Dinophysis spp: The abundance, distribution and the toxicity of DSP in East China sea

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Outline

- The overview of *Dinophysis spp* in East China Sea
- The contamination of DSP in shellfish

According to simple morphological characters (such as size, shape, ± horns or spines, sulcal lists and supporting ribs,

presence/absence of chloroplasts), More than 200 species of *Dinophysis* (and *Phalacroma*) are differentiated ,









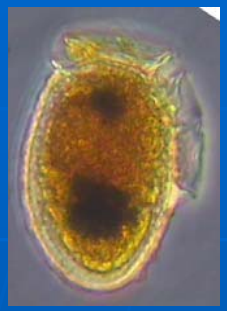


Only 11 species

of *Dinophysis* are toxic or suspected toxic, However, several of these species are common.

Not to scale; photographs by Y. Fukuyo and J. Larsen

The potentially toxic *Dinophysis spp*.in East China sea



Dinophysis acuminata

- widely distributed in temperate waters, found in all the coast of China
- potential producer of OA and DTX-toxins

Dinophysis caudata

- widely distributed in warm temperate – tropical waters, found in South China sea and East China Sea
- toxicity demonstrated in samples from the Philippines

Dinophysis fortii

- widely distributed in warm temperate and subtropical? Waters, found in Bohai and East China sea
- potential producer of OA and DTX-toxins, perhaps the most noxious of the toxic *Dinophysis*

Dinophysis rotundata

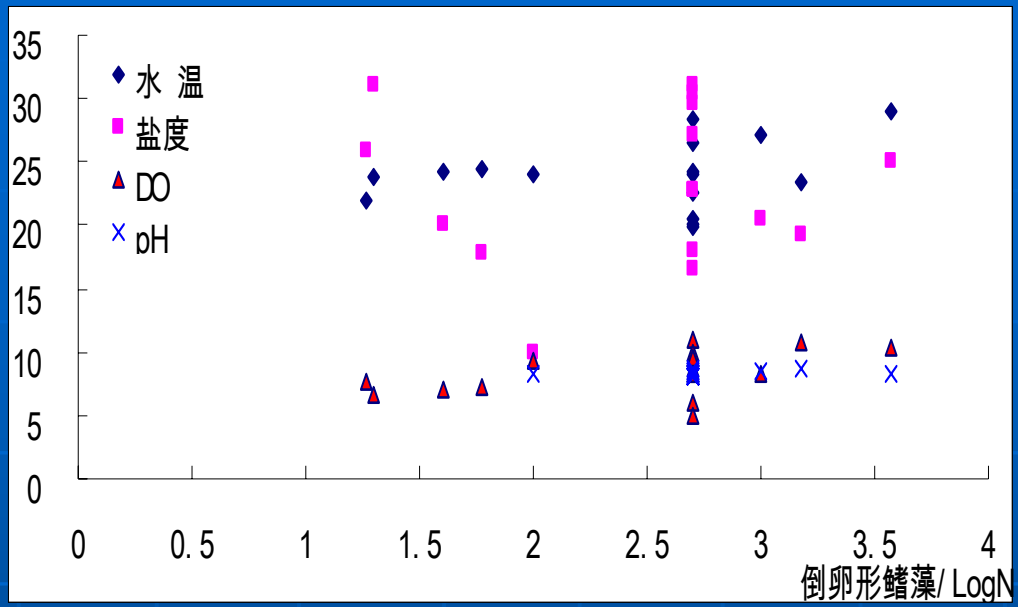
- widely distributed in cold and temperate waters, found in Changjiang estuary
- potential toxin producer

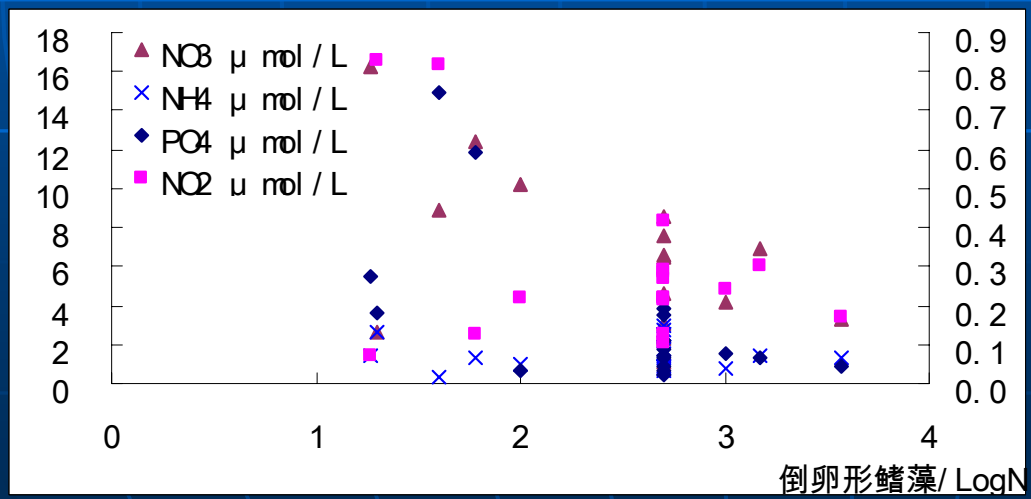
Photo by Jinhui Wang

The Dinophysis spp.in East China sea

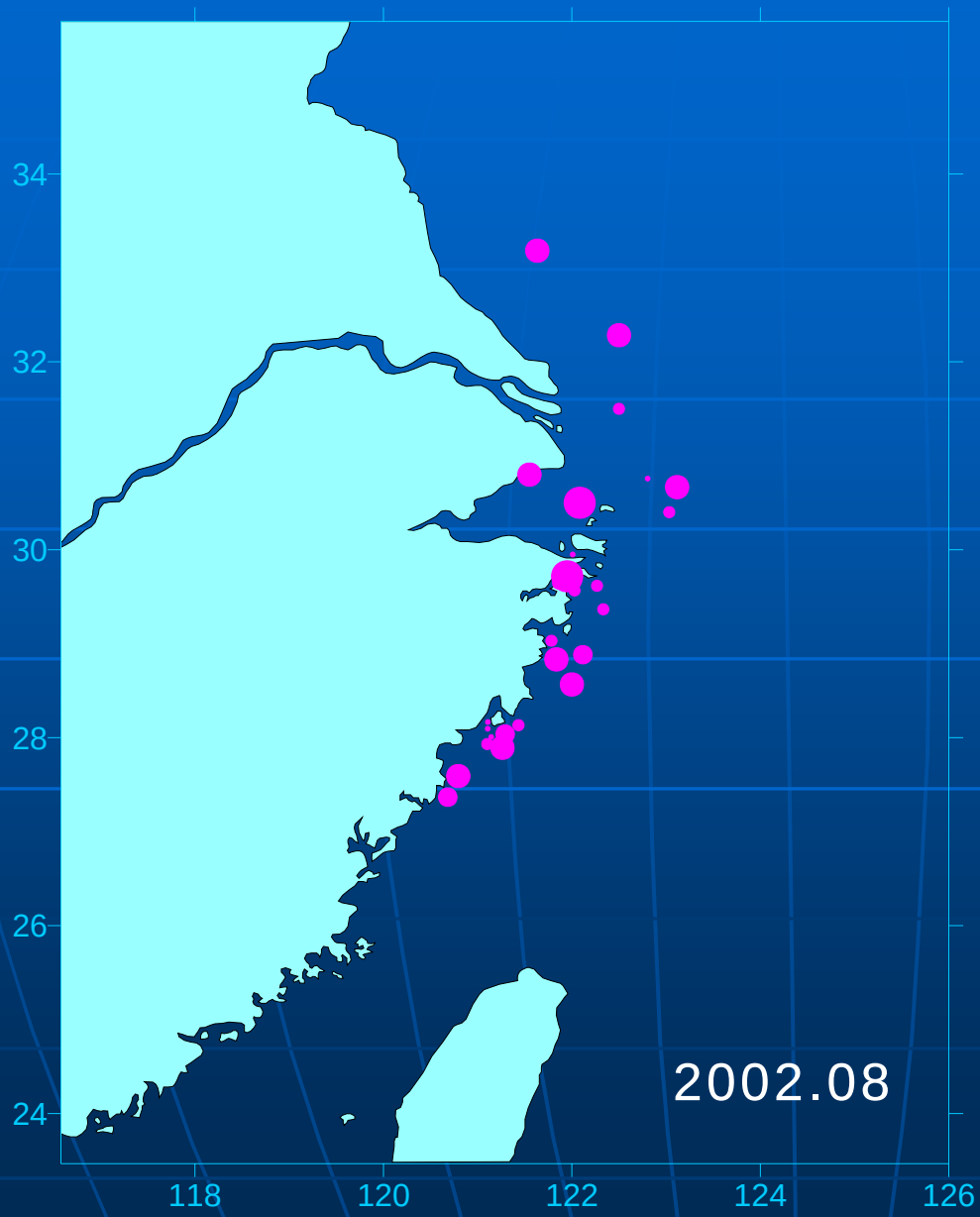
Sampling time	Phytoplankton species	Red tide caused species	Potentially toxic species	Potentially DSP caused species	Sampling time	Phytoplankton species	Red tide caused species	Potentially toxic species	Potentially DSP caused species
1997.11	85		3	*Dinophysis caudata* (20,11%)	2003.11	71	17	2	*Dinophysis caudata*
1998.05			6	*Dinophysis caudata* (5,1%)	2004.02	78	15	1	*Dinophysis caudata* (1000,2%)
				Dinophysis acuminata (2,1%)	2004.06	104	38	8	*Dinophysis caudata* (1000,7%)
				Dinophysis fortii (18,1%)					*Dinophysis fortii* (625,14%)
1999.08			2	*Dinophysis caudata* (8,20%)					*Dinophysis acuminata*
2000.05			3	*Dinophysis caudata* (40,16%)	2004.08	164	60	4	*Dinophysis caudata* (1200,2%)
2001.08			2	*Dinophysis caudata* (1600,14%)	2004.11	81	26	2	*Dinophysis caudata*
2002.08			3	*Dinophysis caudata* (24,21%)	2005.02	61	29	1	
2003.05	85	29	3	*Dinophysis caudata* (800,8%)	2005.05	94	35	5	
2003.06	102	40	8	*Dinophysis fortii* (500,3%)	2005.08	111	44	4	*Dinophysis fortii* (1160,13%)
				Dinophysis caudata (625,26%)					*Dinophysis caudata* (12000,38%)
2003.08	141	50	4	*Dinophysis fortii* (500,8%)	2005.11	77	34	3	*Dinophysis caudata* (800,5%)
				Dinophysis caudata (750,17%)	* refers to the Algae (the average abundance,unit:cell per litre; The occurrence frequency				

the *Dinophysis caudata* can be found in all season in East China sea, other species (D. fortii,D.acuminata,D.rotunda) only found in bloom season(May-August)





Algae	*Dinophysis fortii*		
Items	N	mean	Pearson Correlation
Temperature	17	23.89	0.481
Salinity	17	22.19	0.059
DO(mg/L)	17	8.29	0.436
pH	17	8.33	0.019
COD(mg/L)	17	1.06	0.219
PO4(μmol/L)	17	0.10	-0.352
NO2(μmol/L)	17	0.24	-0.228
NO3(μmol/L)	17	5.11	-0.330
NH4(μmol/L)	17	1.33	-0.079



The *Dinophysis spp* include *D. Caudata*,

D. Acuminata, *D. fortii*

The aboundance of total *Dinophysis spp* range from 100~70000 cell/L

DSP was detected in Mussel by MBA (Dai hong 2005)

The distribution comparison of *Dinophysis spp* in China Coast

Bohai	Yellow sea	East China Sea	South China sea
D. fortii,	*D. fortii,*	*D. caudata*	*D. caudata*
D. acuminata	*D. acuminata*	*D. fortii,*	*D. fortii,*
		D. acuminata	*D. acuminata*
		D. rotunda	*D. Mitra*
			D. miles

The HAB of *Dinophysis spp* in China

1998.09.22, the bloom of *Dinophysis fortii* (223 cell/L) and *Ceratium furca* (1250000 cell/L) in Bohai sea caused great loss, the affected area was near 3000km^2

During several HABs on 1997~1998 in South China sea, the *Dinophysis Caudata* was one of the dominant species.

45 days after bloom in Bohai sea, the shellfish in bloom area and nearby sea area was sampled for detection for OA(ug/g).

Time	sample	Gonade	tissue
11.07	Mussel	24.42	5.15
11.07	scallop	16.83	1.69
11.07	clam	8.64	0.42
11.07	clam	0.86	0.08

Cite from Liu Ning 1999

The OA in shellfish

Time	Location	shellfish	content ng/g	Detection rate	Reference
1995.06~08	Dalian	Mussel		77%	Wang J Y , 1996
1999.11	Shangdong Zhejiang	37sample	1.01~174.95	35%	YUAN Qi,2002
1999.01~02	Zhejiang	Clam, scallop,heptic moon shell	31.7 (15.75—218.95)	45%	YUAN Qi,2002
2001-2004	South China sea	Scallop mussel			WU Shi-wei 2005
2005	Protein Phosphatase Inhibition Assay	Mussel	1.21μg OA eq./kg		Ai-Feng Li 2006

1 of 27shellfish sample beyond the critical limit(200ng/g) .

The biotoxin contamination in shellfish

Consuming habit

- The output of shellfish in 2002 is about 1.132 million ton in China，the consuming shellfish in Shanghai is about 30,000ton which occupied 2.6% that in China.
- About 600,000 ton sea food is consumed in Shanghai every year in which shellfish occupied about 5%。
- About 99% of seafood is sold through wholesale market in Shanghai, very little shellfish will be transferred directly from producer to customer or restaurant.

More than 40 shellfish sold in Wholesale market

Scientific name	Name in Latin	Trivial name	Time occurred	Scientific name	Name in Latin	Trivial name	Time occurred
扁玉螺	*Polynices didyma*	heptic moon shell	Whole year	方斑东风螺	*Babylonia areolata*	Areola babylon	6
波纹巴非蛤	*Paphia undulata*	Venus clam	Whole year	瓜螺	*Cymbium melo*		6
大竹蛏	*Solen grandis*	Razor clam	Whole year	管角螺	*Hemifusus tuba*		6
菲律宾蛤仔	*Ruditapes philippinarum*	Venus clam	Whole year	泥东风螺	*Babylonia lutosa*	lutose babylon	6
翡翠贻贝	*Perna viridis*	Mussel	Whole year	西施舌	*Coelomactra antiquata*		6
海湾扇贝	*Argopectens irradias*	Scallop	Whole year	真曲巴非蛤	*Paphia euglypta*		6
江户布目蛤	*Protothaca jedoensis*	clam	Whole year	皱纹盘鲍	*Haliotis discus hannai*	Disk abalone	6
魁蚶	*Scapharca broughtonii*	Ark shell	Whole year	彩虹明樱蛤	*Moerella iridescens*		1~9
毛蚶	*Scapharca subcrenata*	Blood clam	Whole year	大沽全海笋	*Barnea fragilis*		10,11,12,1,2,3
牡蛎	*Ostrea rivularis*	Oyster	Whole year	紫石房蛤	*Saxidomrs purpuratus*		3,6,12
日本镜蛤	*Dosinia troscheli*		Whole year	青蛤	*Cyclina sinensis*		5~10
文蛤	*Meretrix meretrix*	Hard clam	Whole year	沙海螂	*Mya arenaria*		5~10,1
栉江珧	*Pinna pectinate*	Comb pen shell	Whole year	缢蛏	*Sinonovacula constricta*	Clam	5~11,1~2
皱红螺	*Rapana bezoar*	Periwinkle	Whole year	棕带仙女蛤	*Callista eucymata*		5~8
紫贻贝	*Mytilus edulis*	Mussel	Whole year	半扭蚶	*Trisidos semitorta*		5~9
等边浅蛤	*Gomphina veneriformis*		6~9	杂色蛤仔	*Venerupis variegata*		5~9
焦河篮蛤	*Potamocorbula ustulata*		6~9	总角截蛏	*Solecurtus divaricatus*		6~10,1~2
泥蚶	*Tegillarca granosa*	Ark shell	6~9	黄口荔枝螺	*Thais luteostoma*		6~8
四角蛤蜊	*Mactra quadrangularis*		6~9	泥螺	*Bullacta exarata*		6~8
紫贻贝	*Mytilus edulis*	Mussel	6~9	中国绿螂	*Glauconome chinensis*		6~8
橄榄血蛤	*Sanguinolaria olivacea*		6~9,3	小竹蛏	*Solen strictus*	jackknife clam	6~8,1
齿纹花生螺	*Pterygia crenulata*	crenulated miter					

According to biotoxin assay result of 421 shellfish sample(44 species) during 2002 and 2005.ASP was not detected in all sample, 19 species of shellfish such as *Cyclina sinensis*, *Meretrix meretrix*, *Protothaca jedoensis* and *Solen grandis* etc are free of biotoxin (PSP,DSP,ASP).

PSP was detected in 5 species of shellfish including Ark shell(*Scapharca broughtonii)*, Scallop(*Argopectens irradias)*, heptic moon shell(*Polynices didyma)*，*Gomphina veneriformis* and mussel(*Mytilus edulis*) with the detection rate of41.7%、35.6%、34.6%、12.5% and 5.7% separately, and toxicity of 195.4Mu/100g, 239.5 Mu/100g, 195.4 Mu/100g, 187.21 Mu/100G and 180.79 Mu/100g tissues, the concentrations of the PSP toxins of these shellfish ranged as 20.1μg/100g （4.4~42μg/100g）,25.5~78.5μg/100g and 38.3μg/100g （15.5~49.6μg/100g）separately, the main components were gonyautoxins 2/3 (GTX2/3) and gonyautoxins 1/4 (GTX1/4)

DSP was detected in 25 species of shellfish, the detection rate of 10 species of shellfish ranged from 8 to 26% , including Comb pen shell(*Pinna pectinate)*, Scallop(*Argopectens irradias)*, heptic moon shell(*Polynices didyma)*, mussel(*Mytilus edulis*, *Perna viridis*), Venus clam(*Paphia undulata*, *Ruditapes philippinarum*), Oyster(*Ostrea rivularis)*, Periwinkle(*Rapana bezoar*) and Blood clam(*Scapharca subcrenata*), the toxicity ranged from 5 to 10 Mu/100g, and half of the sample detected okadaic acid with the concentration ranged from 0.007 to 1.255μg/100g; The detection rate of 15 species of shellfish sell in holiday and harvesting period was higher than that sell in whole year, the former almost come from natural growth such as *Moerella iridescens*, *Solecurtus divaricatus*, *Trisidos semitorta*, crenulated miter(*Pterygia crenulata*) etc, and most of the latter come from aquaculture. The toxicity ranged from 5 to 15 Mu/100g with the concentration of okadaic acid ranged from 0.36 4.94μg/100g;

Table 2. DSP toxins in shellfish from Shanghai markets by MBA and HPLC

Shellfish	Sample amount	Species	Market name	MBA	HPLC (μg /100g)
		Babylonia areolata	Tongchuan	+	ND
Gastropod	3/9	*Ampullarum crossean*	Tongchuan	+	ND
		Babylonia lutosa	Tongchuan	+	ND
		Mactra veneriformis	Fuxi	+	ND
		Mevetrix meretrix	Henda	+	ND
		Tegillarca granosa	Shiliupu	+	49.35
		Sanguinolaria olivacea	Fuxi	+	ND
		Paphia euglypta	Tongchuan	+	15.01
Clam	11/22	*Paphia undulata*	Shiiupu	+	12.55
		Mevetrix meretrix	Shiliupu	+	ND
		Gomphina veneriformis	Shiliupu	+	ND
		Cyclina sinensis	Henda	+	ND
		Paphia undulata	Henda	+	ND
		Gomphina veneriformis	Henda	+	18.19
Mussel	2/4	*Mytilus edulis*	Henda	+	ND
		Pinna pectinata	Henda	+	ND
Oyster	1/2	*Crassostrea rivuldri*	Shiliupu	+	0.07
		Solecurlus divaricatus	Henda	+	13.89
Razor clam	3/5	*Solenidae minima*	Tongchuan	+	ND
		Sinonovacula constricta	Henda	+	ND
Scallop	1/1	*Argopecten irradians*	Henda	+	ND

ND: beyond the detection limit

Among 44 samples in June 2005, 21 sample were positive by Mouse bioassay, but only 8 samples were positive by HPLC

TTX but no OA was detected in heptic moon shell

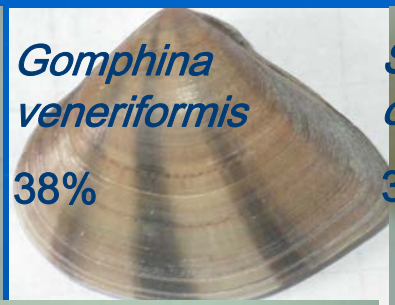
HPLC		LC-MS		
OA	DTX1	OA	DTX1	PTX2
12. 55	—	14.5	—	—

Cite from Wang JH 2006

The Shellfish Susceptible to DSP in China


Paphia euglypta
Detection rate
50%


Ark shell
Tegillarca granosa
Detection rate
50%


Gomphina veneriformis
38%


Sanguinolaria olivacea
33%

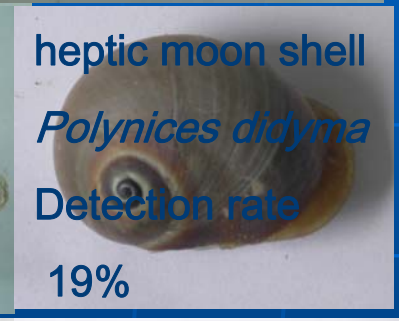

Blood clam
Scapharca subcrenata
31%


Mussel
Mytilus edulis
26%


Venus clam
Paphia undulata
25%


Periwinkle
Rapana bezoar
20%


Trisidos semitorta
20%


heptic moon shell
Polynices didyma
Detection rate
19%

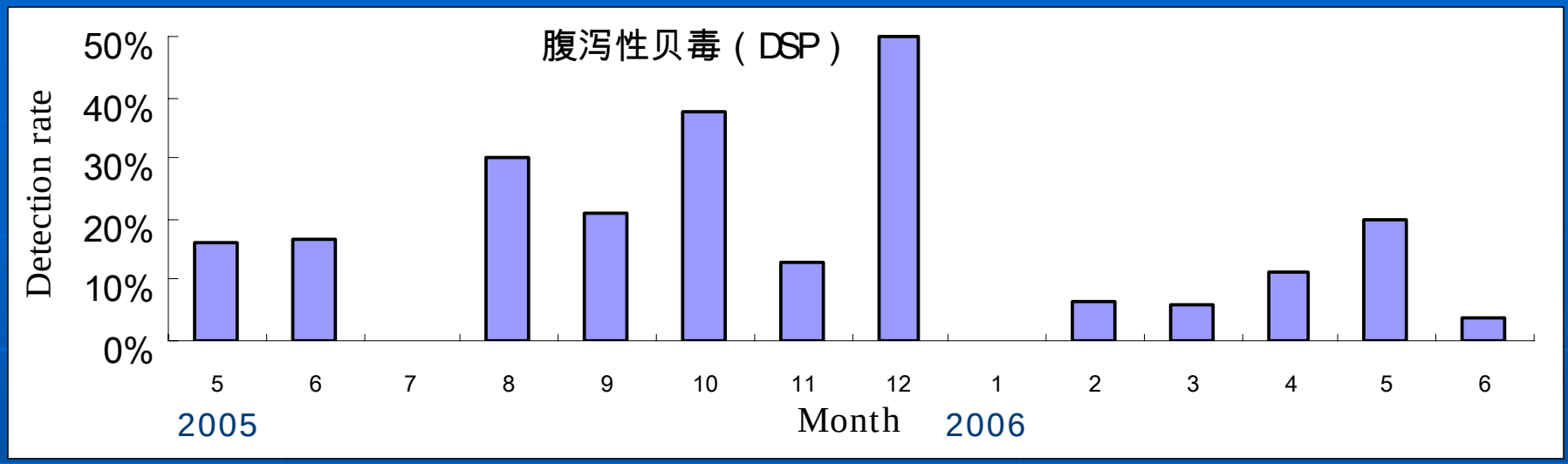

Mactra quadrangularis
20%


Oyster
Ostrea rivularis
17%


Venus clam
Ruditapes philippinarum
14%


Moerella iridescens
12%


Comb pen shell
Pinna pectinate
12%


腹泻性贝毒（DSP）
Detection rate
50%
40%
30%
20%
10%
0%
5
6
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10
11
12
1
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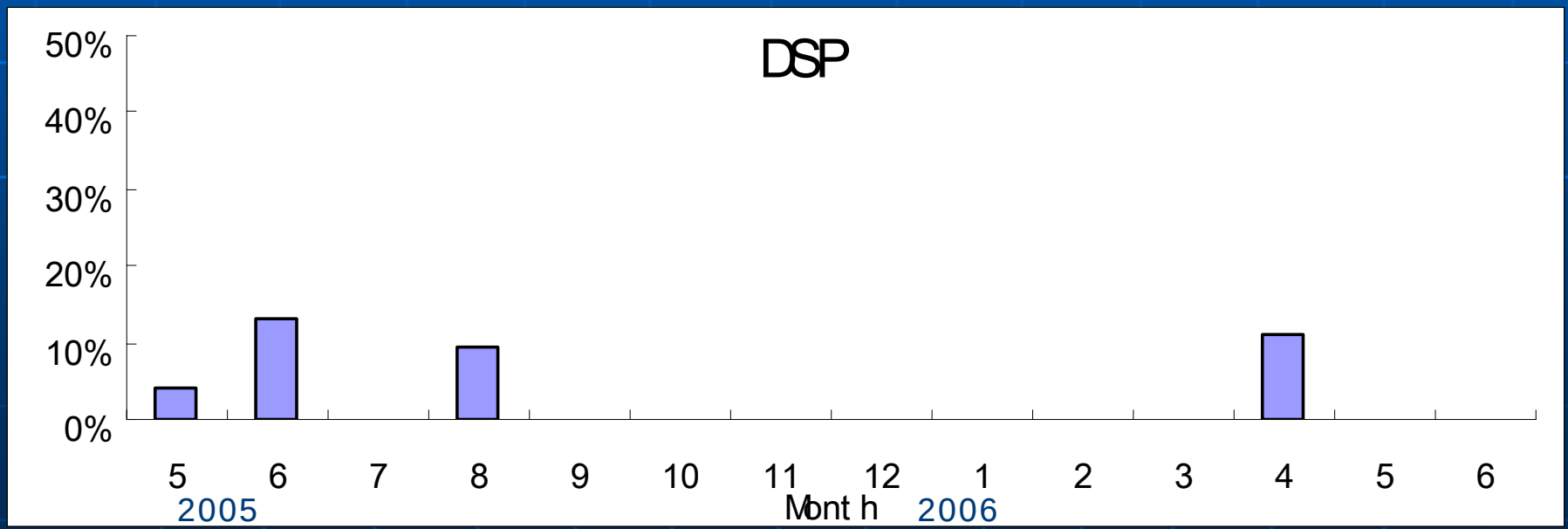
4
5
6
2005
Month
2006


DSP
50%
40%
30%
20%
10%
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6
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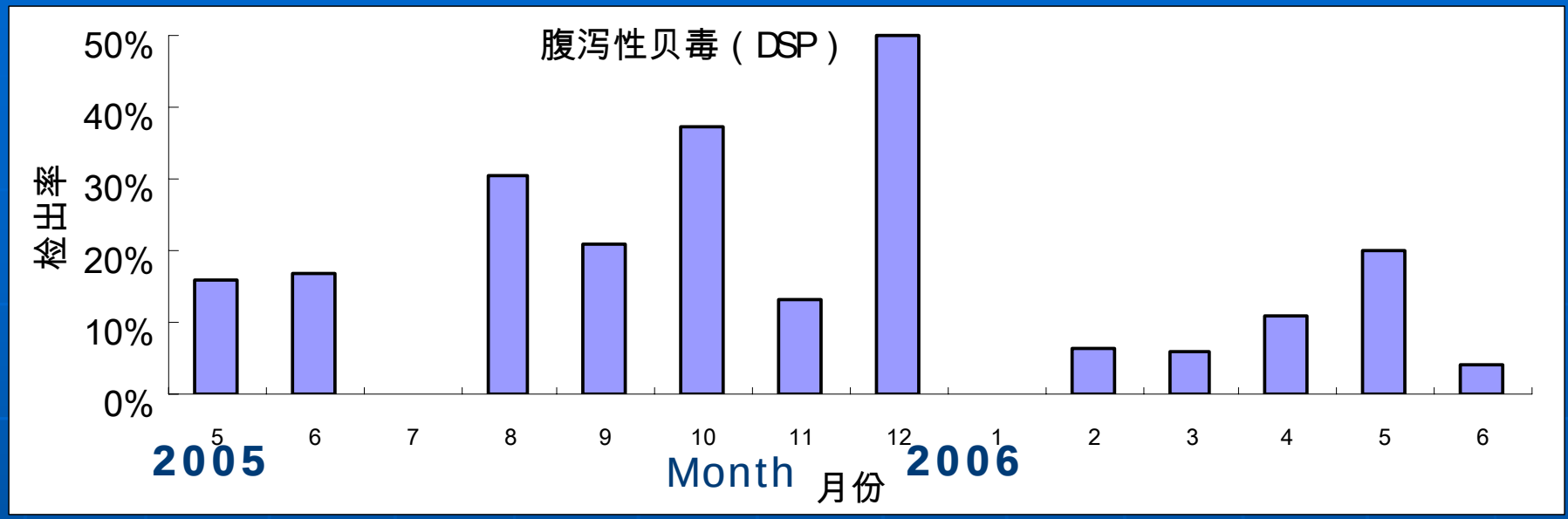
2005
Mont h
2006



Monthly detection rate of DSP in some susceptible shellfish

Shellfish	1	2	3	4	5	6	7	8	9	10	11	12
Polynices didyma	0	0	0	0	0.25	0.14	0.25	0.29	0.13	0	0	0
Mytilus edulis	0	0	0	1	0.2	0.33	0.14	0.43	0	0.25	—	0
Argopectens irradias	0	0	0	0	0.18	0.14	0	0.18	0	0	1	1
Scapharca subcrenata	—	0	0	0	0.33	0	0	0.33	1	1	0	—
Ruditapes philippinarum	—	0	0	0	0.29	0.13	0	0.14	0	0.33	—	—
Ostrea rivularis	0	0	0	0	0	0.4	0	0.25	0	1	0	0
Scapharca broughtonii	0	—	0	0	0	1	—	0.33	0	—	—	1
Perna viridis	0	0	0	0	0	0.4	0	0.17	—	1	0	1

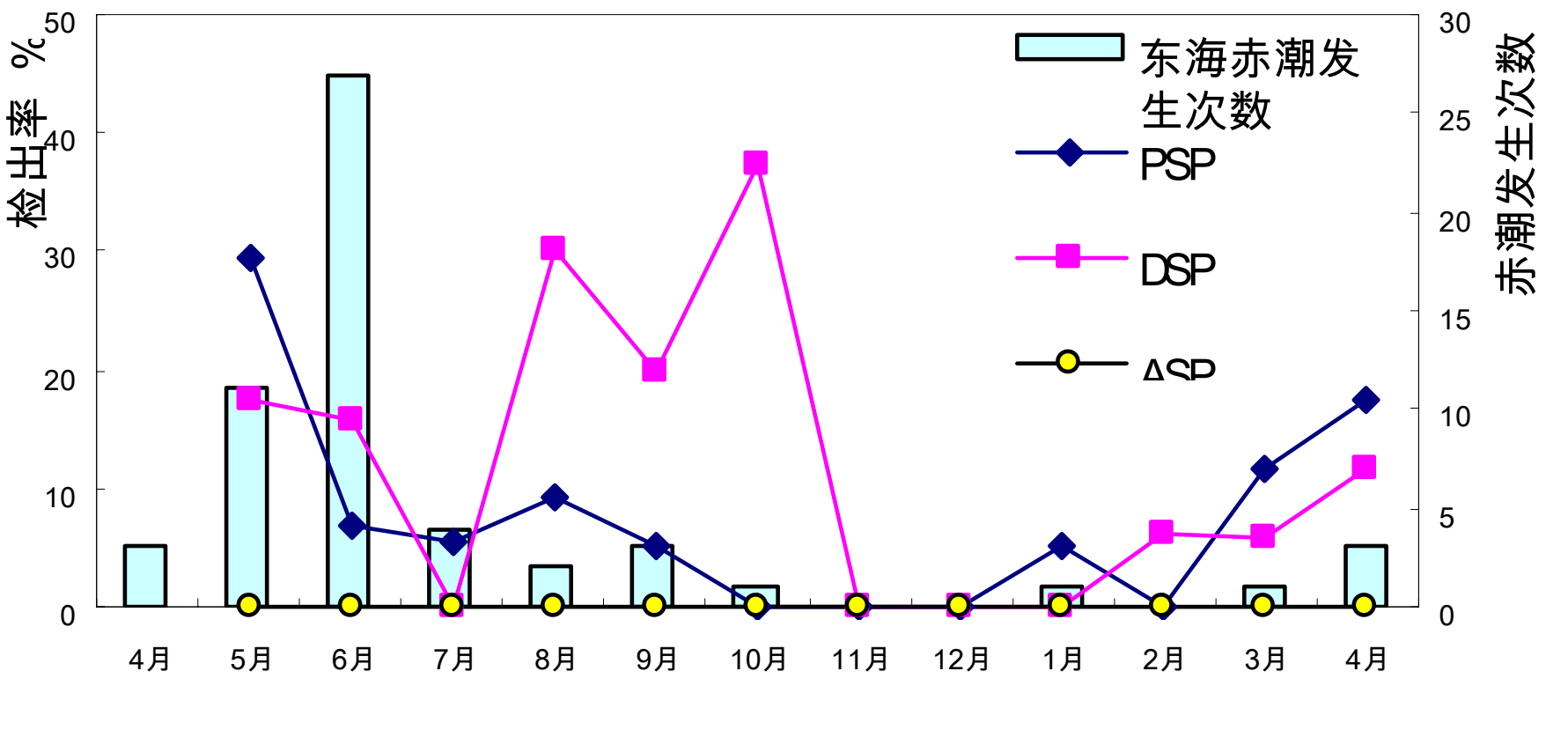
Sample from Shanghai

Year	Number of sample	Detection rate		Sensitive season	Sensitive species
		DSP			
2002	31	10%	9%	5~8月	heptic moon shell、 Periwinkle 、scallop 、 snail(Thais luteostoma
2003	26	20%	30%	5~10月	scallop 、 heptic moon shell、Periwinkle、 mussel
2004	90	10%	9%	5~9月	scallop、 heptic moon shell 、mussel
2005	177	26%	8%	5~9月	mussel、 heptic moon shell 、scallop 、 Blood clam

Sample from east China Sea

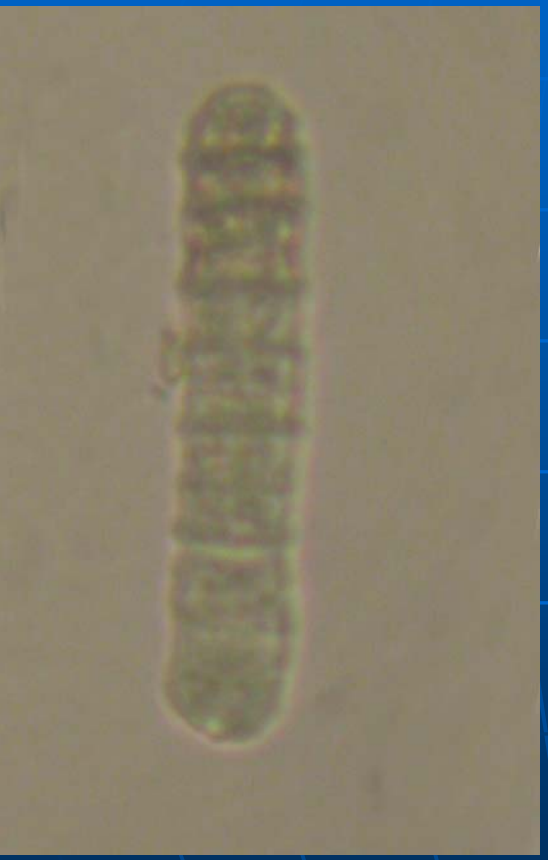
year	Number of sample	Detection rate		Sensitive season	Sensitive species
		DSP	PSP		
1998	53		6%		heptic moon shell 、 mussel
2001	23		0%		
2002	27	11%	4%	8	3 mussel
2003	44	9%	0	5~8	3 mussel
2004	65	3%	3%	5~8	mussel、 heptic moon shell 、 Blood clam
2005	52	19%	0	5~8	mussel 、 snail(Thais luteostoma)、 Periwinkle 、 scallop、 albone

The correlation of HAB occurance and biotoxin detection rate in shellfish



Up to now, no DSP intoxication were recorded, but it may be really not a contentious fact due to lack of clinical Knowledge and the light intoxication characteristic .

Cochlodinium spp in China

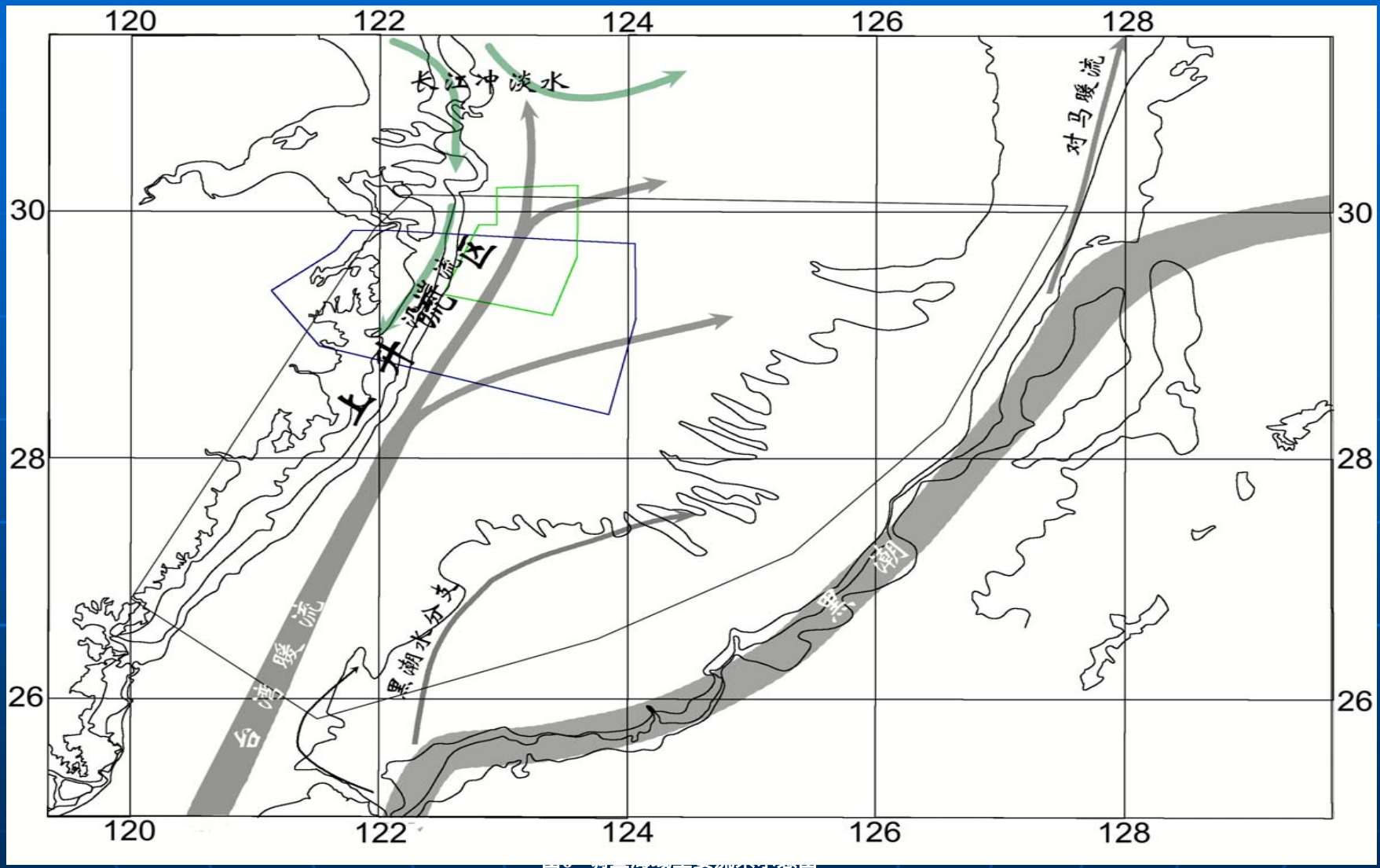


Cochlodinium polykrikoides **was found in East China Sea, but with low abundance**

It was also found in South China sea(during the bloom of Karenia mikimotoi, ***Cochlodinium polykrikoides*** **was recorded in Zhujiang estuary in April 1998)**

In 1990, Toxic dinoflagellate red tide by a ***Cochlodinium sp*****. along the coast of Fujian, China** / Qi, Du (Fujian Fish. Res. Inst., 7 Haishan Rd., Xiamen 361012), Huang, Yijian, Wang, Xiaofeng // ProcC-PHYTOPLANKTON BLOOMS IN THE SEA. Smayda, T.J.; Shimizu, Y. eds. AMSTERDAM NETHERLANDS ELSEVIER 1993. -1993. 3-235～238

The HAB of *Cochlodinium sp* on 1990 caused a direct economic loss of RMB 2 million in which both field fish and cultured fish suffered.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长江冲淡水
对马暖流
上升流区
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http://www.dhjczx.org/chichao/chichao.asp