

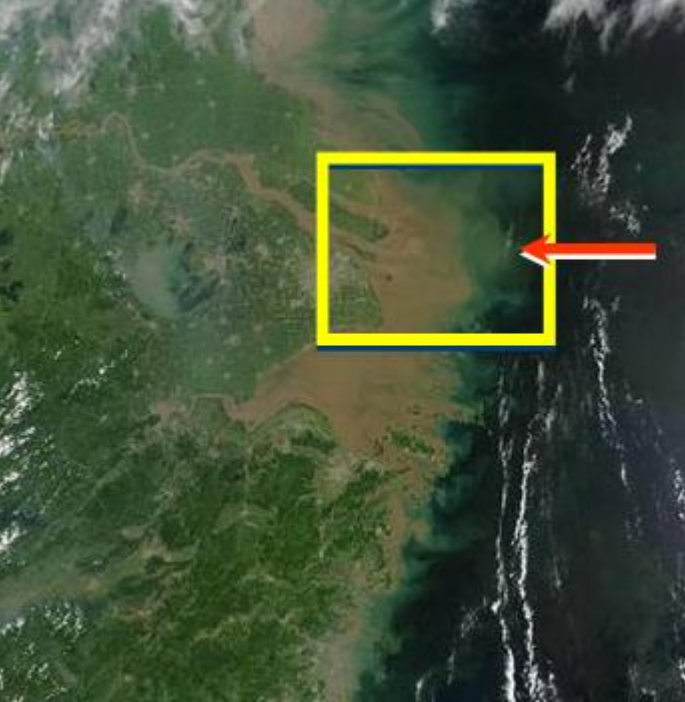
Dominant zooplankton species shift in the Changjiang River Estuary and its possible causes

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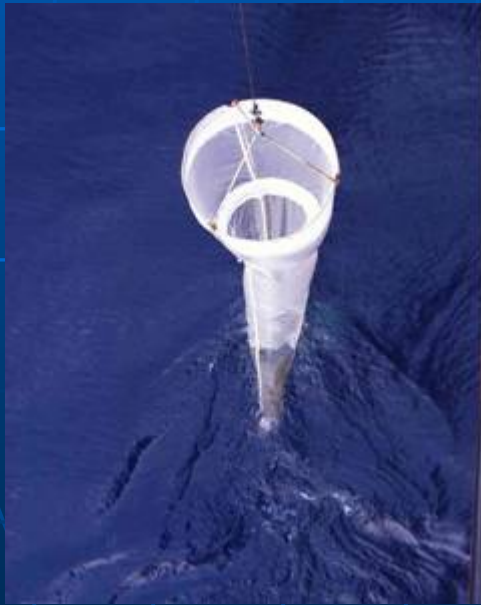
The Changjiang River Estuary (CRE) had attracted attention, because:

- Traditional fishing grounds
- The Changjiang River Diluted Water
- Construction of the Three Gorges Dam

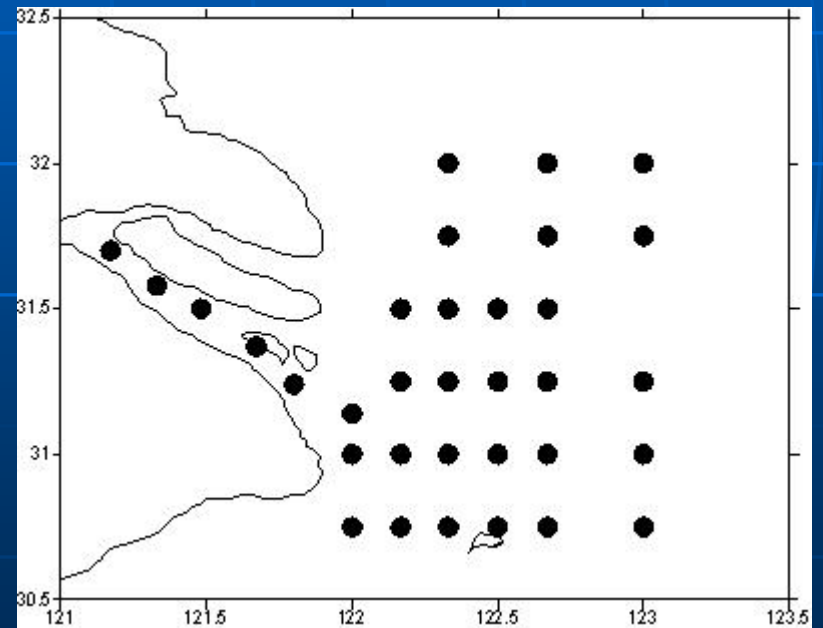


Seasonal investigation was carried out in Spring (May), Summer (August), Autumn (November) and Winter (February) 2004.

Zooplankton sampled by vertical net tows revealed similar community structure with previous studies in all seasons but summer, when *Temora turbina* became the most abundant species.



Conical plankton net
(500 μ m, 0.5m²)



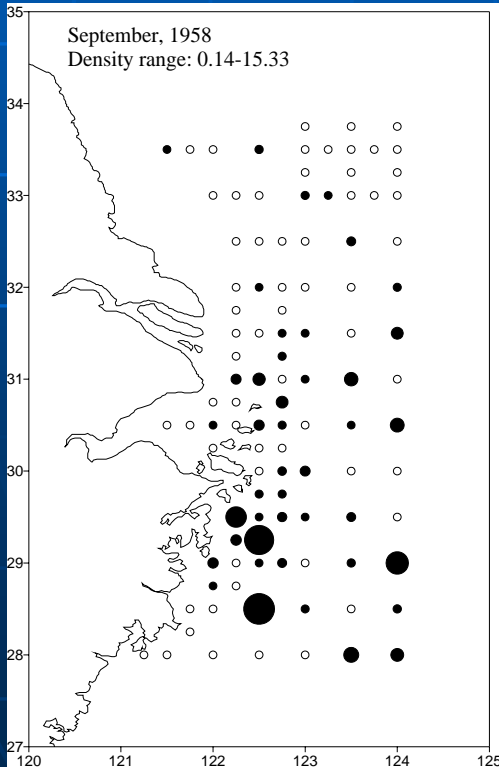
Sampling Sites

Unexpected increase of *Temora turbinata*

T. turbinata is usually considered as tropical-subtropical copepod species (Goswami & Padmavati 1996; Lopez-Salgado & Suarez-Morales 1998; Ara 2002; Dunbar & Webber, 2003).



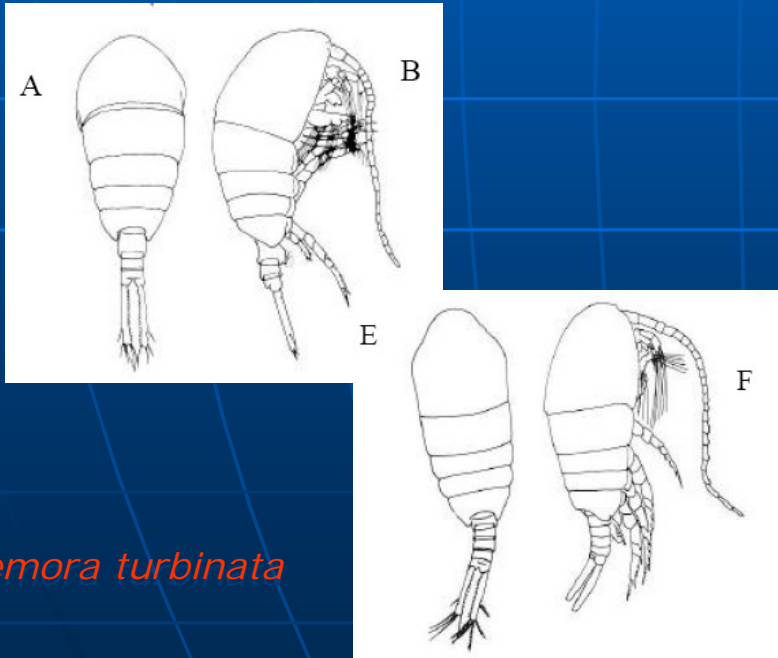
Temora turbinata



It can be sampled in the north of East China Sea and the Yellow Sea in summer, but the density was very low (Zheng et al. 1982).

Unexpected increase of *Temora turbinata*

In August 2004, tropical-subtropical copepod *Temora turbinata* (Dana, 1849) was found the most abundant zooplankton species, while previous dominant species, such as *Calanus sinicus*, *Euchaeta concinna* and *Labidocera euchaeta*, decreased in density and appearing frequency.



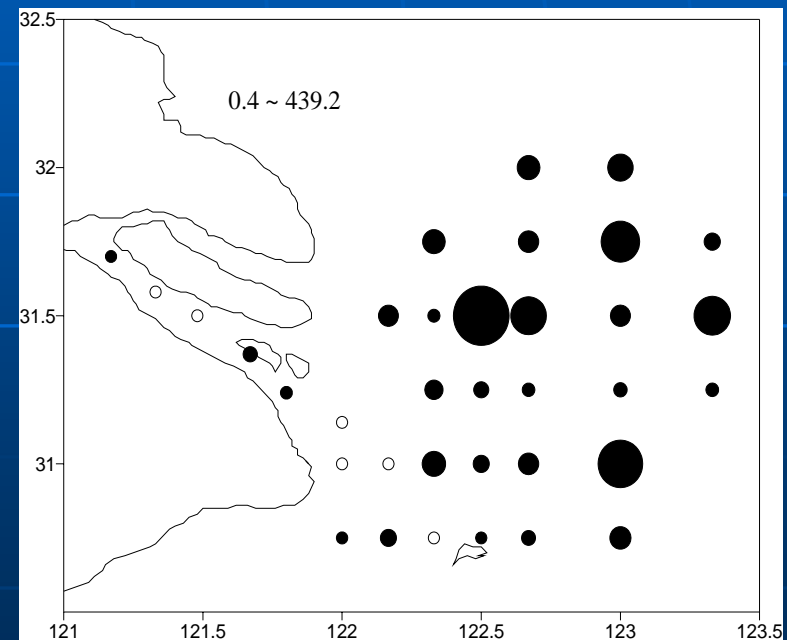
Taxon	Aug. 1986	Aug. 2002	Aug. 2004
<i>Calanus sinicus</i>	0.11	0.50	
<i>Labidocera euchaeta</i>	0.03		
<i>Centropages dorsispinatus</i>	0.03		0.07
<i>Paracalanus spp.</i>			0.04
Euchaeta larvae		0.04	
<i>Temora turbinata</i>			0.09
<i>T. discaudata</i>		0.02	
<i>Acartia pacifica</i>	0.04	0.04	0.08

Dominance index $Y = (n_i/N) \times f_i$

Unexpected increase of *Temora turbinata*

It became the most abundant zooplankton species in this area, with a highest density of 439.2 ind.m⁻³

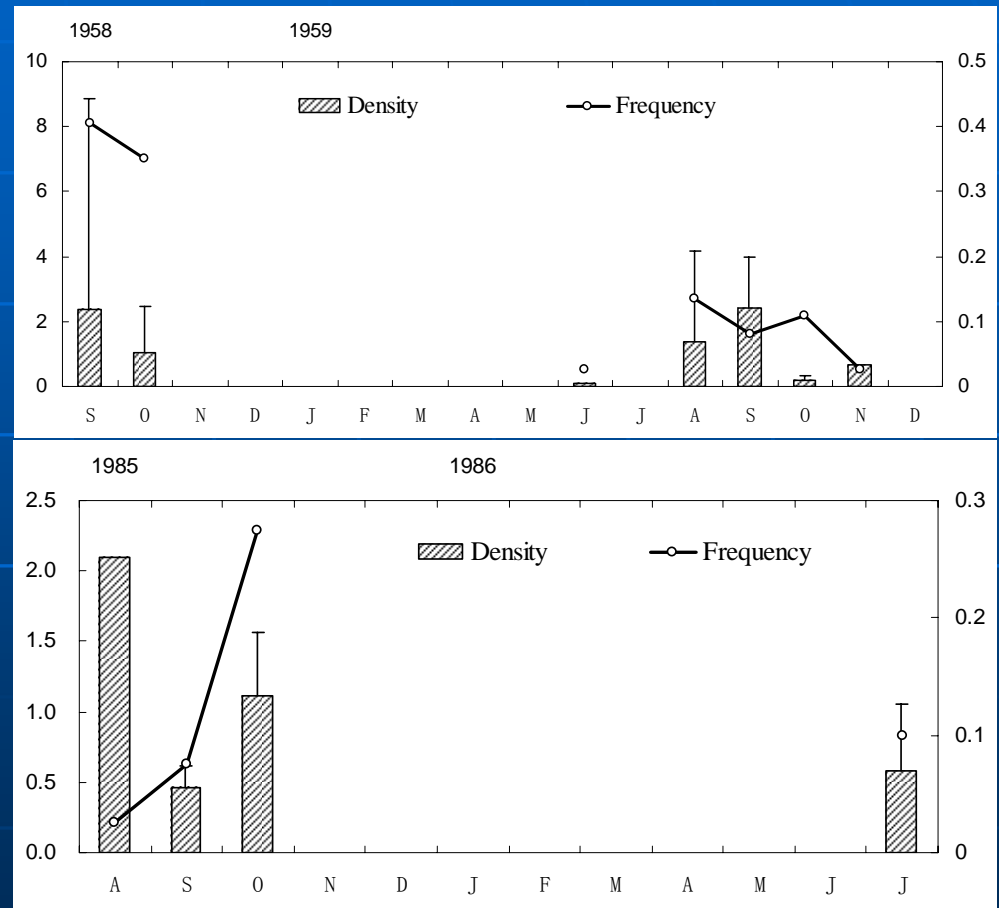
It was observed even inside the river mouth.



Geographical distribution

Temora turbinata along China coasts – Historical data

In the Changjiang River Estuary, *Temora turbinata* was seasonally appeared and non-dominant.



Year-round occurrence in CRE area

Temora turbinata along China coasts – Historical data

T. turbinata presents perennially and dominates in certain months in both sides of Taiwan Strait.

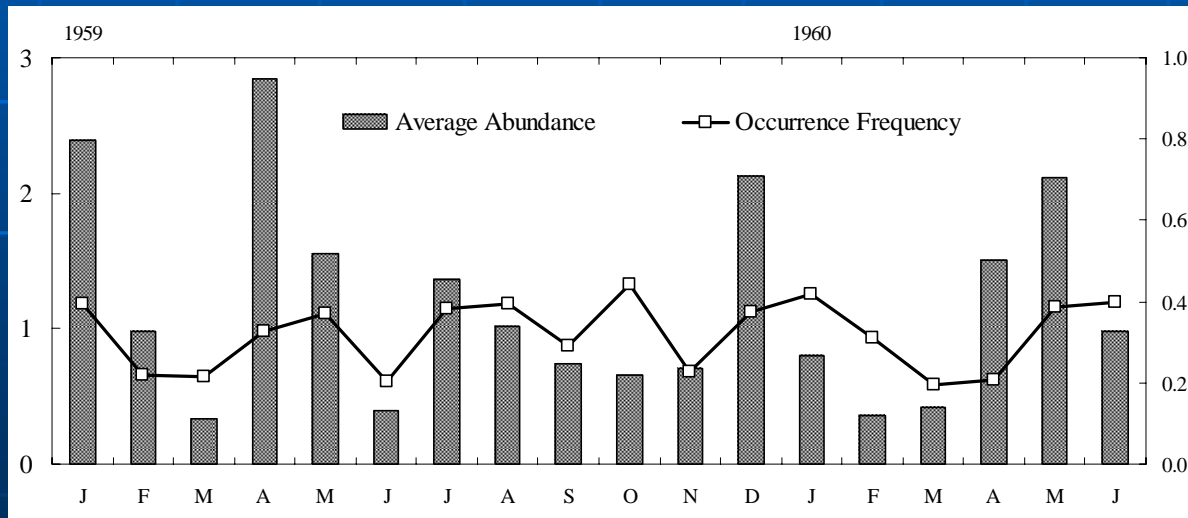
In the Jiulong River estuary, its density was about 11-100 ind m⁻³ from April to June, but less than 10 in the rest of a year (Huang & Chen 1985).

In the north of the Taiwan Strait and south of the East China Sea, it was predominant in August (Hsieh et al. 2005).



Temora turbinata along China coasts – Historical data

It presents perennially in coastal area of the South China Sea, appearing mainly at near-shore stations.



Temora turbinata in the South China Sea, data from 180 stations

T. turbinata tends to be non-endemic species in the Changjiang River Estuary, and its recruitment depends on transportation from south area.

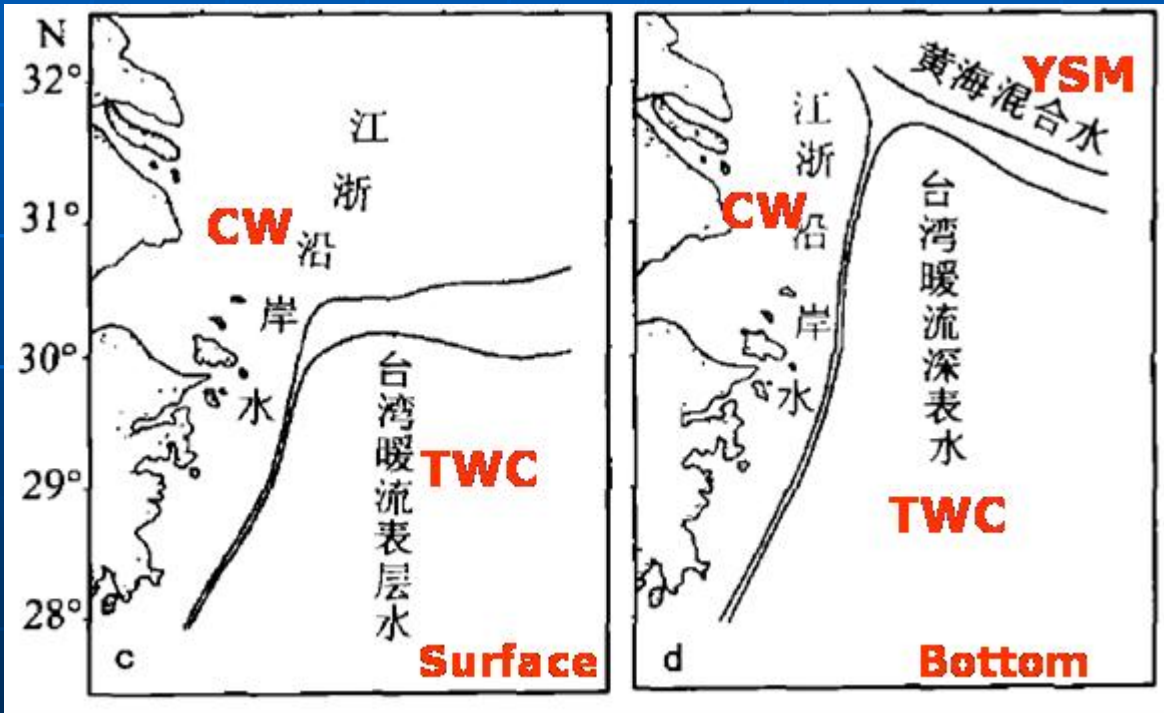
Seasonally occurrence in CRE area but perennially in Taiwan Strait;

Peaked after August in CRE area but April to June in the Jiulong River Estuary.

Physical conditions for transportation into CRE

In summer, both the TWC and CW flow northwards ;

Northwards invasion of the TWC is counteracted by freshwater discharge.



CW: Coastal Water

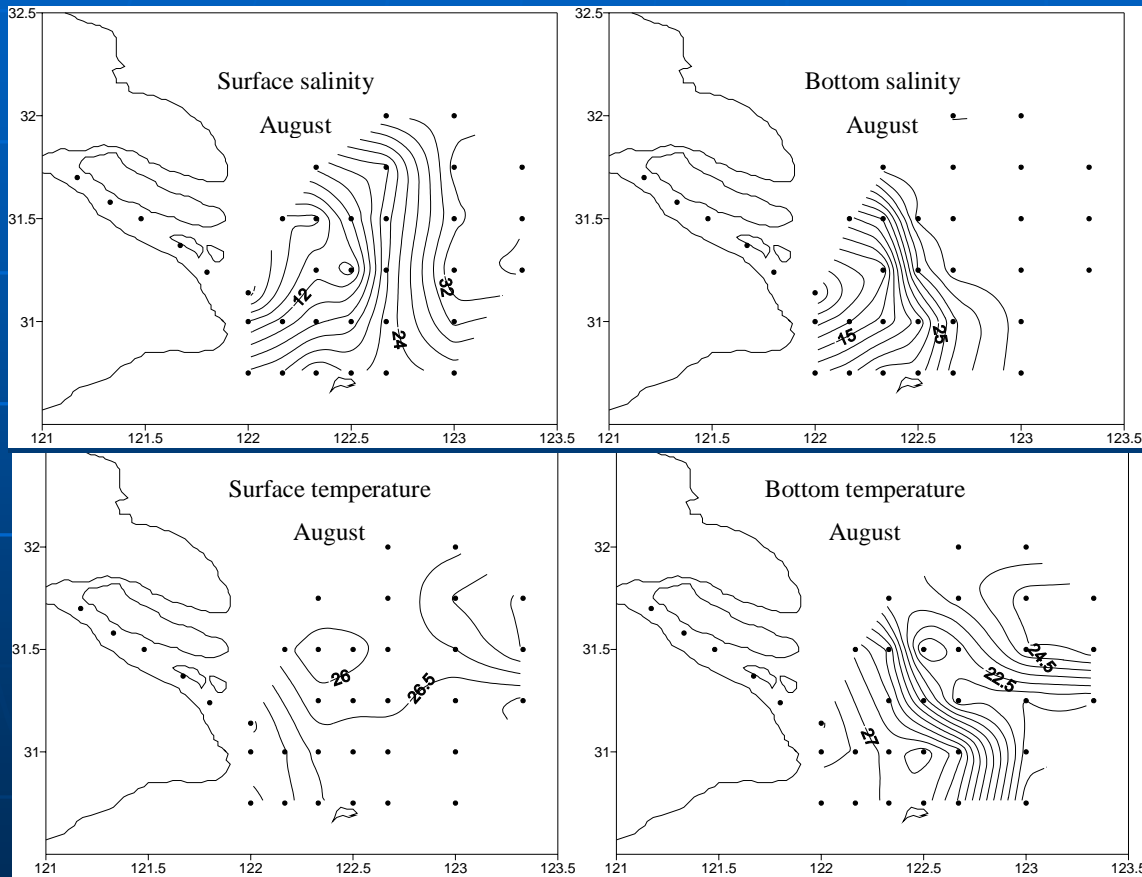
YSM: Yellow Sea Mixed Water

TWC: Taiwan Warm Current

Water mass distribution in this area

From Zhang & Wang (2004)

Physical conditions for transportation into CRE



Freshwater discharge was smaller than the long-term average of in August. TWC water occupied a large area in CRE.

Environmental conditions in August 2004

However, the transportation of TWC itself can not explain the prosperity of *T. turbinata*.

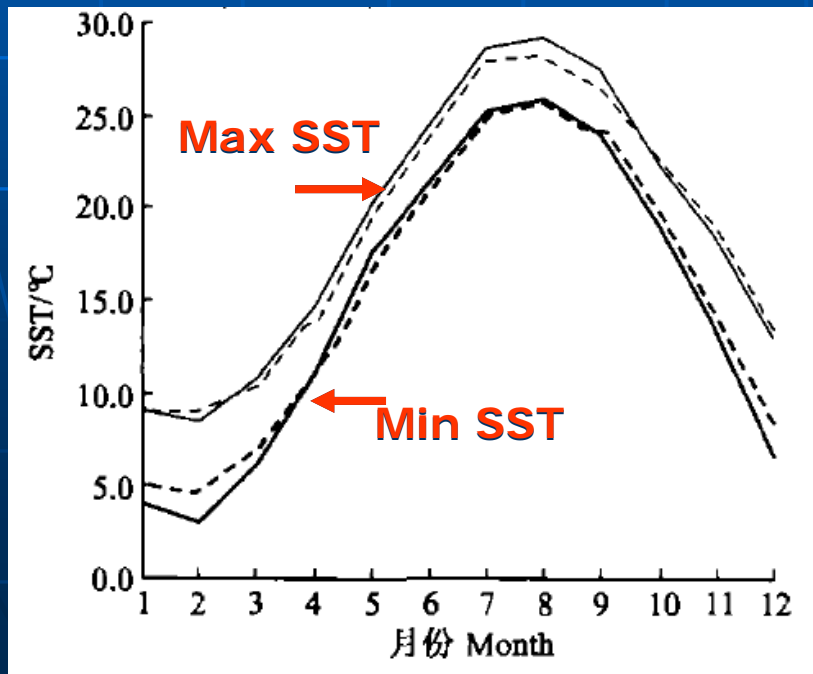
At first, the maximum density observed here is even higher than those from the Taiwan Strait.

Secondly, large amount of *T. turbinata* was not observed in previous studies, such as August 2000, when freshwater discharge was even lower than this study.

T. turbinata presented all year round within a temperature range of 18.6-29.6° C;

T. turbinata is known adapted to high temperature (27-30°C) (Hopcroft and Roff, 1998);

In CRE area, temperature falls in its favorite range from July to September in warm years.



Annual max and Min monthly mean values for SST variation
From Zhou et al., (2005)

Although appeared immediately following water control of the Three Gorges Reservoir, the unexpected increase of *Temora turbinata* is not likely resulted from the induced changes of freshwater discharge.

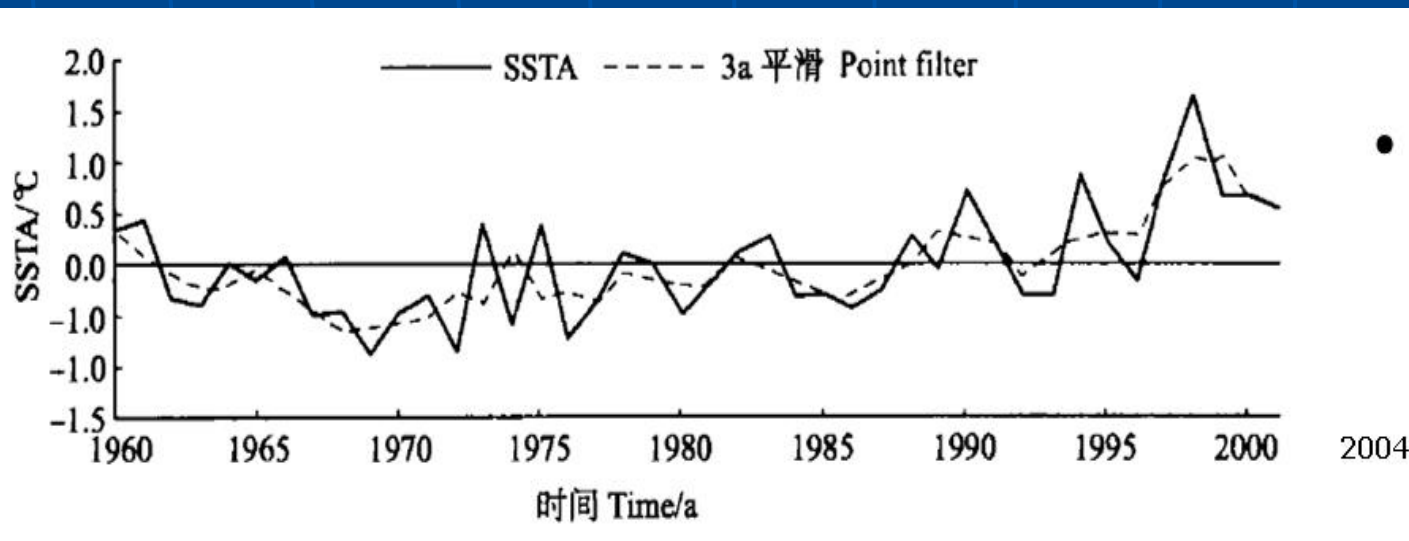
At first, low freshwater discharge can not be induced by water control of the TGR.

Secondly, *T. turbinata* population size tends to be controlled by temperature, rather than salinity.

Possible reasons for prosperity in CRE

The dominant species shift can be a case of northward extension of warm-water species resulted from global warming.

According to inter-annual SST variation, the Changjiang Estuary has entered a warm period since 1986 (Zhou et al., 2005). The SST anomaly in 2004 is positive, indicating that it's also a warm year (Zhou, personal communication).



SSTA time series in the Changjiang estuary

Zhou et al. 2005

Conclusion

Since only seasonally presents, *T. turbinata* may be introduced into CRE area by northwards invasion of the TWC.

Range and amount of transportation are determined by river discharge.

Population abundance depends on local environmental conditions, mainly water temperature.

Climate change is the most possible reason for the unexpected increase of *T. turbinata*.



Thanks for your attention !