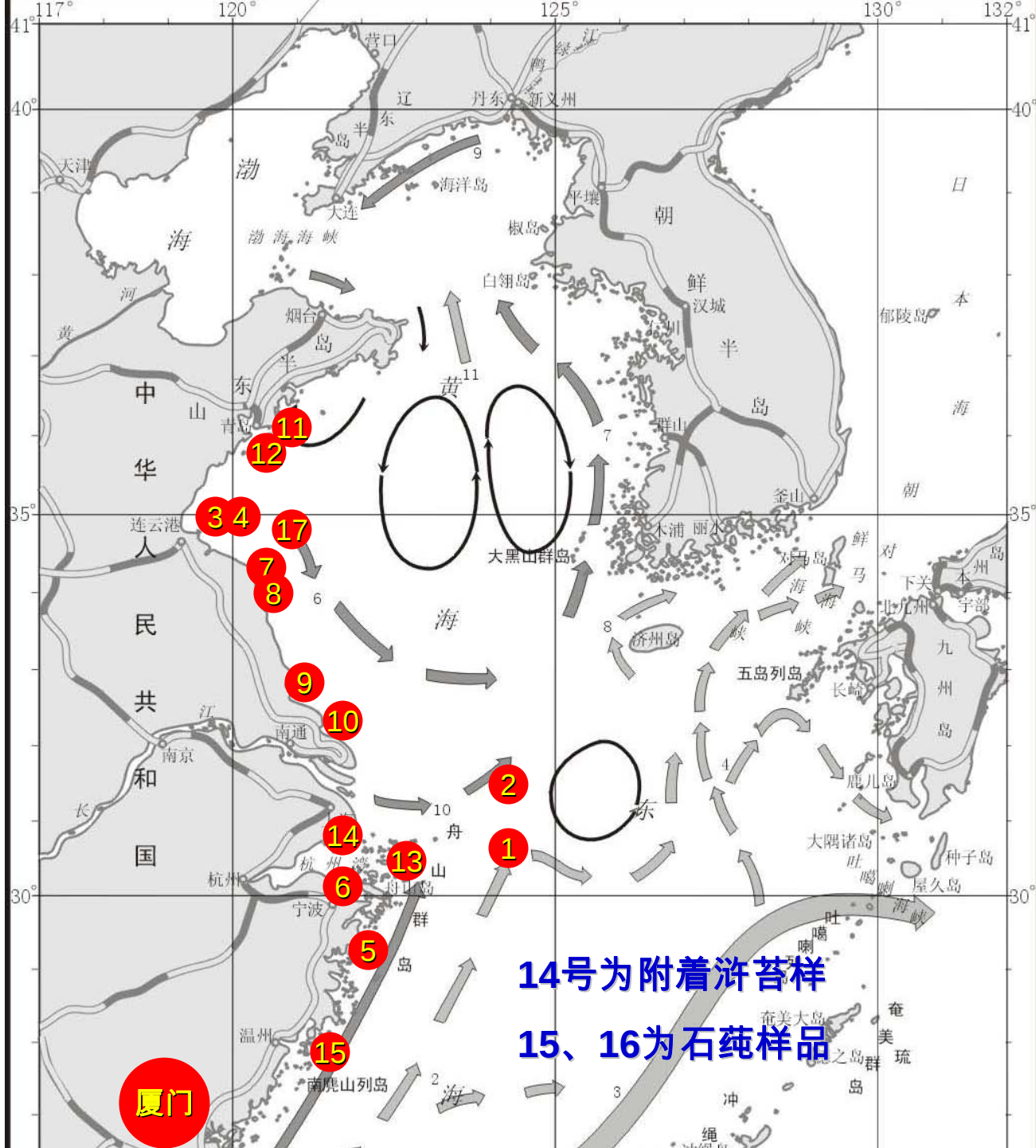




连云港海域采集的浒苔



南通海域采集的浒苔



- 1 sampling**
- 1 长江口1
 - 2 长江口2
 - 3 连云港1
 - 4 连云港2
 - 5 石 浦
 - 6 镇 海
 - 7 盐 城1
 - 8 盐 城2
 - 9 如东新港
 - 10 如东
 - 11 青岛1
 - 12 青岛2
 - 13 舟山朱家尖
 - 14 上海金山城市沙滩
 - 15 温州洞头
 - 16 厦门
 - 17 南黄海

14号为附着浒苔样
15、16为石莼样品

Phylogeography of *Enteromorpha*

- The primer pairs for ITS ,5S rDNA

利用藻类通用引物ITS1/ ITS2 , ITS3/ ITS4 , 5S-F/5S-R对提取的DNA进行ITS和5S扩增。引物序列为

ITS1 (5'-TTTGTACACACCGCCCG-3')

ITS2 (5'-GAATTCTGCAATTCACA-3')

ITS3 (5'-CTCTCAACAACGGATATCT-3')

ITS4 (5'-TCCTCCGCTTATTGATATGC-3')

5S-F (5'- GGTGGGGCAGGATTAGTA -3')

5S-R (5'- AGGCTTAAGTTGCGAGTT -3')

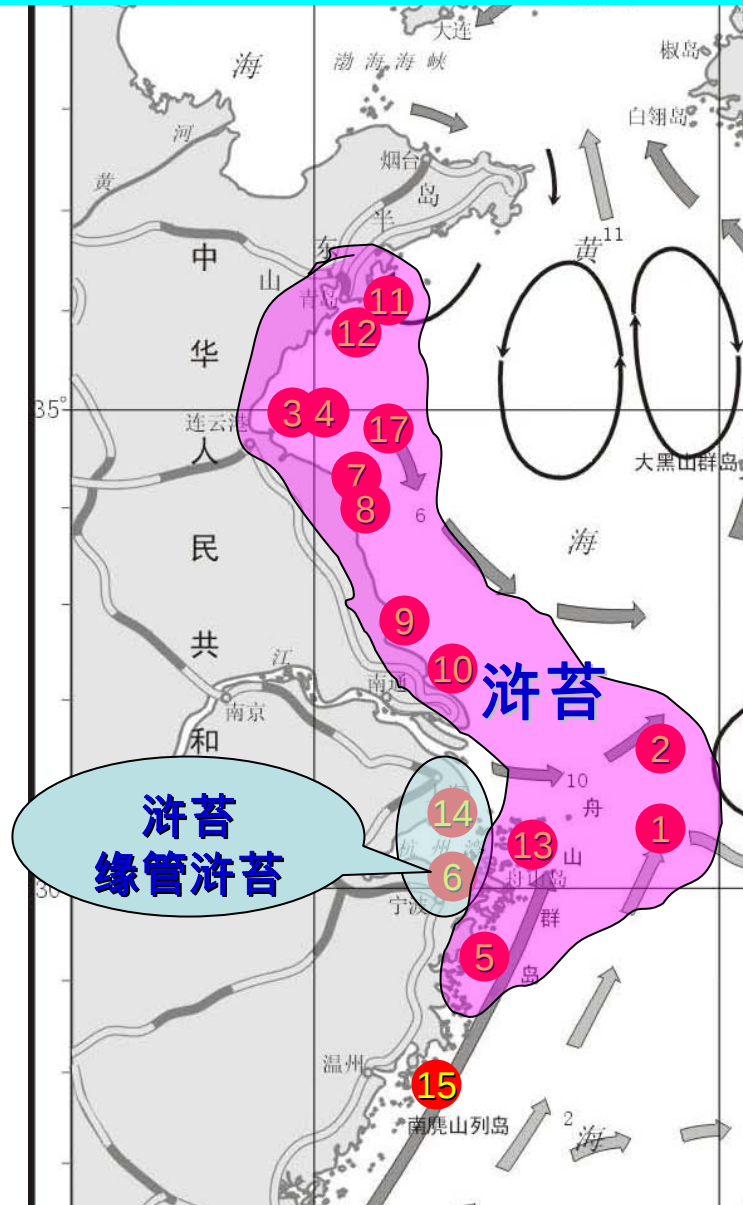
- PCR detection :

M13 (21) Forward Primer : 5'-CTG GTA TCG GAT CGG CTG-3'

M13 (-48) Reverse : 5'-AGC GGA TAA CAA TTT CAC AC-3'

浒苔ITS的PCR结果直接测序 ; 5S rDNA选出的培养好的封存平板进行测序。并应用生物学软件 BioEdit , ClustalX , Mega进行序列比较和分类鉴定

results-5S 序列的测序



- 对14个样品进行PCR并建克隆文库进行测序：
- 采自镇海样品的5S序列跟数据库的序列相比差别比较大，与其它样品序列也有很大差别，序列分析表明该样品为缘管浒苔 (*Ulva linza*) 和浒苔 (*Ulva prolifera*) 的混合样品。
- 除镇海样品外13个样品都有相同的group 1序列，序列分析表明这些样品均为浒苔 (*Ulva prolifera*)。



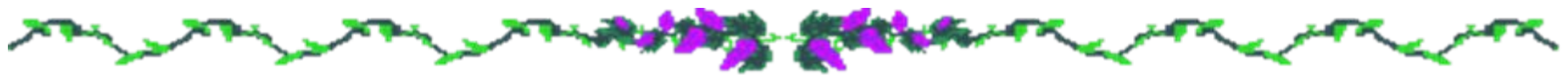
Acknowledgement

Science and Technology Commission of Shanghai Municipality”**Mechanism** of Harmful Algal Bloom in Changjiang estuary and the risk evaluation of Bloom caused by alien algae”(062358101)

Marine Science Fund for Young Scientists, “ HAB related alien algae identification and risks evaluation in Changjiang estuary” (2007129)

The Public Welfare Vocation Scientific Research Foundation of China (oceanography) (200805065)

National high-tech R&D program (863) “the research and development of real-time monitoring techniques and early warning system for harmful Algal bloom” (2007AA092001, 2007AA092003)



谢谢!