PICES 2018 annual meeting

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Research on high risk species of bio-blockage on Nuclear Power Cold Source Water

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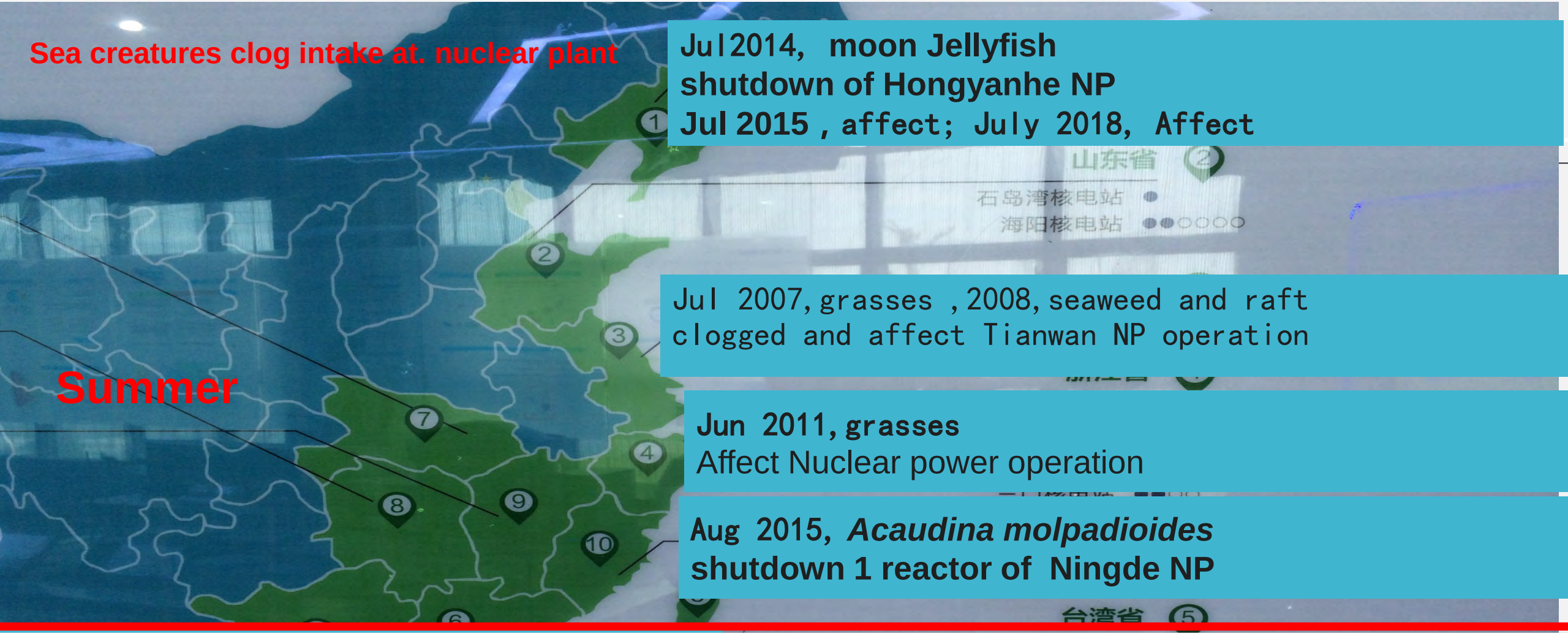
Outline

1. Background
2. Biological feature of caused species
3. High Risk species screen
4. Cause reason analysis
5. results

1Background

According to INPO, 61 clogging events caused NP unit power down or shutdown during 2004-2008, more than 20% of the them directly affect the safety of NP.

Frequent NP clogging events occurred in China recently mainly caused by marine organisms including Microalgae (***Phaeocystis globosa***),Macro-Algae(***Enteromorpha sp, Sargassum***) , Jellyfish (***Aurelia aurita***), sea potato(***Acaudina molpadioides)***, Shrimp, Fish and Laver culture items.

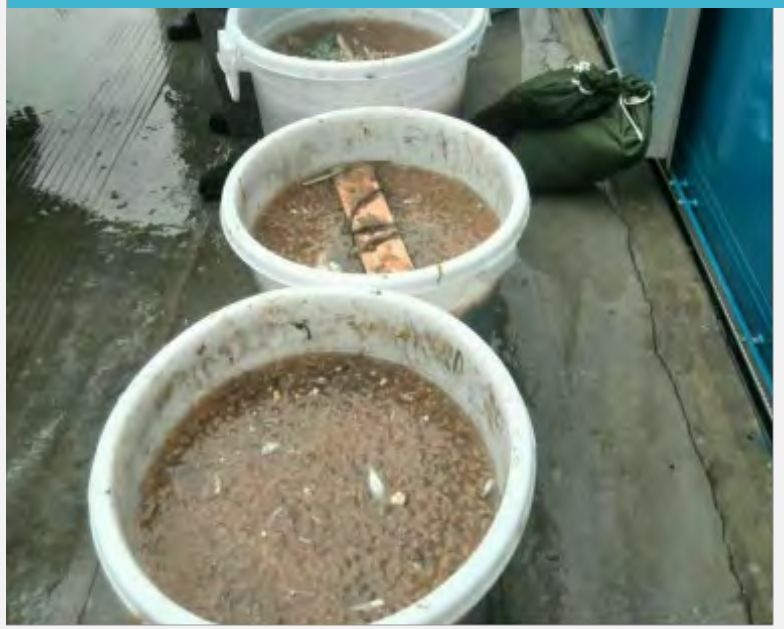

Sea creatures clog intake at. nuclear plant
Jul2014, moon Jellyfish
shutdown of Hongyanhe NP
Jul 2015 , affect; July 2018, Affect
山东省
石岛湾核电站
海阳核电站
Jul 2007, grasses , 2008, seaweed and raft
clogged and affect Tianwan NP operation
Summer
Jun 2011, grasses
Affect Nuclear power operation
Aug 2015, Acaudina molpadioides
shutdown 1 reactor of Ningde NP
台湾省
Dec2014, Phaeocystis globosa
Affect NP operation in Fangchenggang NP
Jan 2015, shrimp
Affect NP operation in Lingao NP
岭澳核电站二期
Winter
marine Macro-Algae
Affect Nuclear power operation in changjiang NP
Jan 2016, shrimp
shutdown of NP plant in lingao NP

NP incidents caused marine organism

Year	Location	Caused Sp	Incidents / Affection
2005	Swedish Oskar NP	Jellyfish	The first reactor temporarily shut down.
2009	French Aerdaishishengke NP	Canadian Ilya	The pump station filtration system blocked.
2010.01	USA Salem NP	Seaweed、Macro-algae	Reactor power down operation
2011.06	Japan Shimane NP	Jellyfish	Reduced power generation
2011.06	Tonis NP ,East Coast of Scotland	Jellyfish	The reactor shut down
2011.07	Aoluote·labin NP ,Hadera, Israel	Jellyfish like organism	NP shut down
2012	Debelo Canyon NP, California,USA	Jellyfish	NP shut down
2013	Swedish Oskar NP	Jellyfish	The reactor shut down.
2013	British Itonis NP	Macro-algae	The reactor shut down
2015	Leningrad NP, St. Petersburg,Russia	Macro-algae	The reactor shut down

Sea potato (*Acaudina molpadioides*) force shutdown of Nuclear Power plant

2015 .08 .08 01:49 ，1 reactors at nuclear power station had been shut down after huge numbers of **Sea potato** were found in sea water clogging the cold source water.



1. questions and research design

source, origin from local or other area?

factors important for bloom/outbreak?

ocean condition cause float and aggregation?

measures for control and prevention?

how forecast and early warning?

Other potential caused species?

2.1Caused sp— *Acaudina molpadioides*

Taxonomic position

Kingdom: Animalia

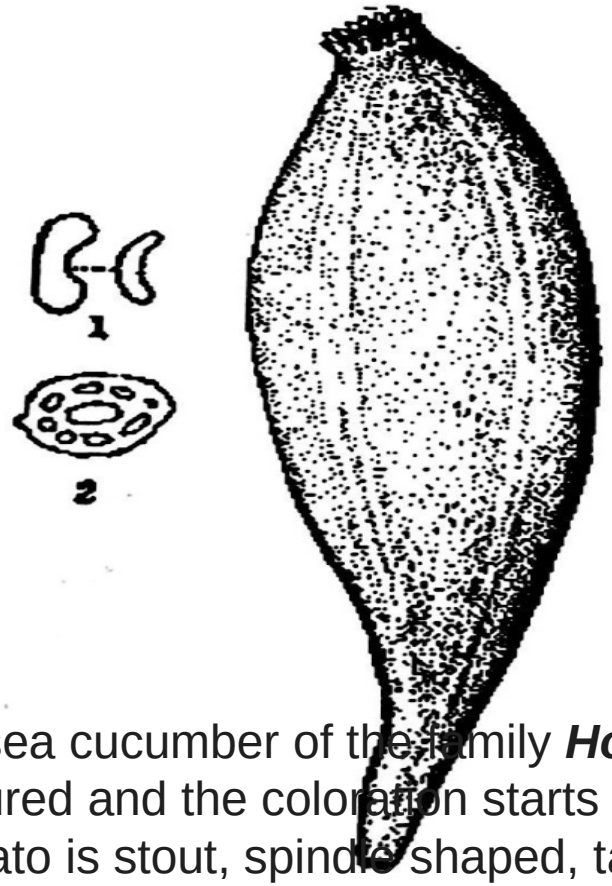
Phylum: Echindoermata

Order: Holothuroidea

Family: Caudinidae

Genus: ***Acaudina***

Species: ***molpadioides***



Many dumb bell (1) in skin and a few irregular madreporite (2)

Acaudina molpadioides (Sea potato) , is a species of sea cucumber of the family ***Holothuroidea*** under Phylum ***Echinodermata***. Its body is consistently flesh coloured and the coloration starts to fade if the animal stays out of water for a long periods. The body of a sea potato is stout, spindle shaped, tapering at the posterior end, making it a distinct species among other sea cucumbers. An additional feature is the presence of 15 tentacles on its body. The body wall of sea potato is smooth and opaque while juveniles have transparent body walls. Tube feet are absent. This is a characteristic feature for this species because to grab onto food, a mucus secretion is released by the sea cucumbers to stick sand particles or other debris on its body with the help of tube feet that sends the collected substances to its mouth.

2.1Caused species--------- Sea potato *Acaudina molpadioides*

Acaudina molpadioides(海地瓜)	
Distribution	South eat coast of China (Fujian ,Guangdong , zhejiang Province) ,shallow sea of Bengal, Australia, Japan, Philippine and Indonesia etc。
size	Max 20cm，generally 3.8cm-11.5cm，Diameter of horizontal section 1.2-4.2cm。
Body wall	Thin and a bit transparent, part of longitudinal muscle band and viscus can be seen from outside)
External features	15 tentacle without bifurcation，2 small pimple in each tentacle. 5 group of miliary tubercle around anus, each group include 4-6 miliary tubercle 。
Internal structure	1 Polian vesicle and 1madreporic canal.strong respiratory trees，a small elongation in each radial piece back-end of calcareous ring.
	Juvenile is white and semi-transparent, the adult is brown with many tiny brown spot. Geriatric individual is mulberry. Inhabit under muddy sediment in 4-15m depth, few in silt 。

2.1 Ecological characteristic- Sea potato

Sea potatoes live in slightly less saline waters occurring in reef, estuarine and muddy areas.

Their mainly distribute in sediment of coast about 20 – 50 meters depths.

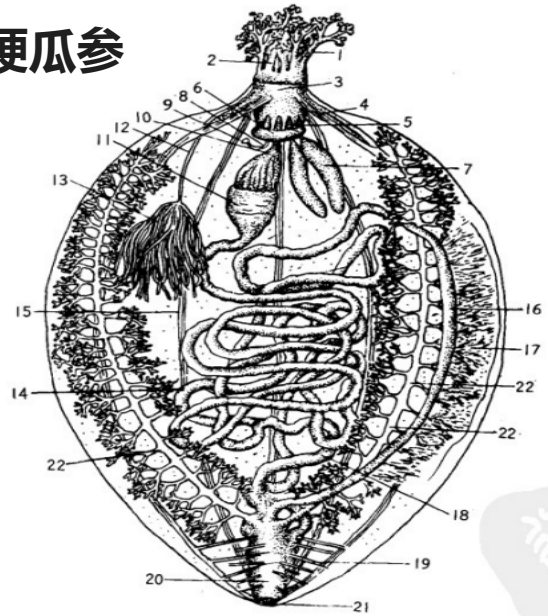
They feed on detritus and other decomposing matter, leaving a bead-like faecal pellet trail behind

The major ecological role they play is cleaning up the sea bed by moving, consuming and mixing marine sediments like earthworms.

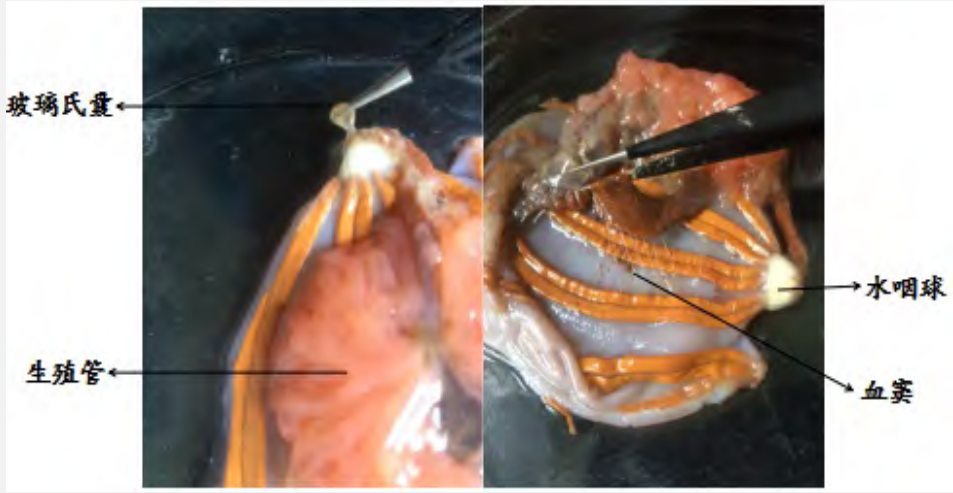
This species occurs in huge quantities as trawl by catch but are commercially less important.

Physiological character

强硬瓜参



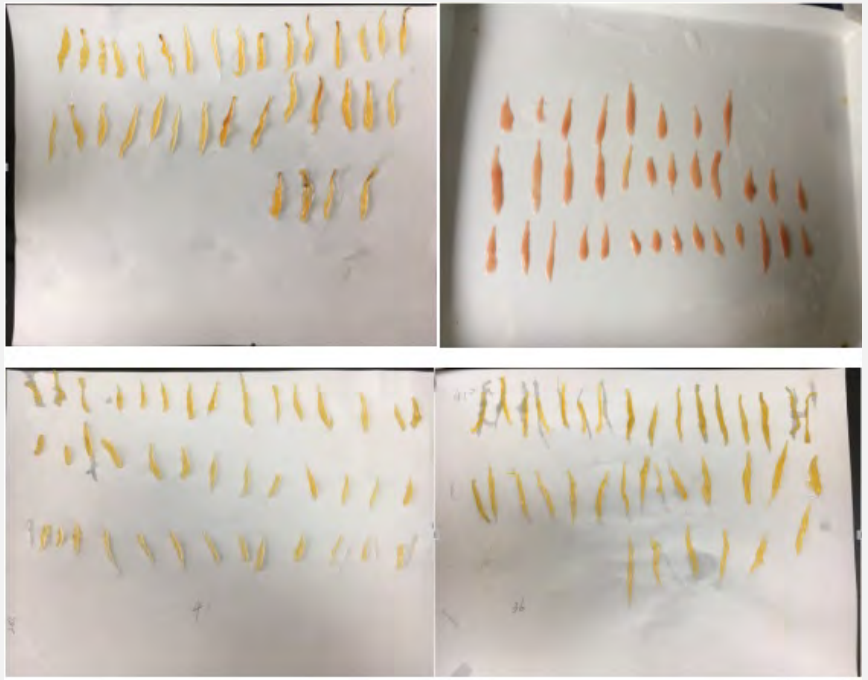
1. 触手 2. 腹面一对小触手 3. 水咽球 4. 收缩肌 5. 石灰环辐板后延部 6. 环水管 7. 玻璃氏囊 8. 石管 9. 筛板 10. 食道 11. 胃 12. 生殖管 13. 生殖腺 14. 下降小肠 15. 纵肌带 16. 大肠 17. 肠系膜 18. 上升小肠 19. 泄殖腔悬肌 20. 泄殖腔 21. 肛门 22. 呼吸树



Internal structure

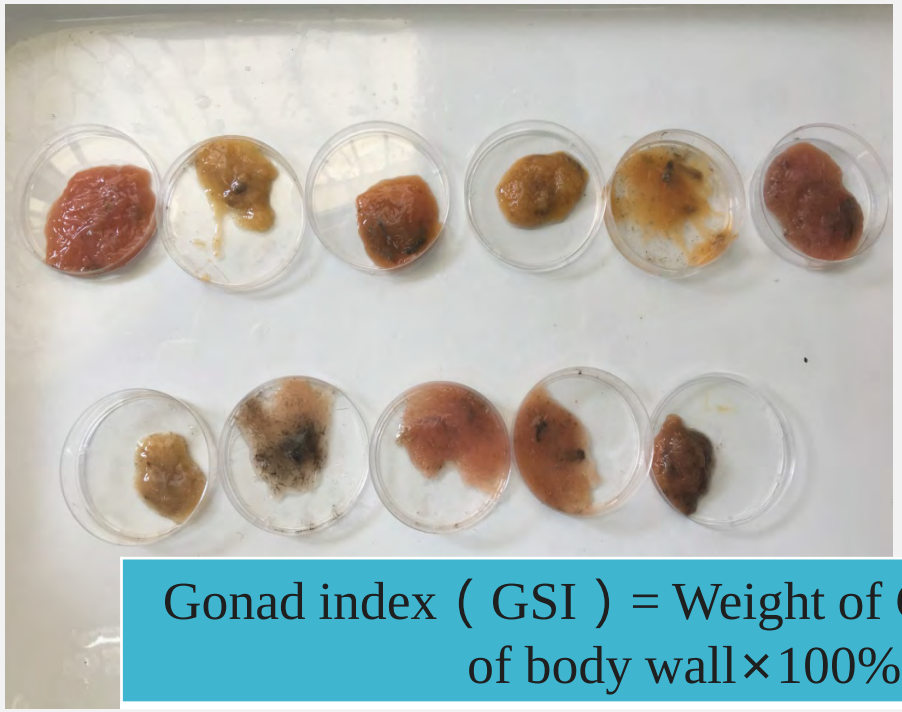
2.2 fecundity

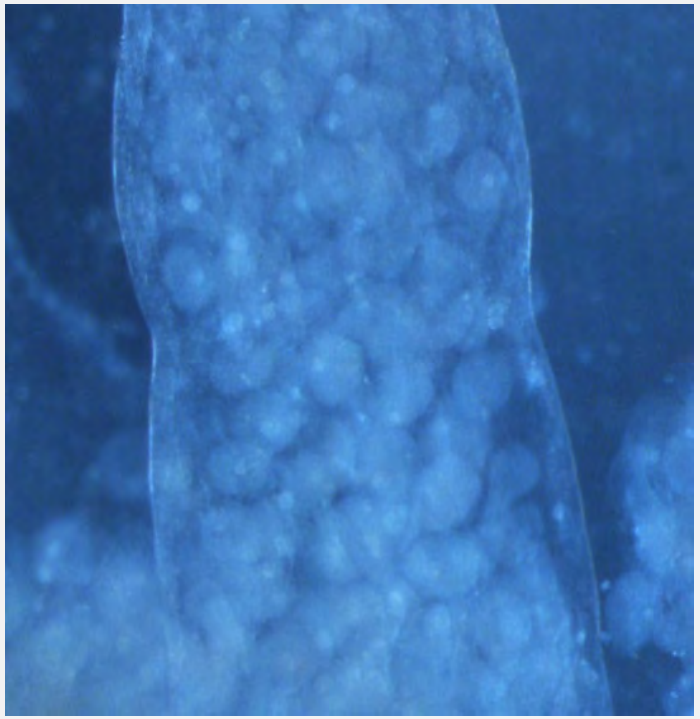
Gonad of sea potato



Gonad of sea potato is made of many Gonoduct (34-41) which cluster at the base, the number of biofurcation of gonoduct is between 2-8.

2.2 fecundity





Gonad index（GSI）= Weight of Gonad/Weight of body wall×100%

Generally the gender can be distinguished by the color of Gonad , The gonad of sea potato is cream white to breast yellow , and the female if pink to orange.

2.2 fecundity

Gender ratio

29 male in 55 total sea potato(52.7%) ，Female 26 occupy 47.3%，the gender ratio of sea potato is about 1：1。

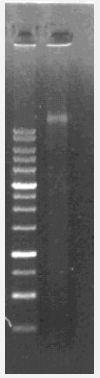
Gonad index

GSI of sea potato is average 26.0%，Maximum is 53.3%，Minimum is 8.4%。According the sea cucumber seedling, the criteria of high maturity is that GSI is greater than 16.6%。There were 46 sea potato which the GSI was greater than 16.6%，that means 88.5% of sea potato in May is maturity。

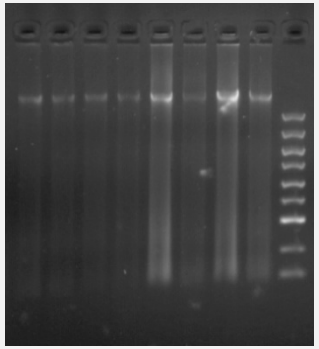
2.3DNA and Mitochondrial Sequencing

Molecular biology

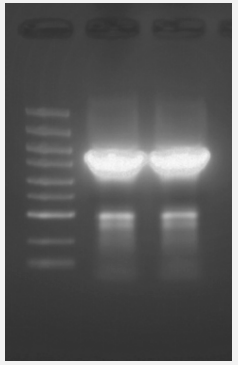
Genomic DNA extraction，make transcriptome and Mitochondrial Sequencing。



Genomic DNA extraction in SP



Genomic DNA extraction in 8 sediments



Part sequence of 16sRNA-COI by PCR

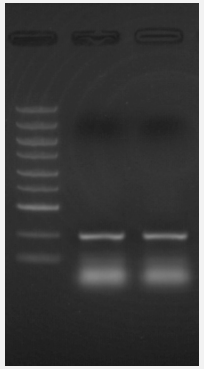
The Primers were designed based on a*16S ribosomal RNA* and *cytochrome oxidase subunit I (COI)* from NCB data base（this two gene adjacent each other, forward primer was designed on 1*6sRNA*，reverse primer was designed on *COI*），sequence was about 1659bp。

Design of specific Primers

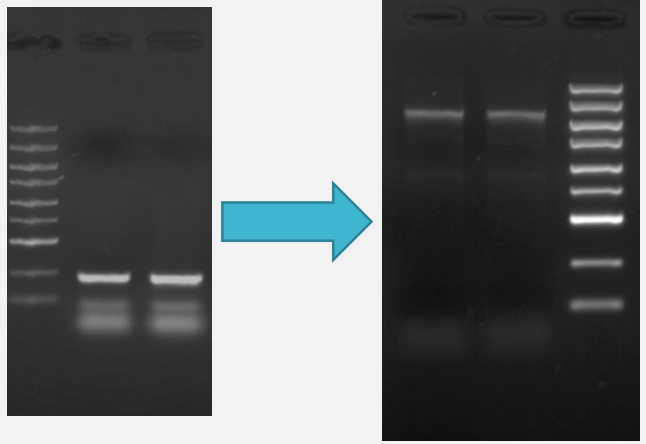
Design of specific Primers for sea potato。

Mitochondrial DNA map of *Apostichopus japonicus* （16,105bp ）

5 paragraph (each about 3K) was divided to design degenerate primer according to Mitochondrial DNA Seq of other Holothuroidea sp, the site of degenerate primer located on COX2、ND4、CYTB、ND1。



PCR of COX2 （100um primer has dimer ; 10um no amplification stripe ）this Seq is about 242bp



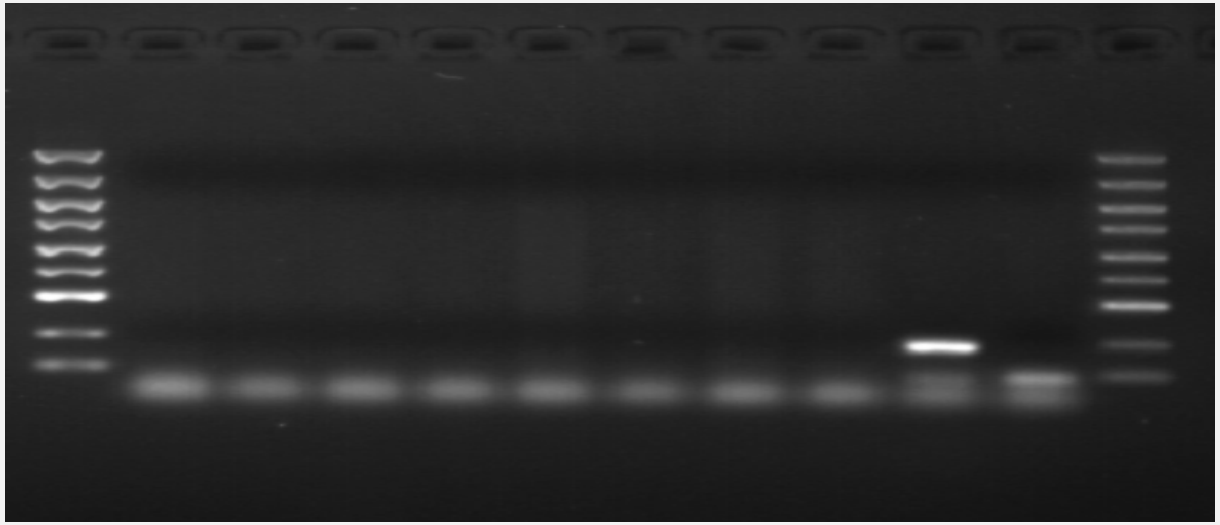
PCR of NDI （the Seq is about 229bp)

Partial PCR of NDI-16sRNA

Design of specific Primers

Design of specific Primers

Screen DNA for 8 Sediment sample by using 3 amplified Seq of 16sRNA、COX2 and ND1

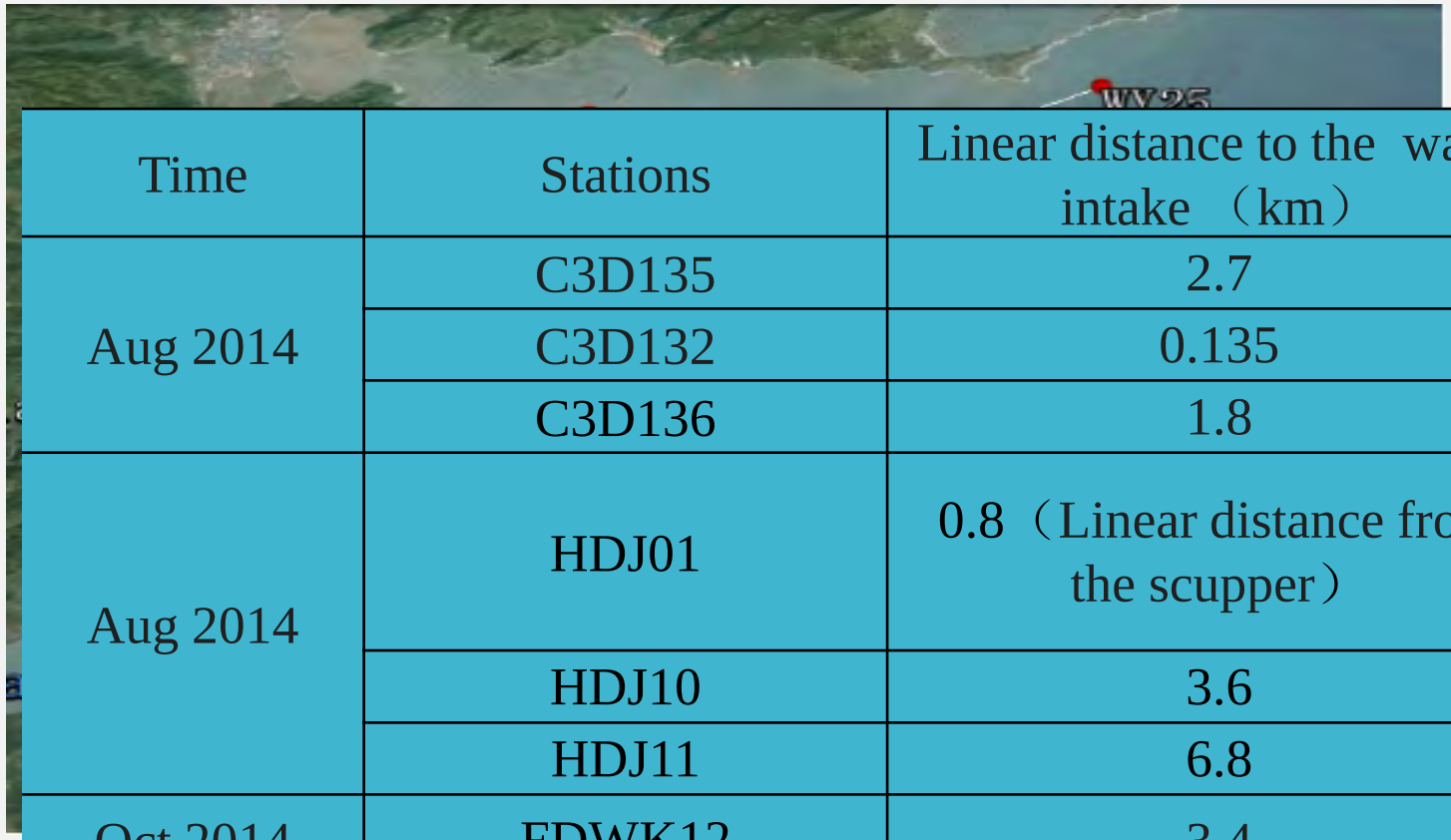


PCR of different templet on Mitochondrial ND1。Results from left to right：DNA of 8 sediments，DNA of sea potato （positive control ）,DNA of Sea tunicate (*Styela clava*)（ negative control ）

No amplification of COX2 in all templet including positive control. No amplification of 16sRNA in all templet including positive control, but stray band on negative control.

2.4The distribution

The distribution of sea potato in adjacent sea areas



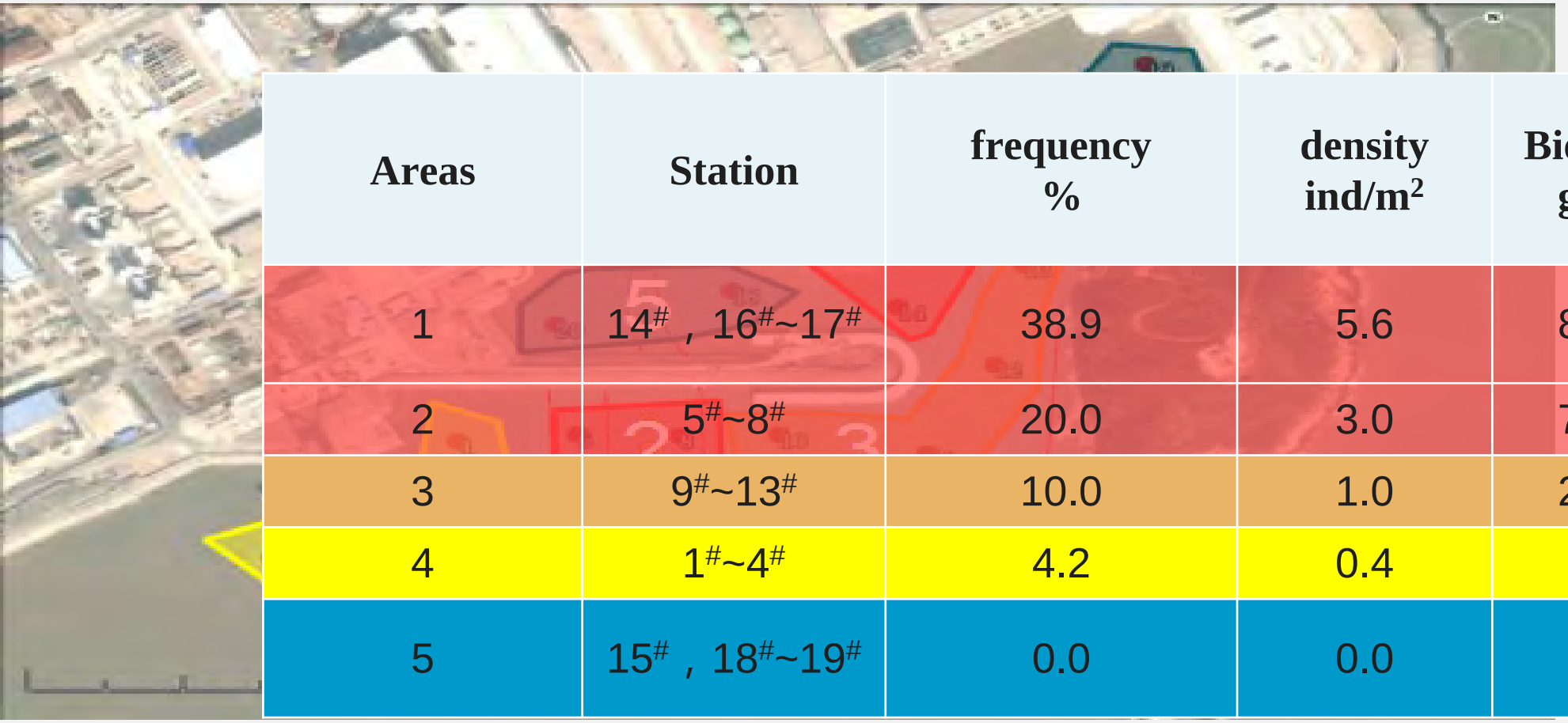
May 2016, No sea potato was found

Time	Stations	Linear distance to the water intake （km）	Density ind/m²	Biomass g/m²
Aug 2014	C3D135	2.7	5	11.80
	C3D132	0.135	15	10.75
	C3D136	1.8	5	17.70
Aug 2014	HDJ01	0.8（Linear distance from the scupper）	5	0.40
	HDJ10	3.6	10	10.50
	HDJ11	6.8	15	68.10
Oct 2014	FDWK12	3.4	10	64.00
May 2015	A2D35YQ010	11.0	15	326.30

2.4 The distribution near cool water source inlet

The distribution of sea potato in cool water intake canal

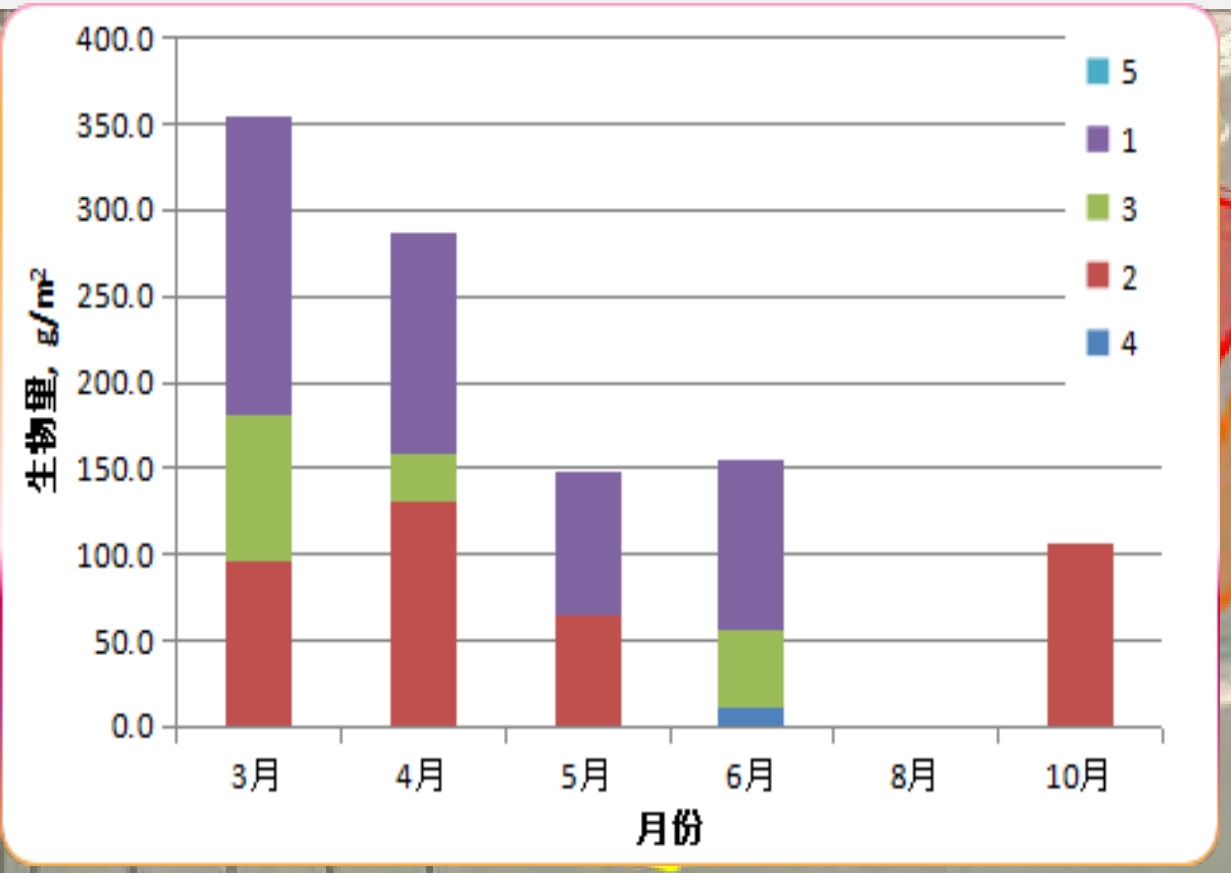
The detection rate of acaudina molpadioides in theWater intake was high, and the number showed the characteristics of regional and seasonal changes



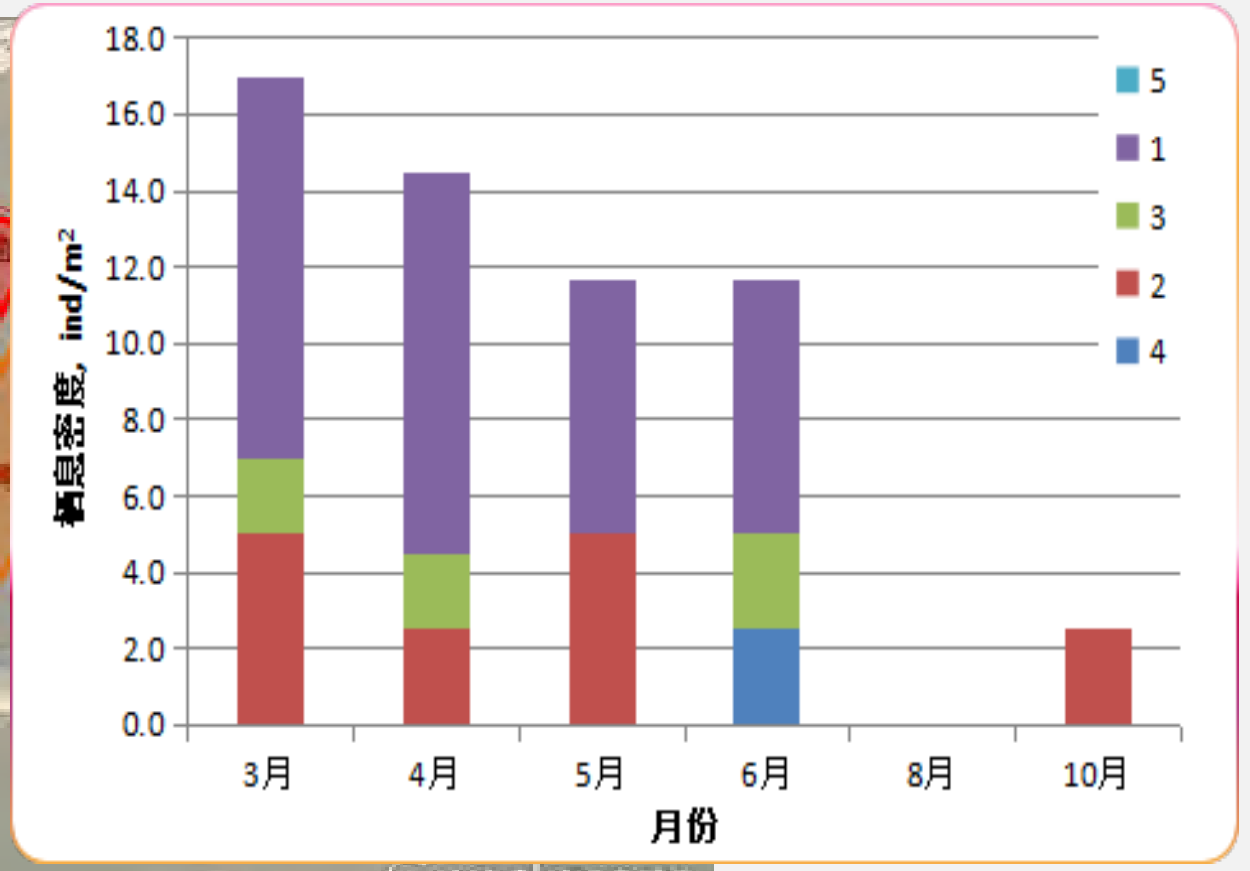
Areas	Station	frequency %	density ind/m^2	Biomass g/m^2	Impact factor
1	$14^{\#}$, $16^{\#}$~$17^{\#}$	38.9	5.6	80.8	8.4
2	$5^{\#}$~$8^{\#}$	20.0	3.0	79.7	5.5
3	$9^{\#}$~$13^{\#}$	10.0	1.0	24.8	2.0
4	$1^{\#}$~$4^{\#}$	4.2	0.4	1.9	0.6
5	$15^{\#}$, $18^{\#}$~$19^{\#}$	0.0	0.0	0.0	0.0

2.4 The distribution nearby cool water source inlet

Biomass

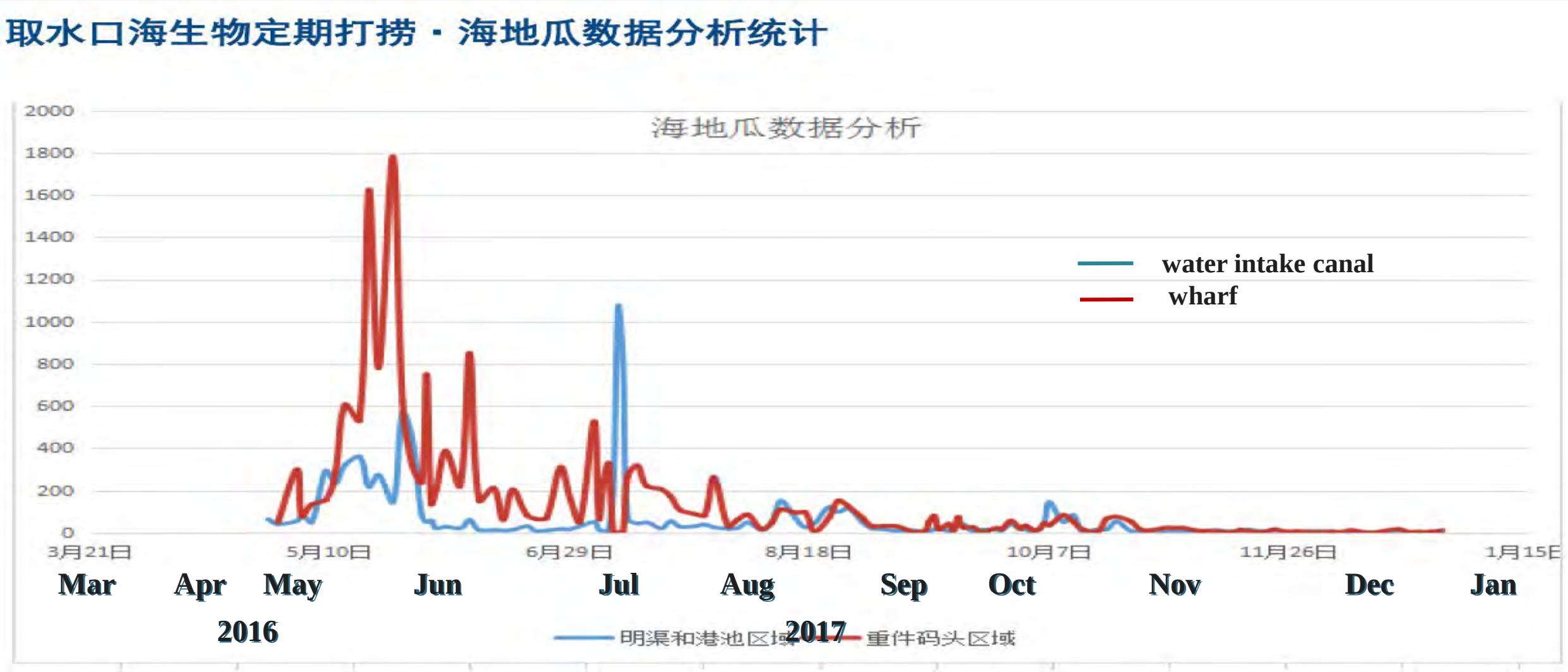


Density



2.5 seasonal variation

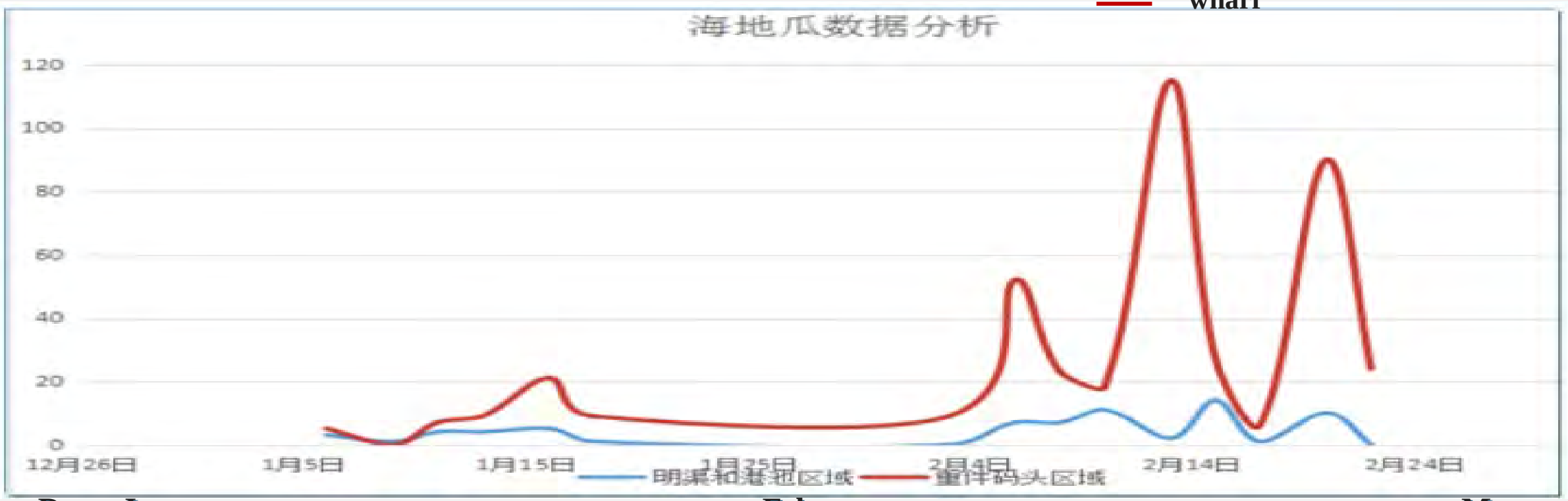
The seasonal variation of sea potato in cool water intake canal



2.5 seasonal variation

The seasonal variation of sea potato in cool water intake canal

water intake canal
wharf



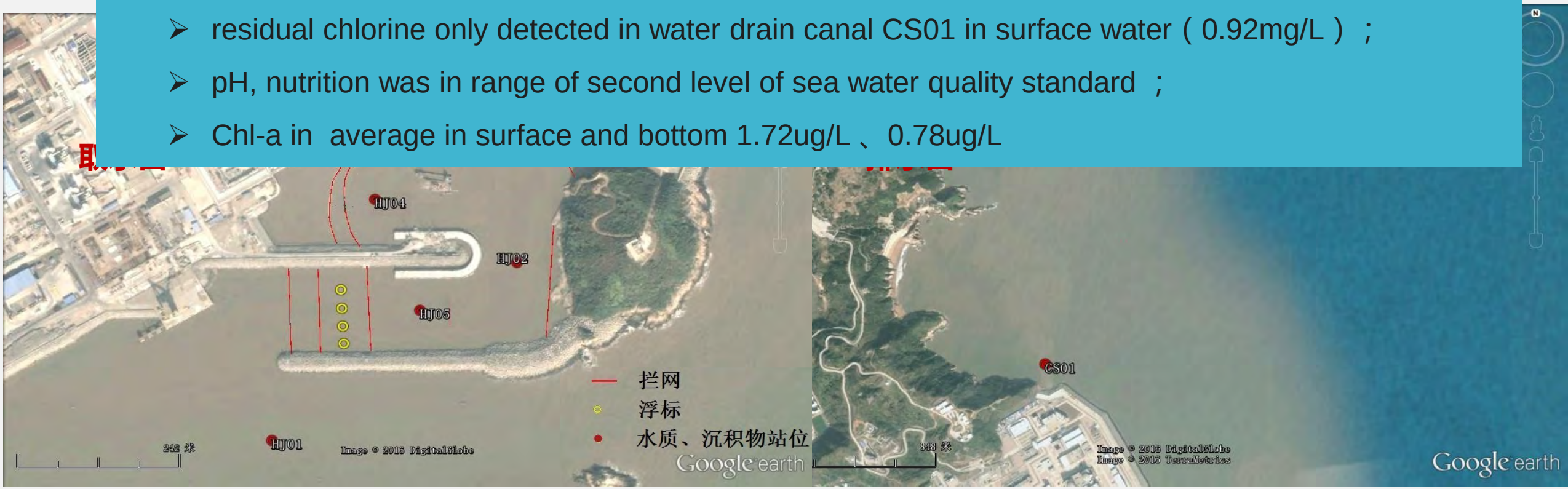
Dec Jan Feb Mar

2016 2017

2.6 The environmental condition

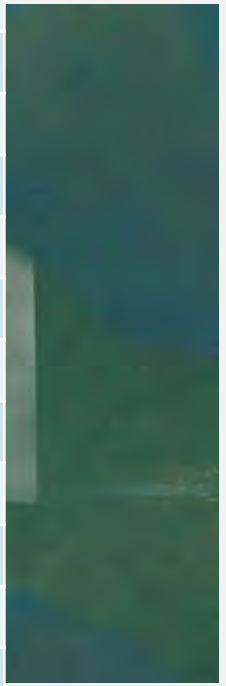
2016.3.29~30,sea water, sediment, biological investigation。

- salinity（26.5~26.7）；
- Suspended substance（85.0 mg/L~255 mg/L）；
- residual chlorine only detected in water drain canal CS01 in surface water（0.92mg/L）；
- pH, nutrition was in range of second level of sea water quality standard ；
- Chl-a in average in surface and bottom 1.72ug/L、0.78ug/L



2.6 The environmental condition

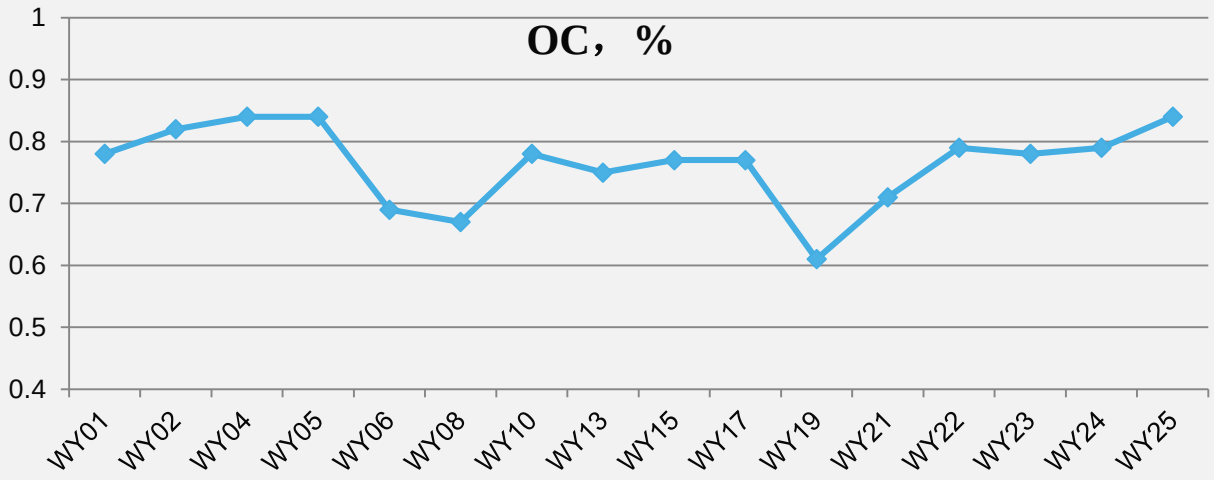
station	Temp ℃	Sal	pH	Do mg/L	COD mg/L	Po4 mg/L	IN mg/L	SS mg/L
WY01	21.4	28.8	8.54	8.36	0.84	0.0011	0.0519	106
WY02	21.6	28.7	8.53	9.12	1.66	0.0011	0.0209	92.0
WY04	21.4	28.9	8.39	7.88	2.52	0.0014	0.0555	48.0
WY05	21.4	28.1	8.69	9.84	4.48	0.0008	0.0235	34.0
WY06	21.3	28.1	8.51	10.7	2.67	0.0008	0.0225	33.7
WY08	21.3	29.0	8.47	9.48	4.76	0.0008	0.0231	61.3
WY10	22.1	28.7	8.40	11.5	2.11	0.0016	0.0353	79.0
WY13	20.3	29.5	8.47	9.22	1.88	0.0008	0.0396	100
WY15	20.8	29.1	8.36	12.5	0.67	0.0011	0.0831	90.7
WY17	20.4	29.4	8.40	11.1	2.89	0.0014	0.0259	86.0
WY19	19.8	29.8	8.37	12.3	1.49	0.0016	0.0282	98.3
WY21	21.4	28.6	8.38	11.5	1.23	0.0019	0.0270	80.3
WY22	19.6	30.6	8.25	10.4	1.40	0.0011	0.119	109
WY23	20.7	29.5	8.42	13.1	0.58	0.0019	0.120	125
WY24	19.8	29.8	8.39	7.38	1.95	0.0011	0.0381	72.0
WY25	20.5	29.1	8.29	9.44	0.69	0.0024	0.110	28.7

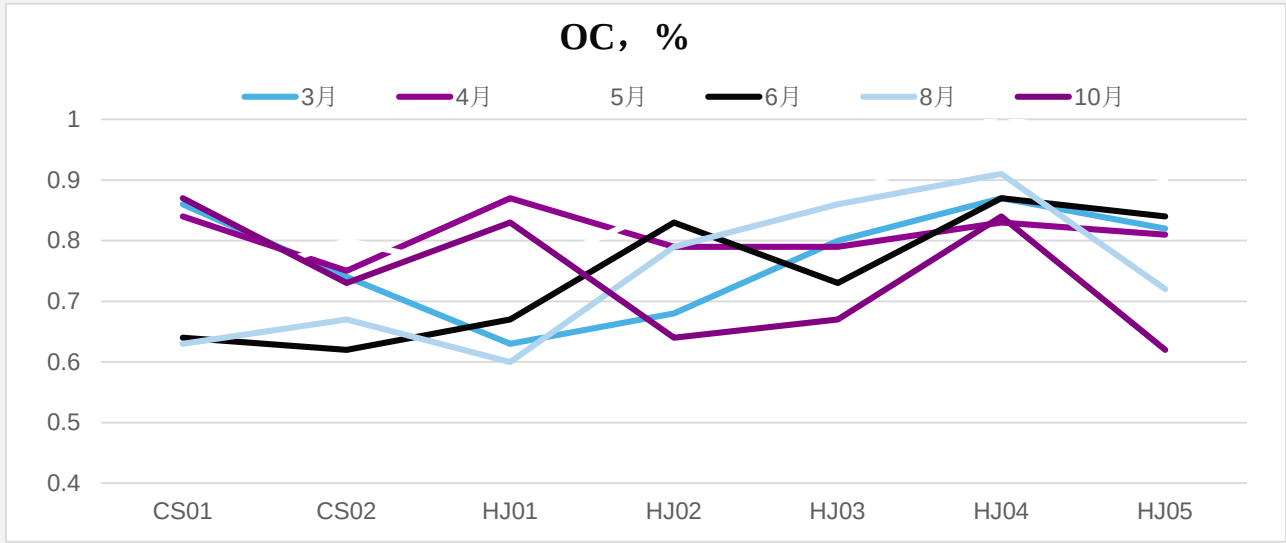


2.6 The environmental condition

Organic carbon in sediment

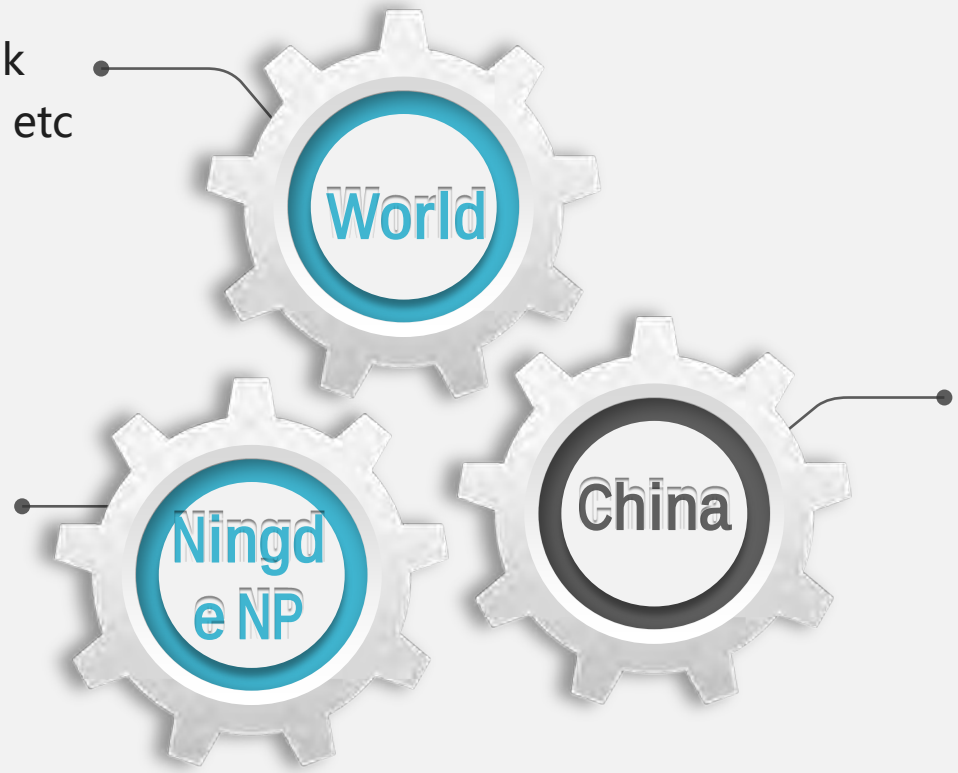
The change of organic carbon content in this sea area was not significant, (0.77 ±0.09)%, and there was no obvious changing tendency





3 screen other potential caused sp

•Jellyfish、 Canadian oak algae, seaweed, sea ice, etc



•Sea potato, fish,

•Jellyfish、microalgae、macro-algae, seaweed, shrimp、sea potato、debris etc

Screen principle
Big size or Group forming organism

Caused sp in recent NP cold source water clogging incidents：

1、Phytoplankton

Group forming such as Phaeocystis globosa

2、Zooplankton

Gregariousness and Colloid，such as Jellyfish；

3、benthos

gregariousness in extreme weather condition such as sea potato.

4、Macro algae

Such as laver and Enteromorpha prolifera，

5、nekton

Fish /shrimp

Screen principle

Net type	Mesh size	Main function
Oil barrier	20cm×300cm	Obstruct floating oil contamination
Fouling net	120mm×120mm	Marine floating debris
Eel net	2mm×2mm~3mm×3mm	Laver
Vertical block	Upside 50mm×50mm , Underside 10mm×10mm	upside Obstruct laver in spring and winter, cultured bamboo pole in summer , underside mainly obstruct organism (size > 10mm) such as sea potato
Drum filter network	3mm×3mm	Block types of tiny suspension

Drum filter network blockage cause the safety of cold water source of NP. The size of organism greater than Drum filter network mesh (>3mm) are potentially risk species.

Blockage risk index system

Blockage risk index system was established by analytic hierarchy process

	Criteria layer	Index layer
Disaster risk index (D)	Characteristic of creature index (C)	Environmental suitability (C_1)
		Reproduction mode and ability (C_2)
		Distribution of predator (C_3)
		Habitat capacity (C_4)
	Blogging index (B)	Size of individual (B_1)
		bioaccumulation (B_2)
		buoyancy (B_3)
		abundance (B_4)

Blockage risk index system

Caused organism screen aims to identify potential risk organism block the inlet of NP. Multi level fuzzy evaluation method was established reference risk assessment model to screen the potential caused organism, computational formula as below ：

$$D = C \times B \quad (1)$$

D refers Disaster risk index， *C refers* Characteristic of creature index， *B* refers Blogging index 。

$$C = \sqrt[n]{\prod_{i=1}^{n} C_i} \quad (2)$$

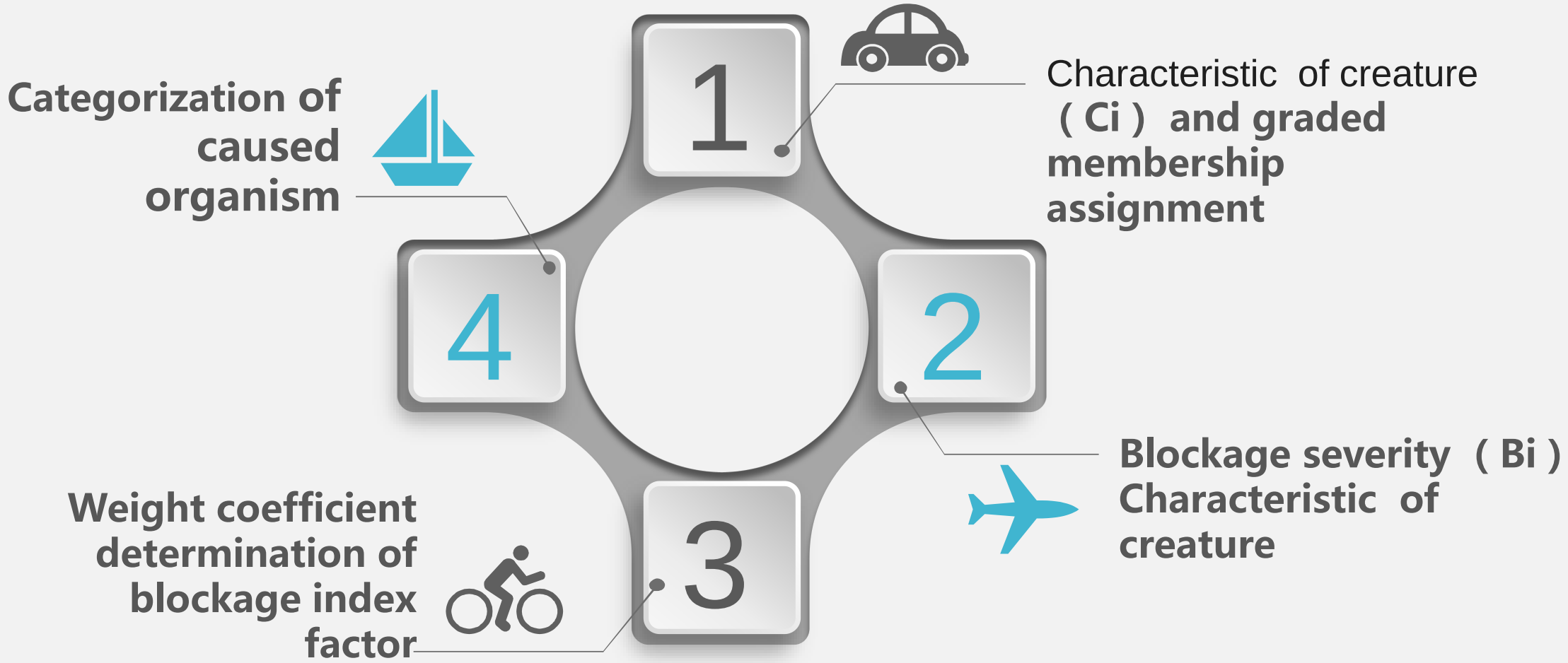
I is index factor， C_i refers graded membership assignment of Characteristic of creature index factor。

$$B = \sum_{i=1}^{n} B_i \times W_{B_i} \quad (3)$$

B_i refers graded membership assignment of blockage risk index factor。 ， W_{bi} refers wight of blockage risk index facto *i*。

Blockage risk index system

Assignment of each risk index factor was made by Qualitative grading assignment , as below:



Screen principle

（1）Characteristic of creature（**Ci**）**and graded membership**，as the below table。

Factor	Membership value				
	0.01	0.25	0.50	0.75	1.00
C_1（Environmental suitability）	Extremely low	low	Medium	High	Extremely high
C_2（Reproduction mode and ability）	Sexual reproduction，extremely low fecundity	Sexual reproduction，low fecundity，1 generation several years	Sexual reproduction，medium fecundity，1 generation per year	Sexual reproduction，high fecundity，3-5 generation per year	Sexual /asexual reproduction，extremely high fecundity，short period
C_3（Distribution of predator）	Large area distribution	Medium area distribution	Small area scattered	Extremely small area	Not sure
C_4（Habitat capacity）	Extremely low abundance，poor viability	low abundance，poor viability	medium abundance，medium viability	high abundance，good viability	Extremely low abundance，unexceptionable viability

Blockage risk index system

（2）Blockage severity （B_i）**and graded membership** ，as the below table。

factor	Membership value				
	0.01	0.25	0.50	0.75	1.00
B_1（Size of individual）	<0.5mm，no blockage	Be equal or greater than 0.5mm, less than 1mm，not easy cause blockage	Be equal or greater than 1mm, less than 2mm，some possible cause blockage	Be equal or greater than 2mm but less than 3mm，easy cause blockage	Be equal or greater than 3mm，very easy cause blockage
B_2（bioaccumulation）	Very low intensity of aggregation, no blockage	low intensity of aggregation, slightly blockage	Medium intensity of aggregation, blockage	High intensity of aggregation, blockage	Extremely high intensity of aggregation, severely blockage
B_3（buoyancy）	Extremely high kinetism, not easy floating	High kinetism, not easy floating	Medium kinetism, floating	Weak kinetism, easy floating	Extremely Weak kinetism, extremely easy floating
B_4（abundance）	Extremely low abundance, extremely low indensity	low abundance, low indensity	Medium abundance, medium indensity	high abundance, high indensity	extremely high abundance, extremely high indensity

（3）Weight coefficient determination of blockage index factor

Weight coefficient was determined by expert ranking method.。 computational formula as below ：

$$B_i = 2[m(1+n) - R_i]/[mn(1+n)] \quad (5)$$

B refers weight of factor *i*，*m* refers number of experts，*n* refer number of factors，*Ri* refers weight sum of each factor i（*i*=1，2，…，n）。

Weight coefficient of this 4 factor was determined by 20 experts，as below

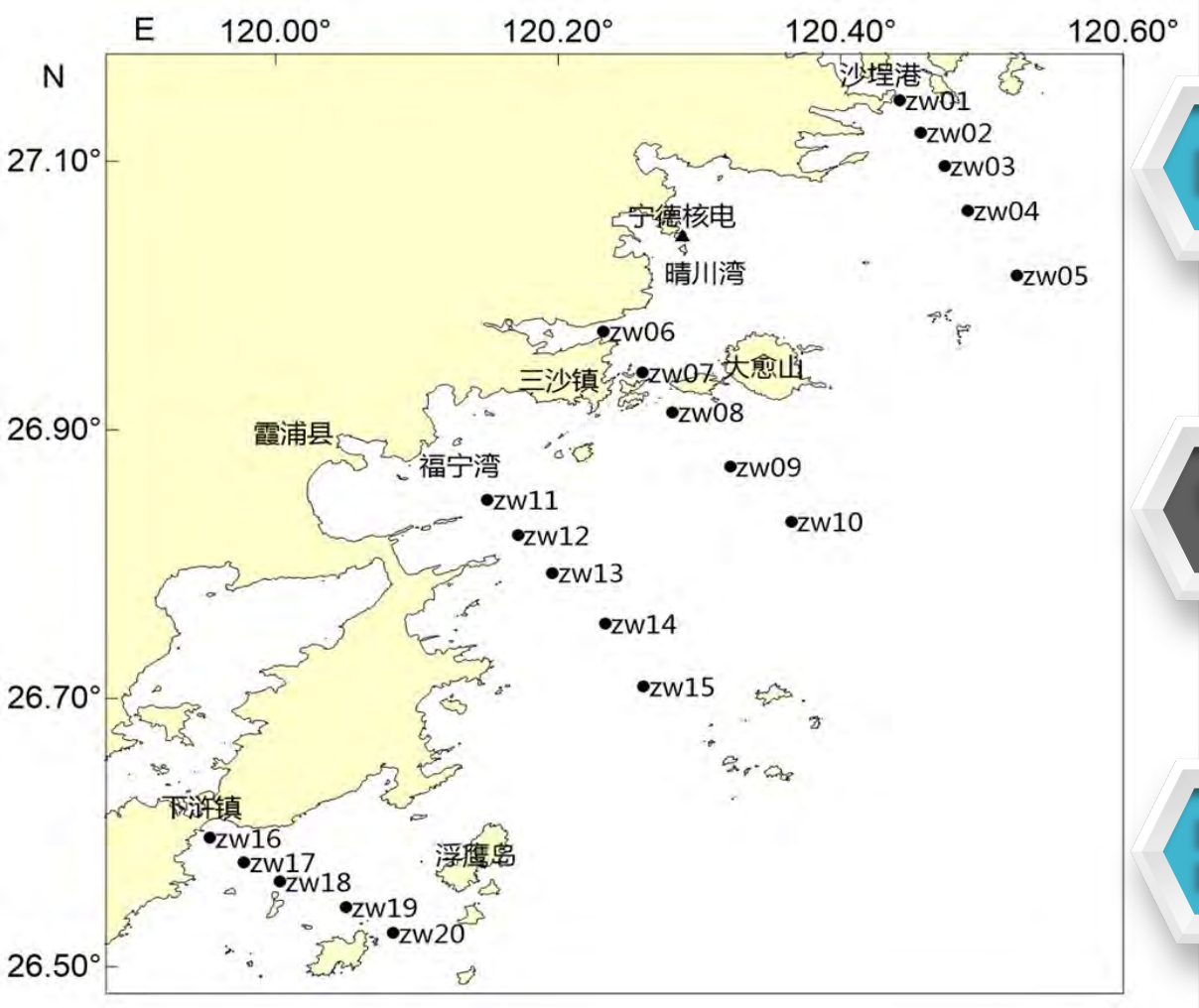
W_{B1}	W_{B2}	W_{B3}	W_{B4}
0.325	0.350	0.225	0.100

（4）categorization of risk organism

D value	**0.000~0.249**	**0.250~0.499**	**0.500~0.749**	**0.750~1.000**
Blockage risk	low	medium	high	Extremely high

categorization of risk organism see table to judge the possibility of blockage by specific organism. ：0.000~0.249 low risk；0.250~0.499 medium risk ；0.500~0.749 high risk；0.750~1.000 extremely high risk，high risk (> 0.5) organism need pay attention for forecast.

Basic database



coverage

120.00° ~ 120.55°E，26.50° ~ 27.17°N

Investigation station

20

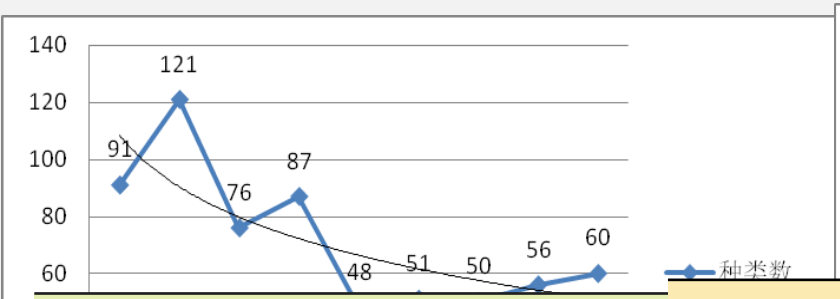
Time sereis

2007-2016, 9 years data

* 样品采集与分析均按照《海洋监测规范》（GB17378-2007）的规定执行。

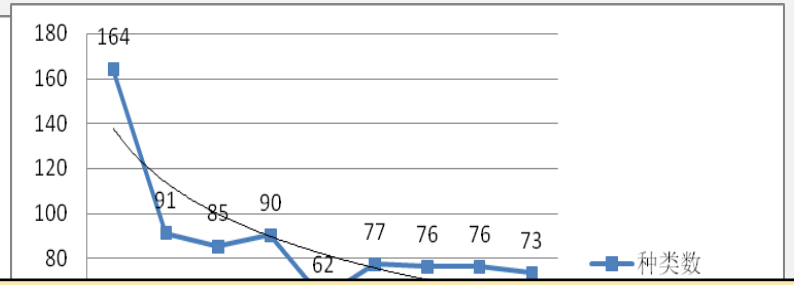
Basic database

phytoplankton

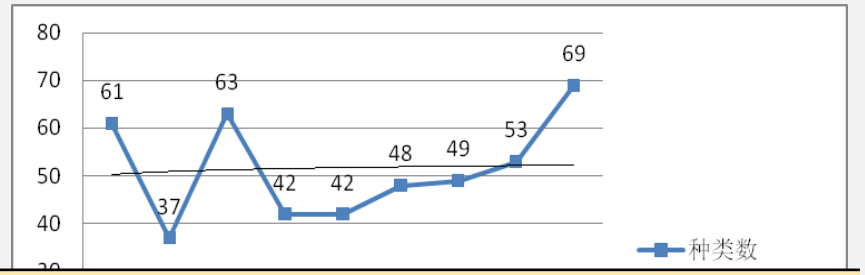


序号	种类	物种中文学名
1	枝角类	肥胖三角溞
2	水母类	拟细浅室水母
3	水母类	双生水母
4	桡足类	锥形宽水蚤
5	桡足类	亚强真哲水蚤
6	桡足类	小拟哲水蚤
7	桡足类	强额拟哲水蚤
8	桡足类	尖额谐猛水蚤
9	桡足类	精致真刺水蚤
10	桡足类	驼背隆哲水蚤
11	桡足类	刺尾纺锤水蚤
12	桡足类	太平洋纺锤水蚤
13	毛颚类	肥胖箭虫
14	毛颚类	百陶箭虫
15	磷虾类	中华假磷虾
16	介形类	齿形海萤
17	背囊类	软拟海樽
18	栉水母类	球型侧腕水母

zooplankton



benthos

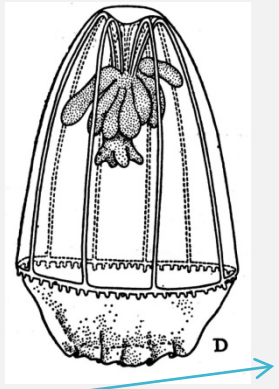


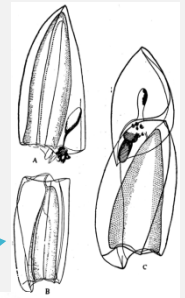
序号	种类	物种中文学名	物种拉丁学名	年份 2007	2008	2009	2011	2012	2013	2014	2015	2016
1	环节动物	杰氏内卷沙蚕	*Aglaophamus jeffreysii*						0.08*			
2	环节动物	不倒翁虫	*Sternaspis scutata*		0.10*	0.02	0.03		0.06	0.03	0.08	0.05
3	环节动物	双鳃内卷齿蚕	*Aglaophamus dibranchis*				0.12*	0.03		0.23*	0.15*	0.12*
4	环节动物	双形拟单指虫	*Cossurella dimorpha*				0.05				0.04	
5	环节动物	丝异须虫	*Heteromastus filiforms*				0.07	0.11*			0.12	0.02
6	环节动物	长吻沙蚕	*Glycera chirori*				0.03	0.03				
7	环节动物	西方似蛰虫	*Amaeana occidentalis*									0.04
8	环节动物	梳鳃虫	*Terebellides stroemii*	0.02*								
9	环节动物	异足索沙蚕	*Lumbrineris heteropoda*		0.03							
10	环节动物	拟节虫	*Praxillella praetermissa*					0.03				
11	环节动物	稚齿虫	*Paraprionospio* sp.							0.04		
12	棘皮动物	薄倍棘蛇尾	*Amphioplus praestans*				0.03	0.03				
13	甲壳动物	豆形短眼蟹	*Xenophthalmus pinnotheroides*		0.08	0.03*	0.09	0.11				
14	甲壳动物	绒毛细足蟹	*Raphidopus ciliatus*						0.05			
15	纽形动物	纽虫	*Nemertinea*						0.04			
16	软体动物	棒锥螺	*Turritella bacillum*			0.03					0.02	0.03

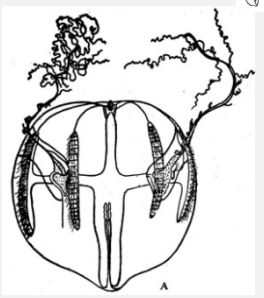
High risk species in Ningde NP

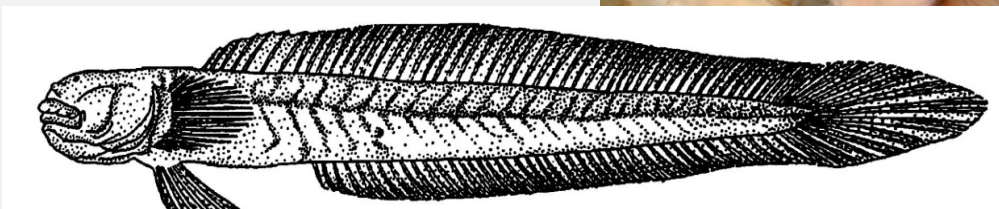
screen High risk species 。

类群	序号	物种中文学名	物种拉丁学名
zooplankton	1	Medusae	*Aglaura hemistoma*
	2	Medusae	*Lensia subtiloides*
	3	Medusae	*Diphyes chamissonis*
	4	Ctenophores	*Pleurobrachia globosa*
	5	Tunicates	*Dolioletta gegenbauri*
benthos	6	Echinodermata	*Protankyra bidentata*
	7	Coelenterata	*Actiniaria*
	8	Chorelata	*Oxyurichthy tentacularis*





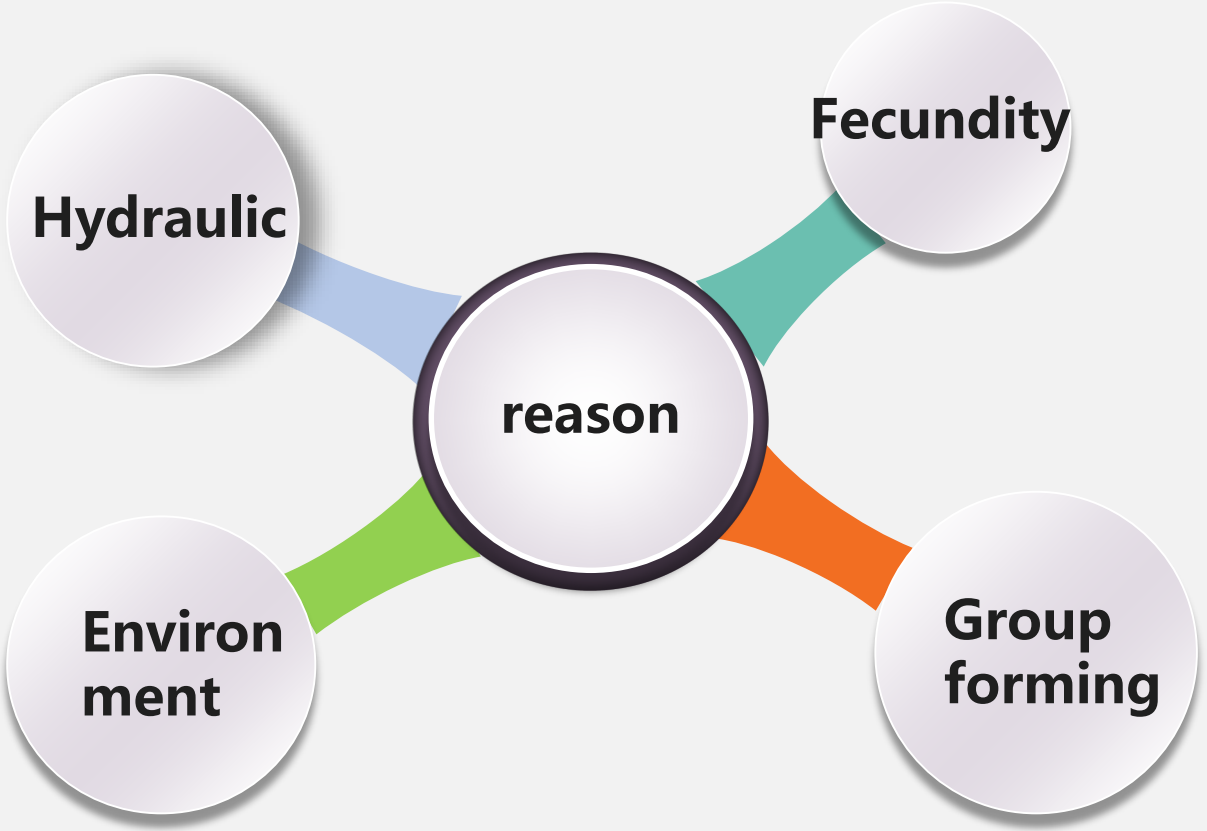




3High risk organism

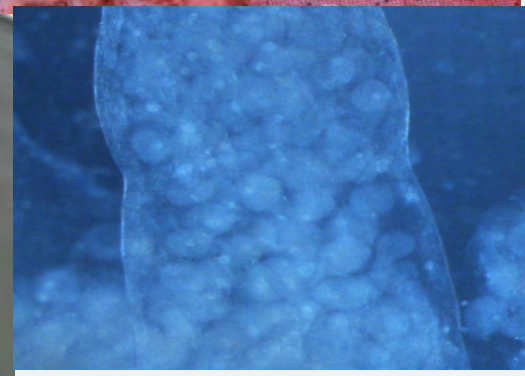
source		spcies	
Organism screened by risk assessment	1	*Aglaura hemistoma*	Medusae
	2	*Lensia subtiloides*	Medusae
	3	*Diphyes chamissonis*	Medusae
	4	*Pleurobrachia globosa*	Ctenophores
	5	*Dolioletta gegenbauri*	Tunicates
	6	*Protankyra bidentata*	Echinodermata
	7	*Actiniaria*	Coelenterata
	8	*Oxyurichthy tentacularis*	Chorelata
Visit investigation	9	laver、kelp	Aquaculture
Caused sp	10	***Acaudina molpadioides***	Echinodermata
	11	*Tachypleus tridentatus*	Crustacea
	12	Fish group	

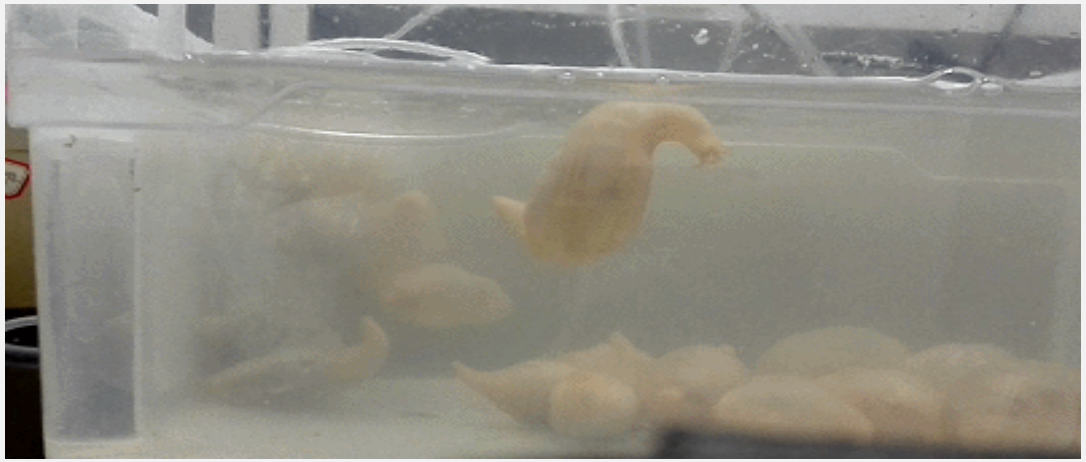
4 reason analyze



4 possible reason analysis of the incident

1、Weak swimming ability.
2、High toughness and large deformation.
3、Strong breeding ability and more multiply cells.
4、high water content,and easy to suspend.





4 possible reason analysis of the incident

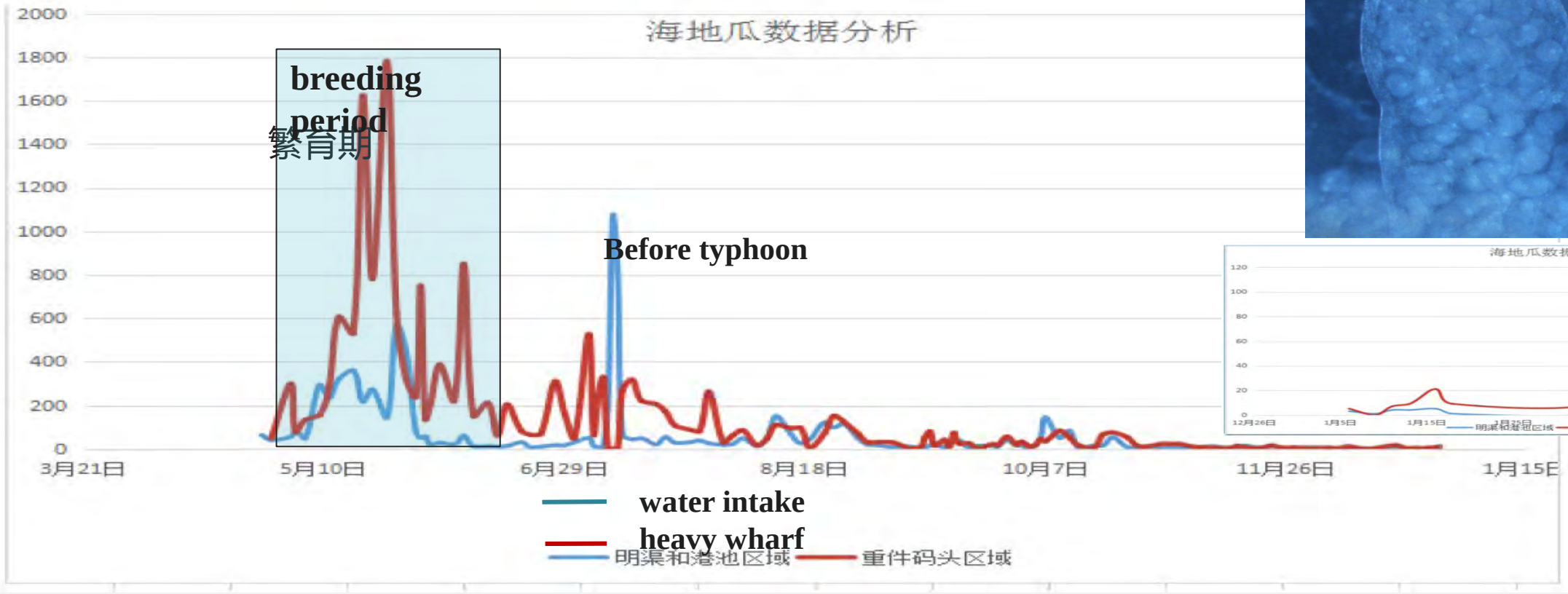
- **High abundance in spring and summer**. The abundance maximum 20ind/m^2 , average 3 ind/m^2 ; Biomass maximum 418.1g/m^2 , average 66.47 g/m^2。so estimated

Total number		Suspension ratio in water			
		100%	50%	30%	10%
Maximum	Number(10^4)	86.4	43.2	25.9	8.6
	Weight（T）	12.5	6.3	3.8	1.3
Minimum	Number(10^4)	9.6	4.8	2.9	1.0
	Weight（T）	8.8	4.4	2.6	0.9
Average	Number(10^4)	40.0	20.0	12.0	4.0
	Weight（T）	10.6	5.3	3.2	1.1

4 possible reason analysis of the incident

4.1High fecundity in breeding season

By the bottom trawl to salvage , high number of acaudina molpadioides existing mature germ cells during May to June; breeding period around May ~June. The water temperature is 20~27 DEG C and the salinity is 27~33.

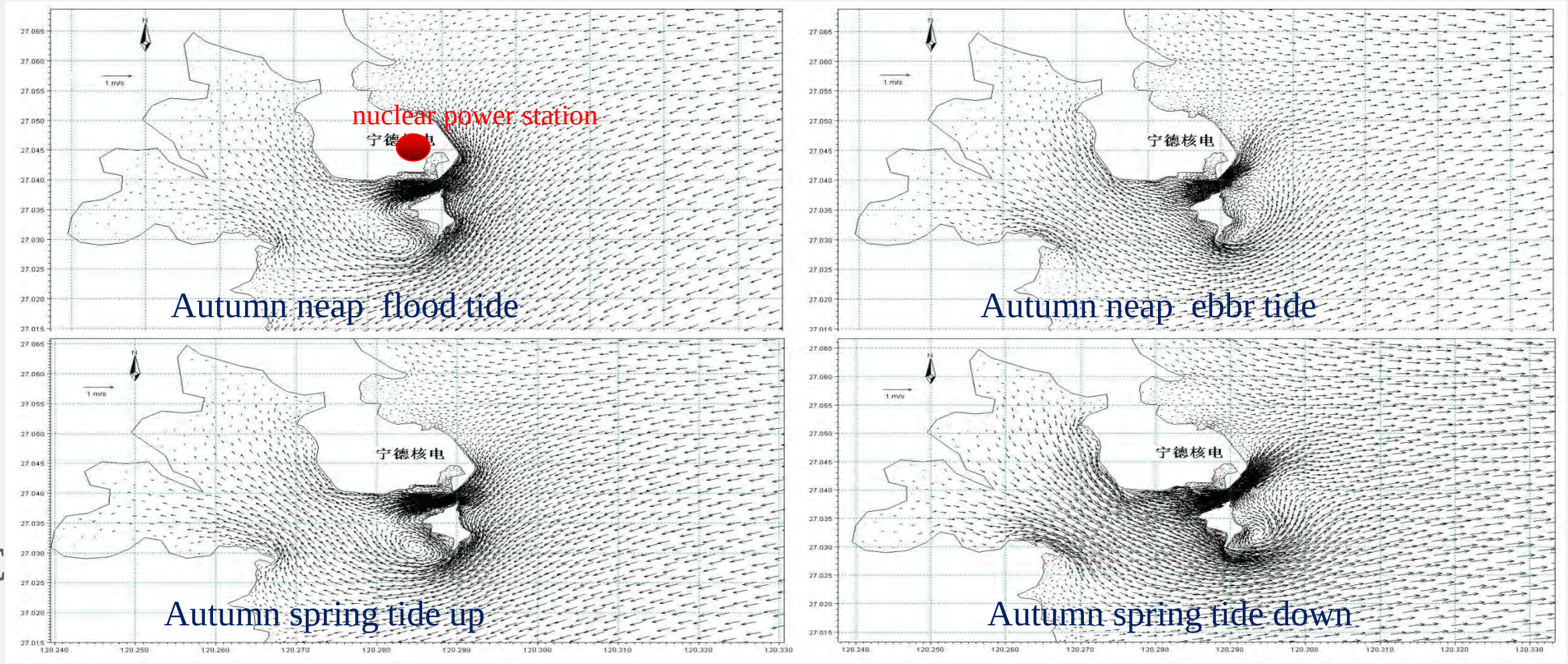


4.2 Cool source water intake process changed the hydrodynamic condition, accumulate and screen the sea potato

Nuclear has a large cool source water intake, about 80 * 104 m3/h, use drum screen filter water impurities.

Hydrodynamic effect

Without water intaking, hydrodynamic force effect by tidal power；



1 C

2.Hydrodynamic effect

After water intaking,form orientation flow near the water intake sea area. The external tide flow into intake port when flood tide and the basin water flow into intake port when ebb tide .

The tidal current in the vicinity of the engineering area is mainly from the northeast to the southwest, which is divided into two parts by the jump island and then into the bay.

Under the influence of terrain conditions, the tidal current on the south side of the channel between the project area and the jumping island is relatively large and small at the top of the Bay and other open shoreline.

The nuclear power plant has a huge amount of cold source water which has a significant influence on the power flow of the intake.

A wide range sources of seawater when spring and ebb tide, seawater in the Bay and the outer sea could enter the water intake.

4 possible reason analysis of the incident

4.3 the typhoon intensify the accumulation

The outbreak time is August 7~8th, 2015

A. the accident coincided with the Soviet Union typhoon and with a large-scale rainfall in 2015 .

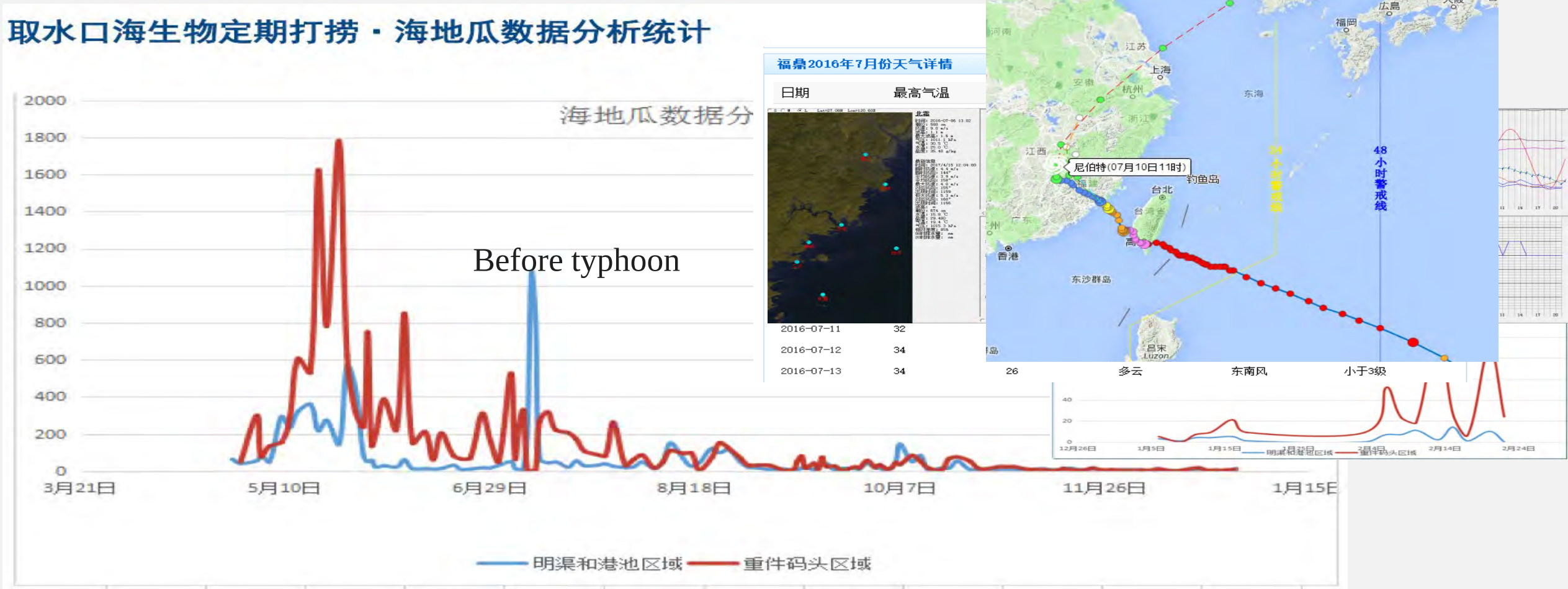
B.after the breeding season 2~3months, the blockage performance for small acaudina molpadioides(2cm).

B.

日期	最高气温	最低气温	天气	风向	风力
2015-08-01	35	25	多云	东北风	小于3级
2015-08-02	36	25	多云	西北风	小于3级
2015-08-03	35	24	晴~多云	东南风	小于3级
2015-08-04	35	25	多云	西北风	小于3级
2015-08-05	35	24	晴~多云	西北风	小于3级
2015-08-06	34	25	多云	东北风	小于3级
2015-08-07	33	26	阵雨~大雨	东北风	小于3级
2015-08-08	27	25	大暴雨	东南风	小于3级
2015-08-09	28	26	大雨~中雨	东南风	小于3级
2015-08-10	29	25	中雨~阵雨	西南风	小于3级
2015-08-11	32	25	阴	东南风	小于3级

4 .3 possible reason analysis of the incident

The number of sea potato increased significantly during Nepartak typhoon 1 on July 6th 2016 typhoon wave may help the sea potato accumulate in shallow surface, easy to suspend

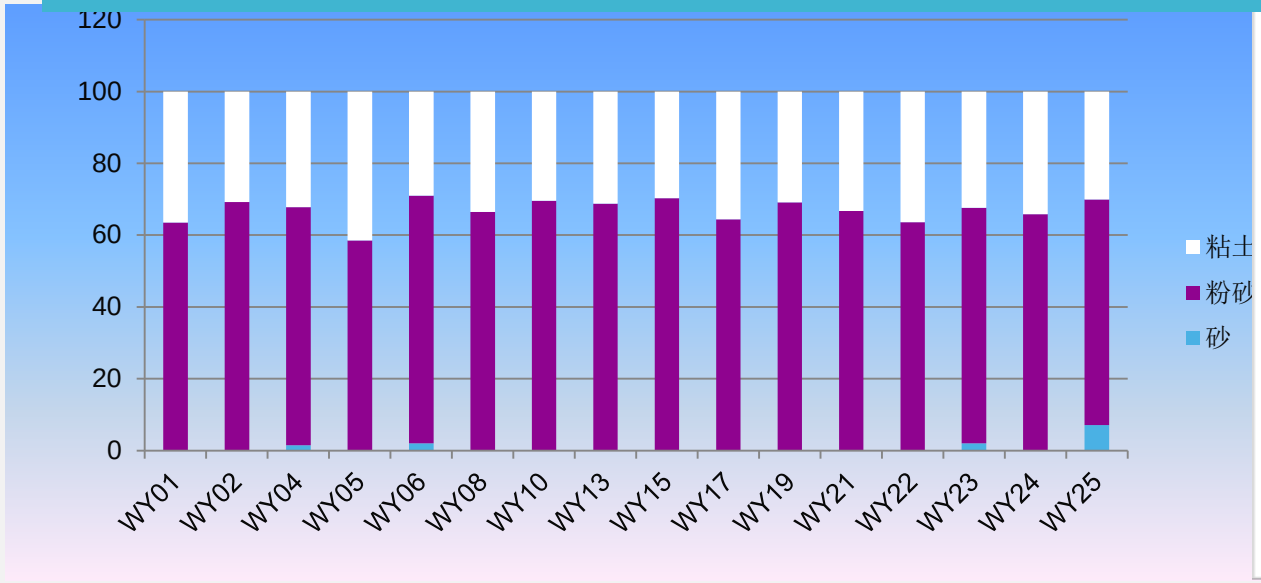


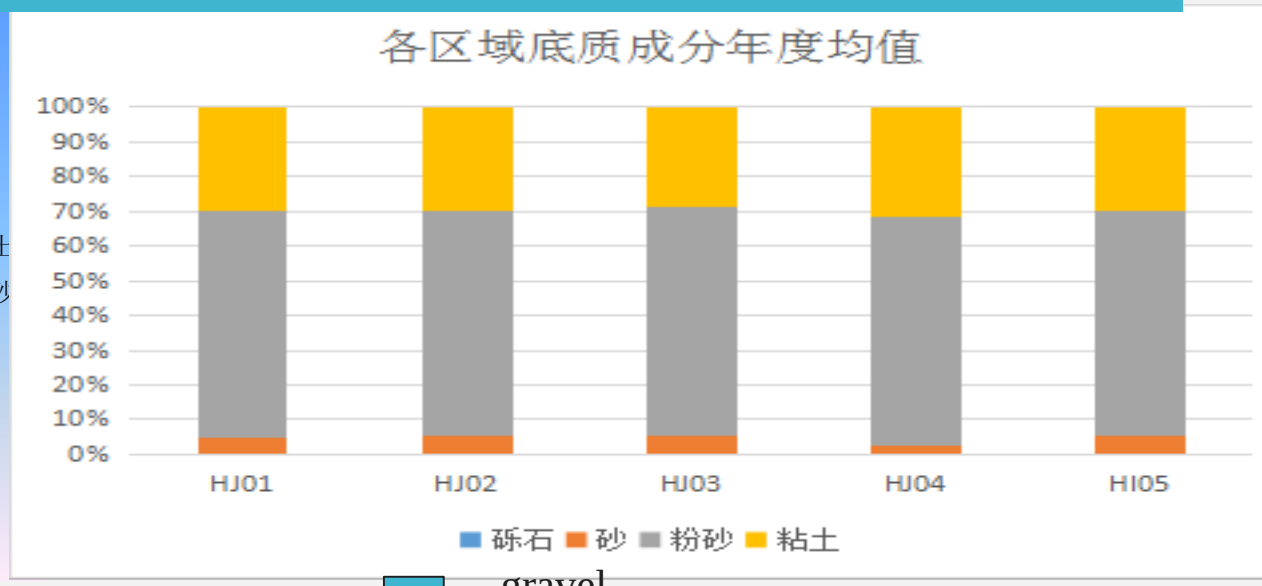
4.4 suitable sediment

4.4 The environmental condition in adjacent sea area

grain size composition in sediment

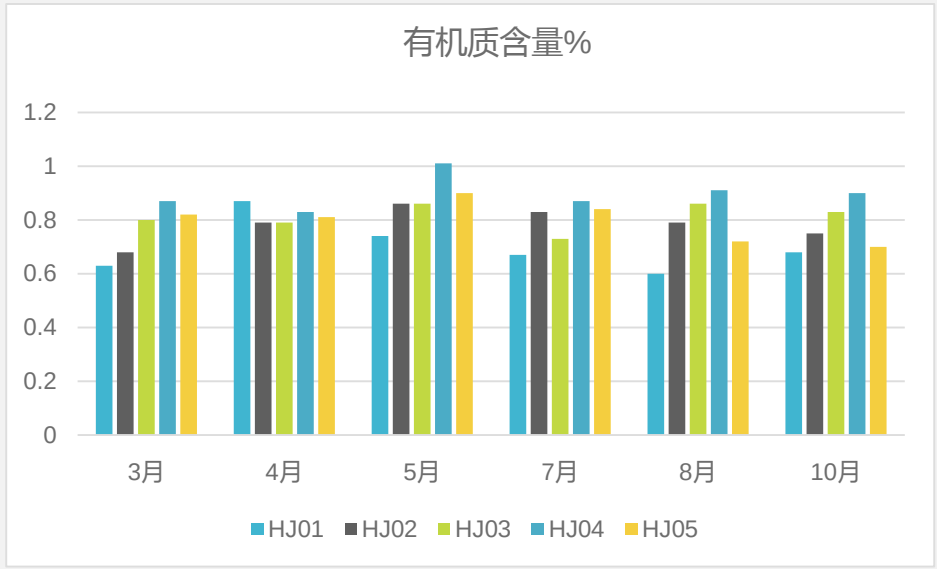
Acaudina molpadioides widely distributed, sediment feeding habits.
the content of organic carbon is stable,relatively high, and the sediment type is consistent in this sea areas, which is beneficial for sea potato



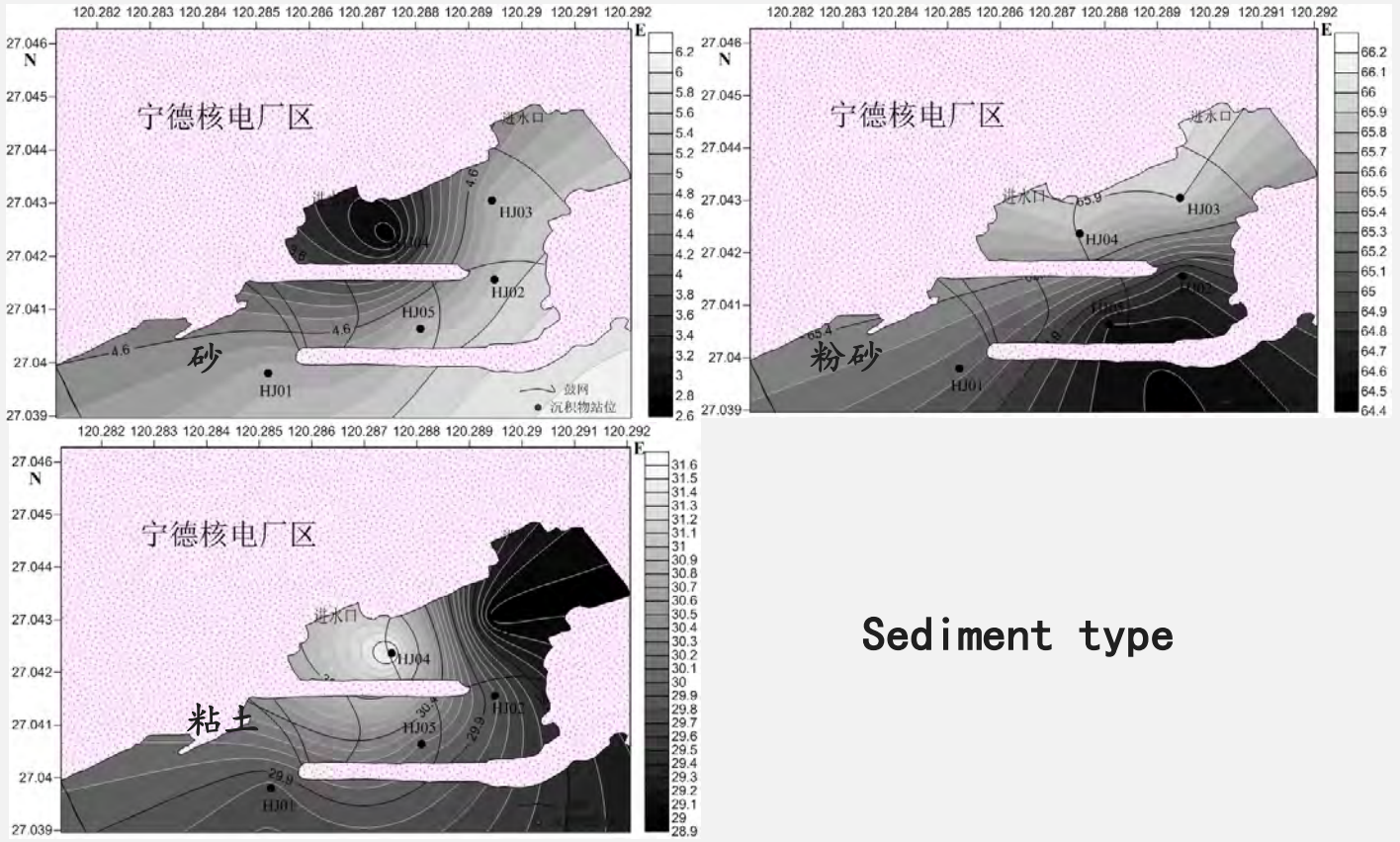


dinas
silt
clay

gravel
dinas
silt
clay



Organic carbon %



Sediment type

the sediment type is mainly clay silt.

5 prevention and

5.1 resource utilization

1) Sea food

2) Health products

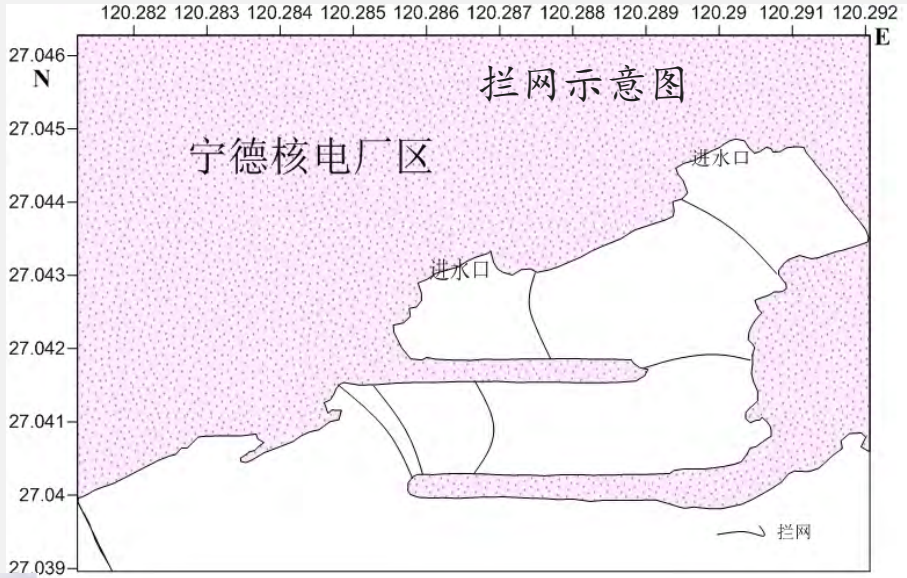
3) Marine Natural Products and Marine Drugs Research

Du L, Li ZJ, Xu J, Wang JF, Xue Y, Xue CH, Takahashi K, Wang YM, The anti-tumor activities of cerebrosides derived from sea cucumber *Acaudina molpadioides* and starfish *Asterias amurensis* in vitro and in vivo.

. J Xu，YM Wang，TY Feng，B Zhang，T Sugawara，Isolation and anti-fatty liver activity of a novel cerebroside from the sea cucumber *Acaudina molpadioides*.《Bioscience Biotechnology & Biochemistry》, 2014, 75(8):1466

TT Long, JF Wang, HE Min, XU Hui, HU Shi-Wei, Suppression effect of *Acaudina Molpadioides* chondroitin sulfate on the differentiation of 3T3-L1 preadipocytes by activation of Wnt signaling passway, 《Chinese Journal of Marine Drugs》, 2013

5.2 physical block



Net block, dredging

summary

The sea potato has high fecundity in breeding season. Long term stable sediment types (silty clay) and substrate component content (organic carbon) provide a suitable growth environment *for Acaudina molpadioidea* , which results in abnormal proliferation of it.

The events was the comprehensive effect of the rapid increase in the number of *Acaudina molpadioidea* during the breeding period and the typhoon weather

.

Besides caused species including sea potato, another 8 high risk species such as jellyfish, anchorage etc should pay attention.

specific Primers can be designed to detect Adult in sediment and larvae in water column.

Acknowledgement

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- East China sea Branch, SOA.
- The paper was also contributed by following colleagues
- Mr Hongbo wang(Ningde NP), Mr Yunpu Yang(Huahai Marine consultation), Dr Chao Lu (Ningde marine environmental monitoring center, SOA)