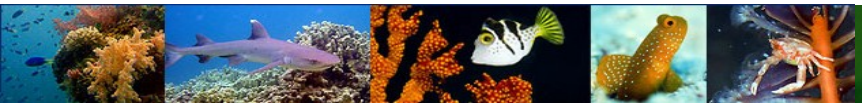
国家海洋局
State Oceanic Administration People's Republic Of China

Zooplankton diversity and its long-term variation in China Sea: implications of climate change

Qing Yang, Hongjun Li

National Marine Environmental Monitoring Center, China

2012.5.18

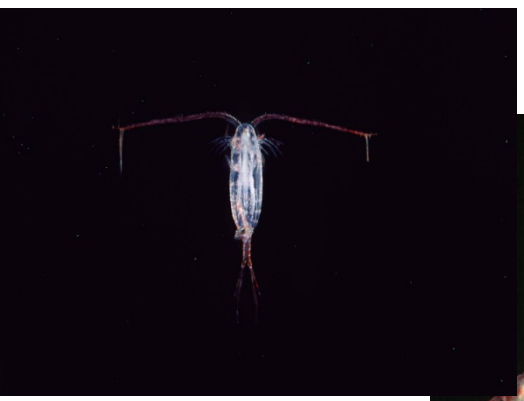


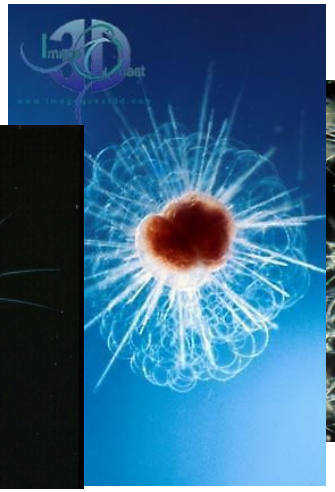
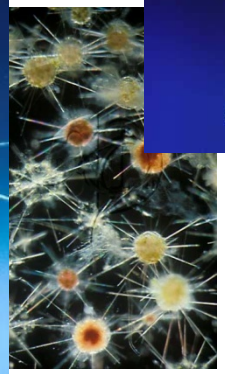
Introduction and brief summary of methods

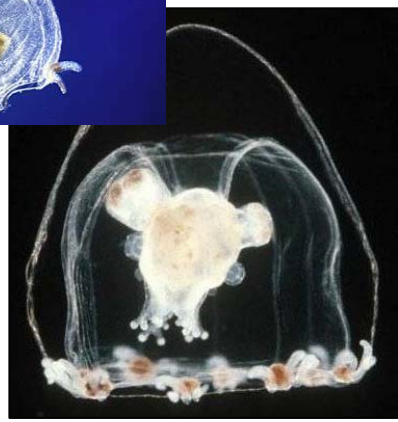
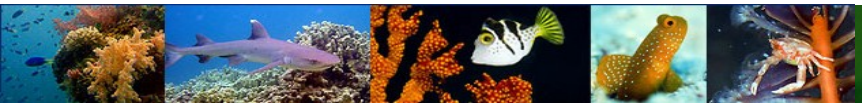
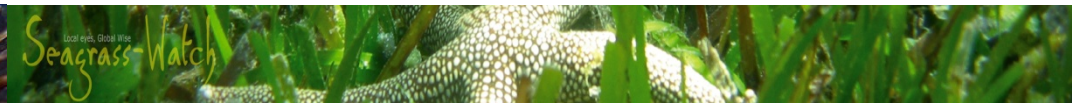
❖Zooplankton-good indicator of climate change

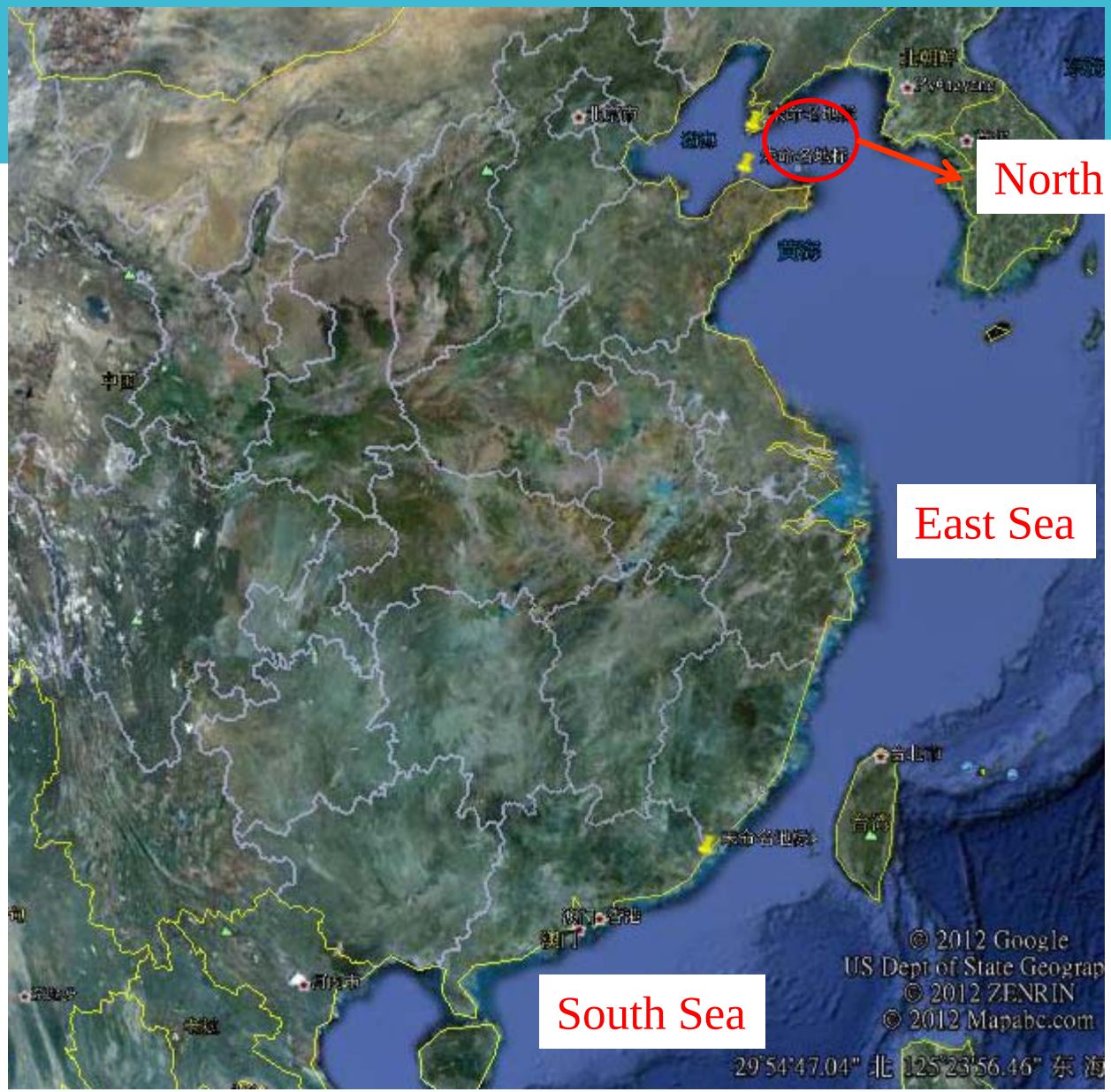
1. Few Zooplankton species have been commercially exploited.
2. Short life history.
3. Dramatic changes in distribution due to free floating character.
4. Nonlinear responses of biological communities

➞amplify environmental perturbations?

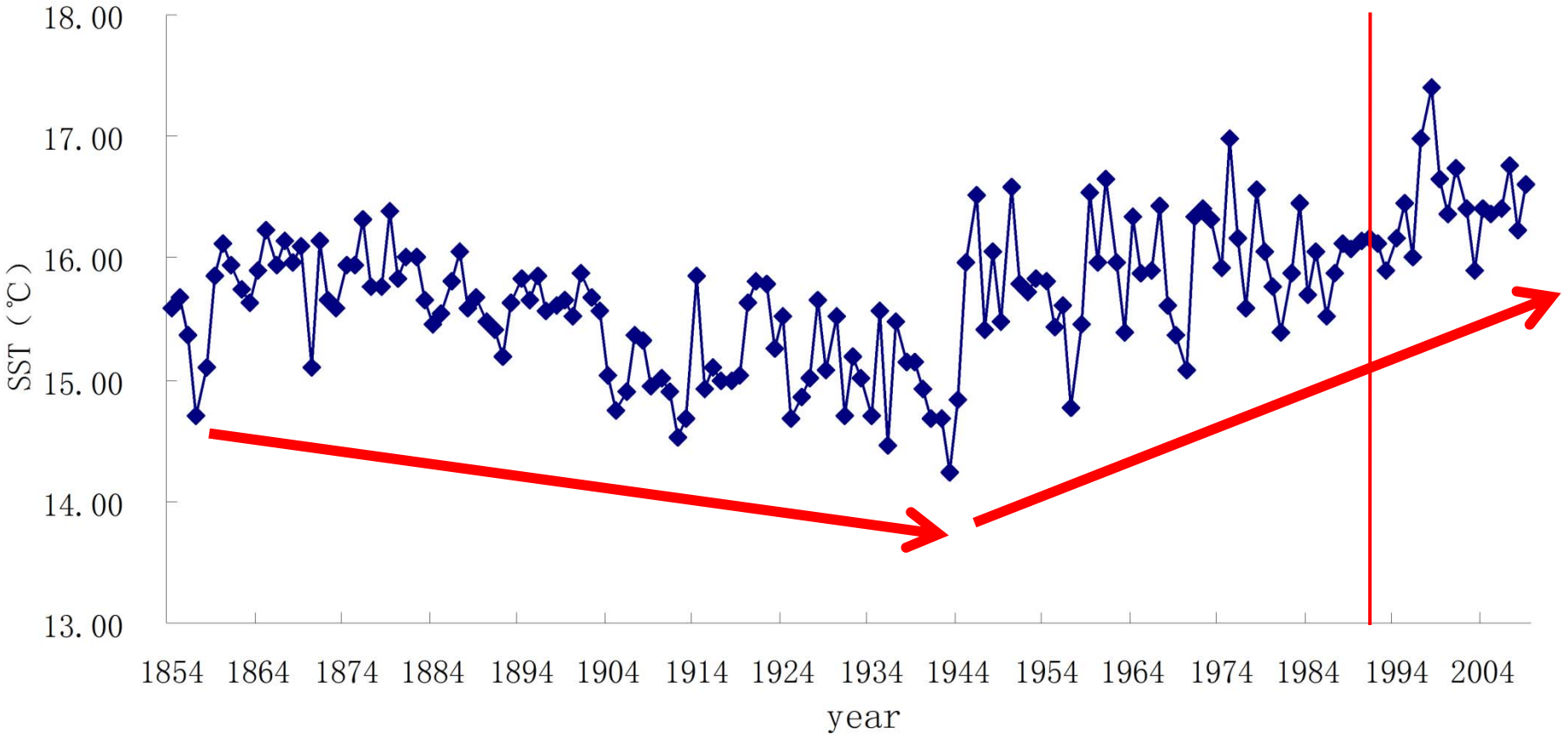


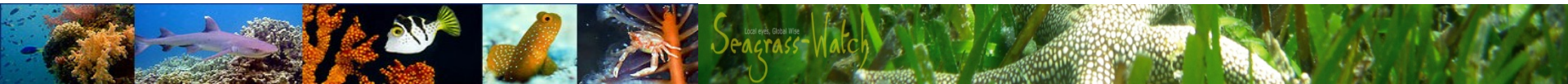




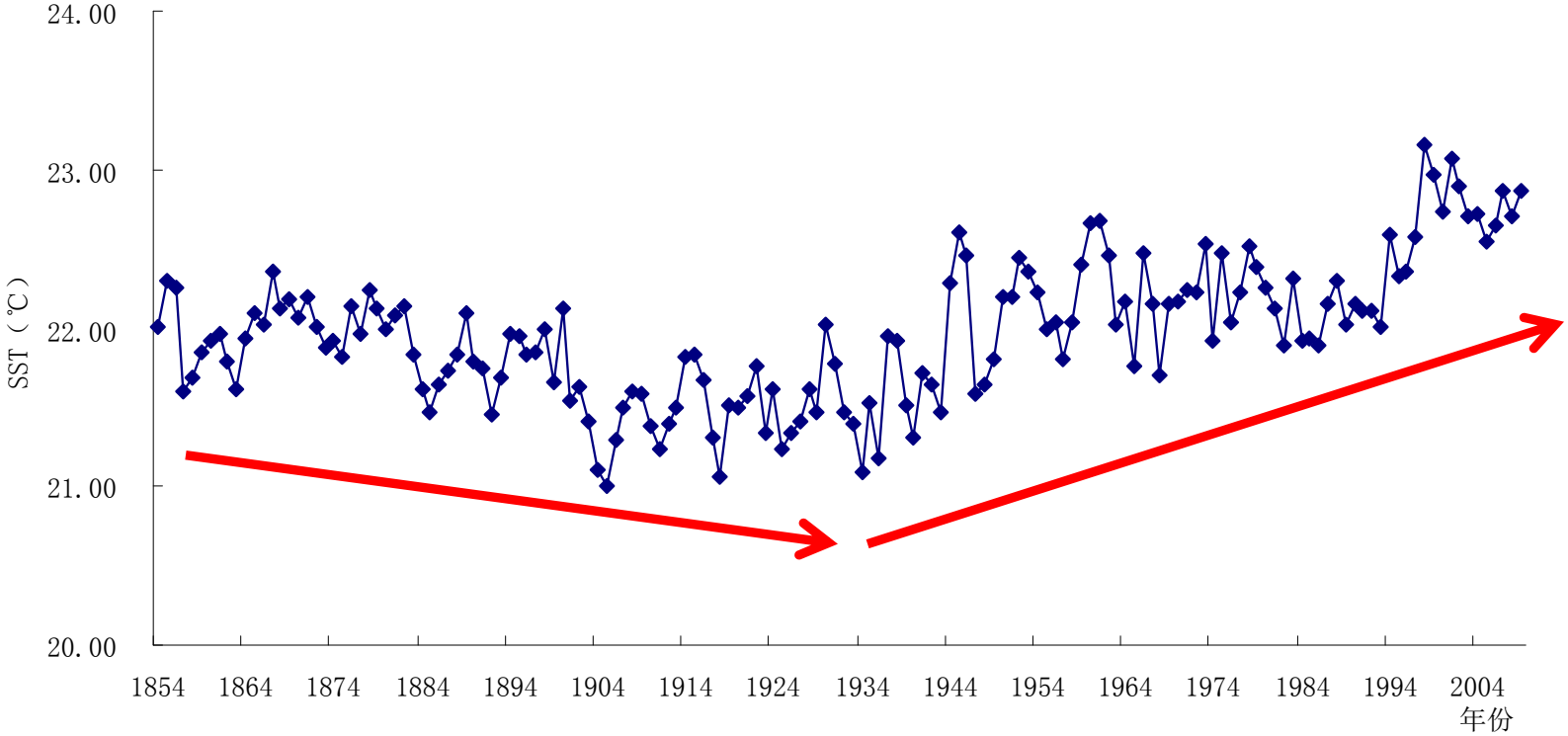


Overview of Marine Environment Monitoring in China

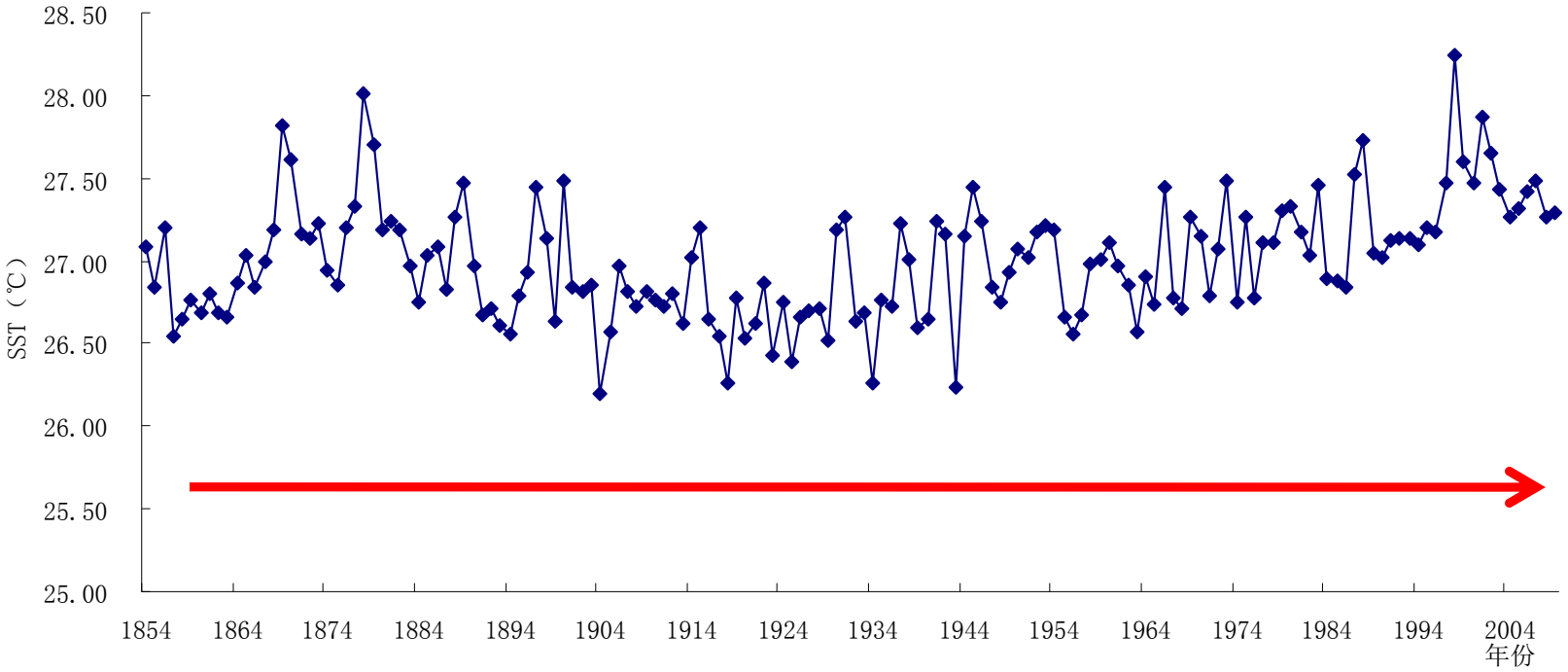



Mean annual sea surface temperature (SST) of Northern Yellow Sea in the past 100 years

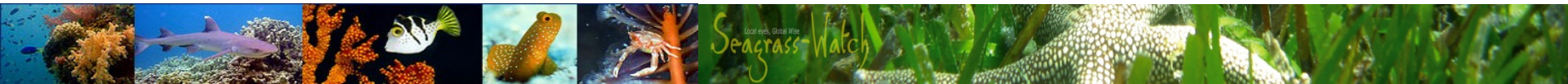




Mean annual sea surface temperature (SST) of East Sea in the past 100 years



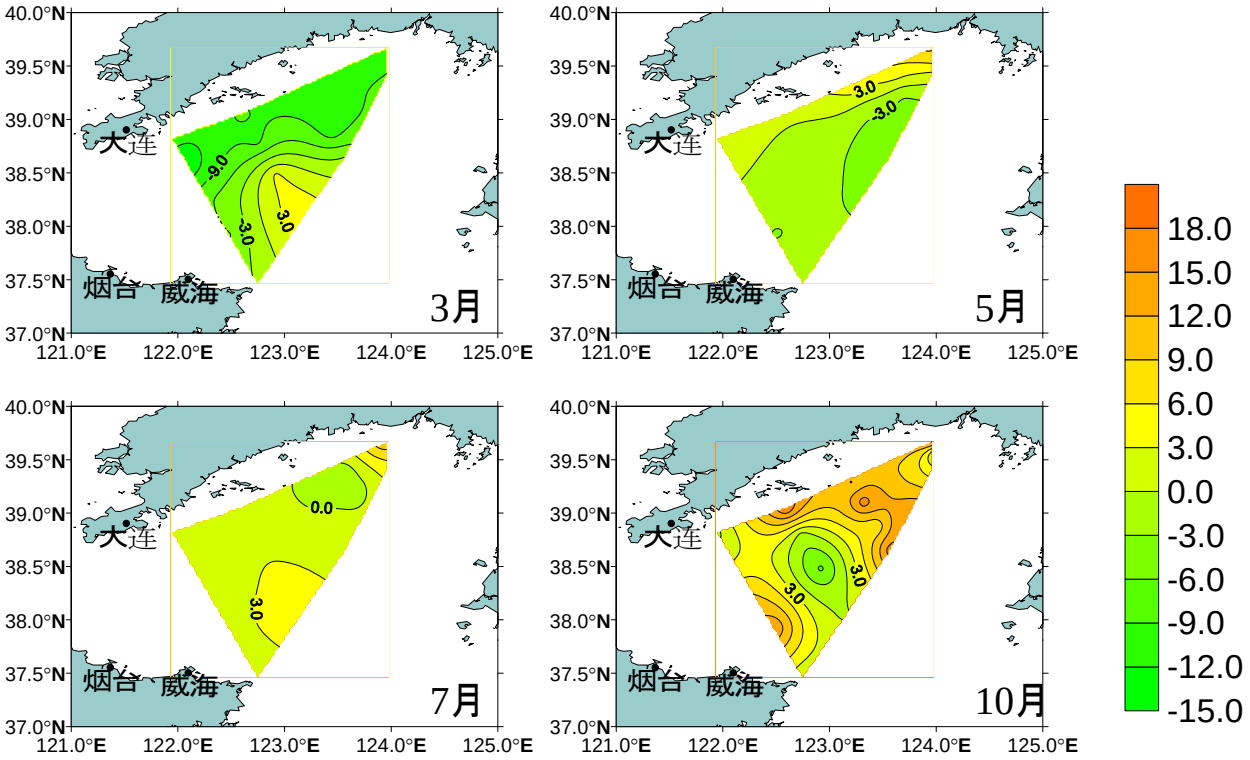
Mean annual sea surface temperature (SST) of South Sea in the past 100 years



Sea surface CO_2 divider and sea-air CO_2 exchange in Northern Yellow Sea in 2009

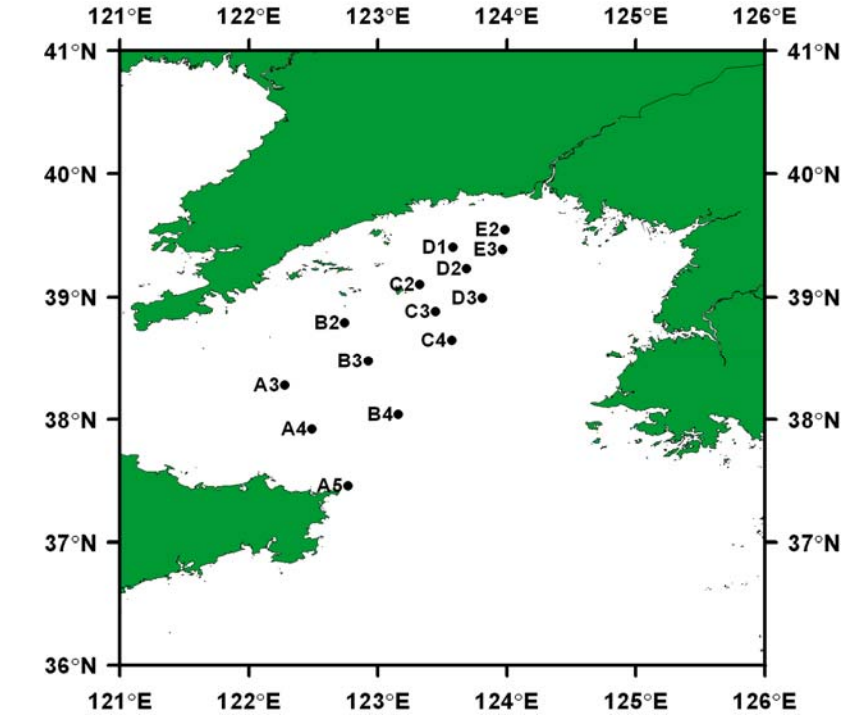
Time	Sea surface CO_2 divider （μatm）	Mean value for Sea surface CO_2 divider （μatm）	Mean value for sea-air CO_2 exchange （mmol·m^{-2}·day^{-1}）
March	261~444	322	-7.2±1.2
May	330~469	392	0.6±0.6
July	305~566	405	1.5±1.4
October	338~534	441	6.3±3.6

Note: positive value means sea releasing CO_2 to atmosphere (carbon source); negative value means sea absorbing CO_2 from atmosphere (carbon converge).

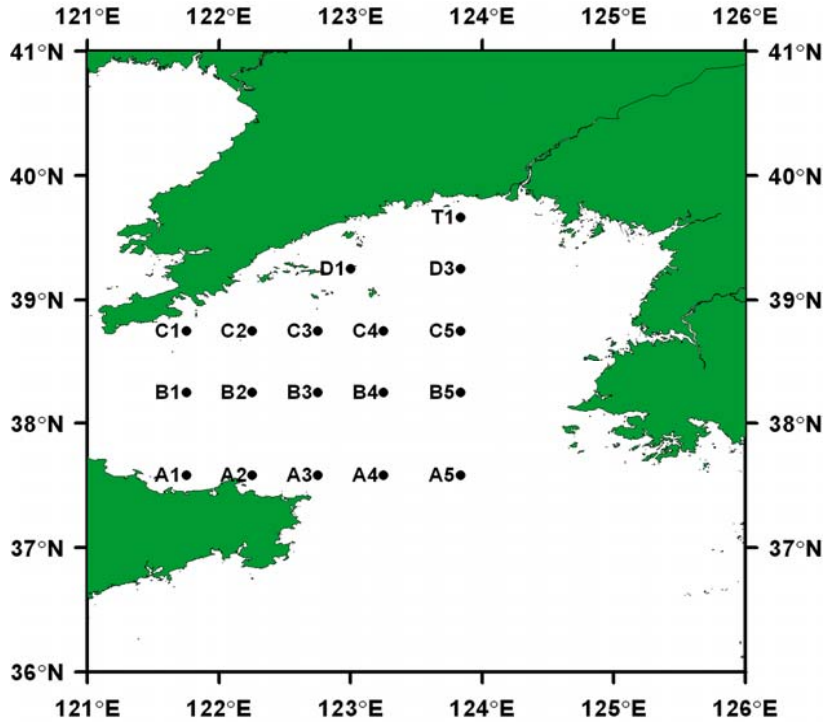


Distribution of sea-air CO_2 exchange ($mmolm^{-2} \cdot day^{-1}$) in North Yellow Sea in 2009

Effects of climate change on zooplankton diversity



Vs.



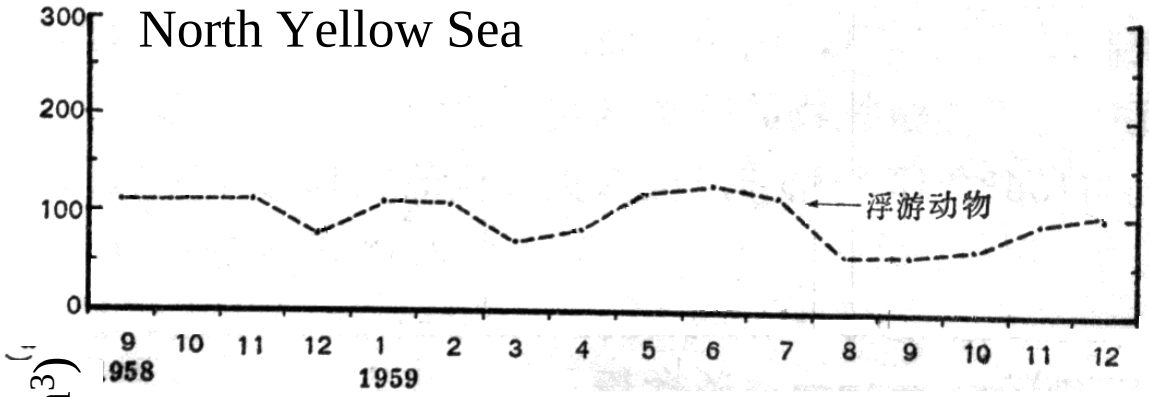
1959

2009, 2010

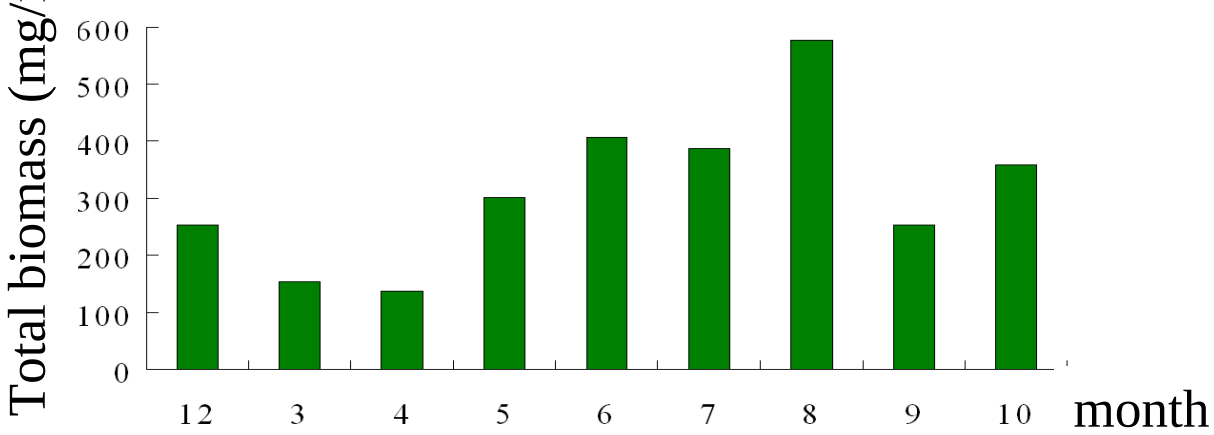
Zooplankton monitoring stations in North Yellow Sea

Zooplankton diversity comparision (1959 vs. 2009)

Zooplankton total biomass increased and season variation changed.

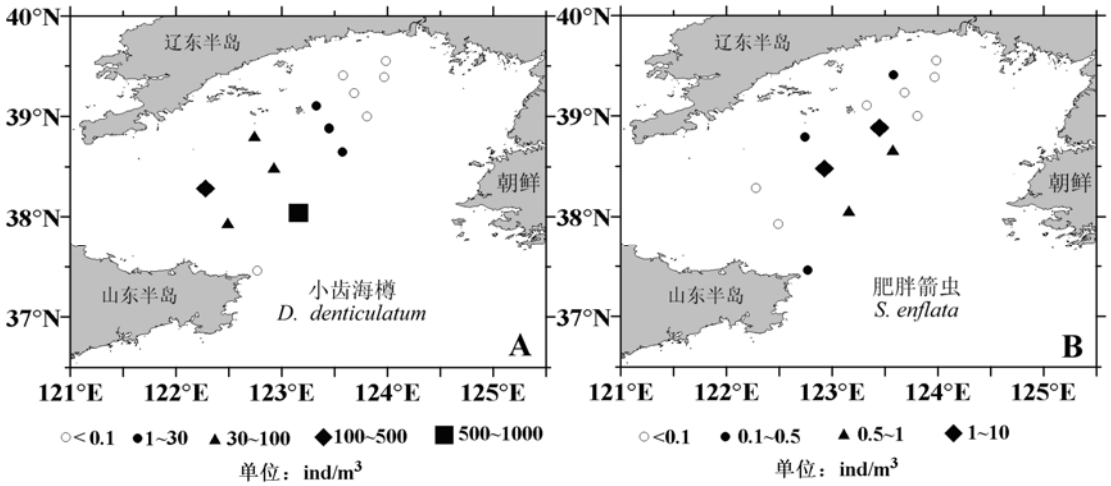


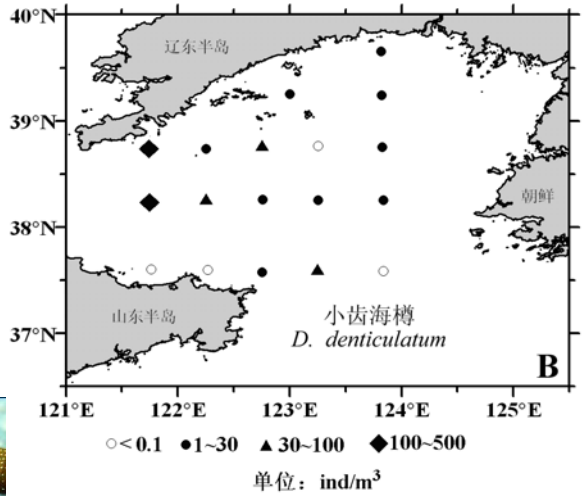
1958~1959



2009~2010

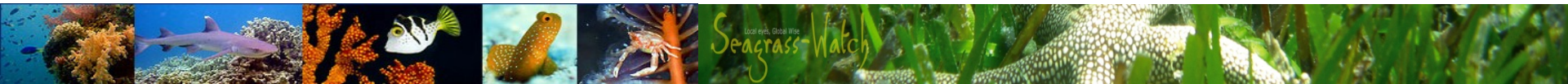
- Zooplankton community structure changed, with warm-temperate species moving northword.



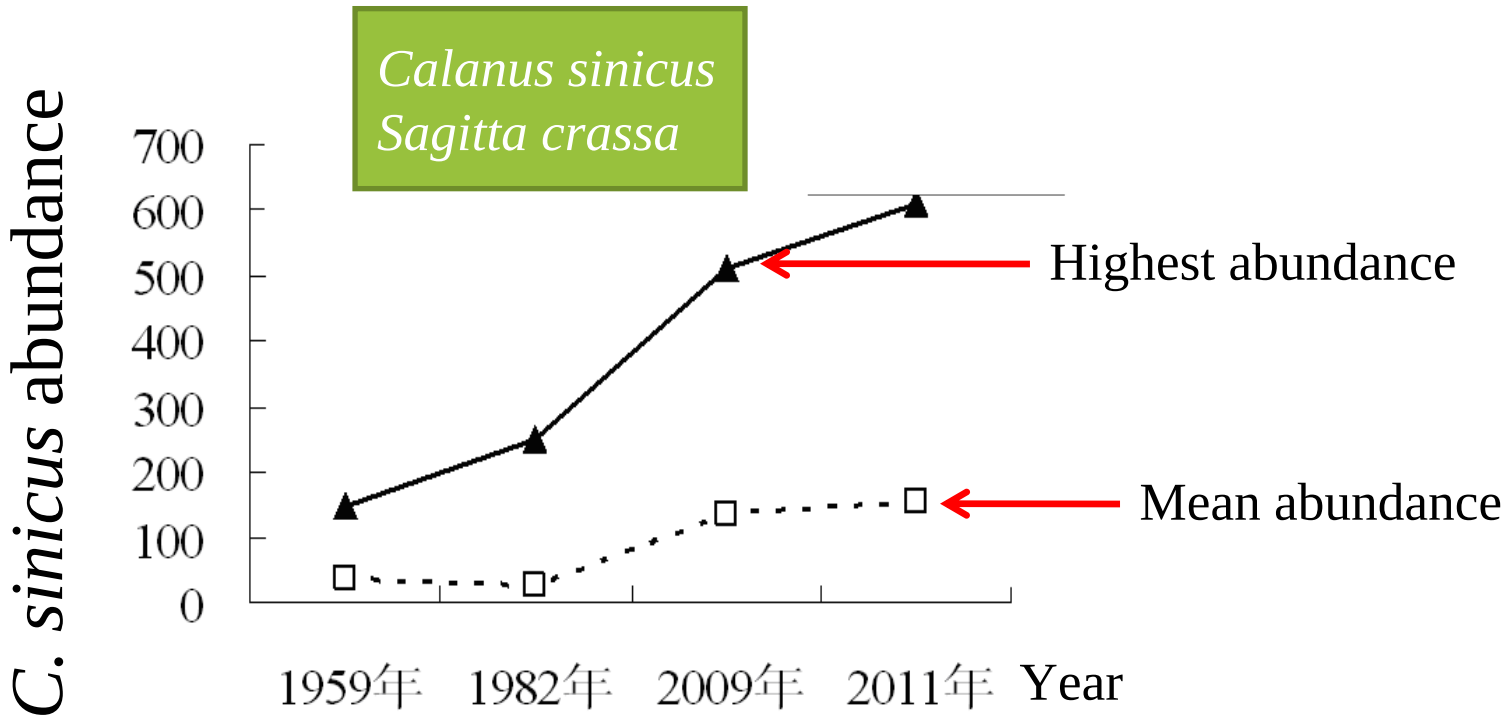



Abundance of two warm-temperate species in 1982 and 2009.

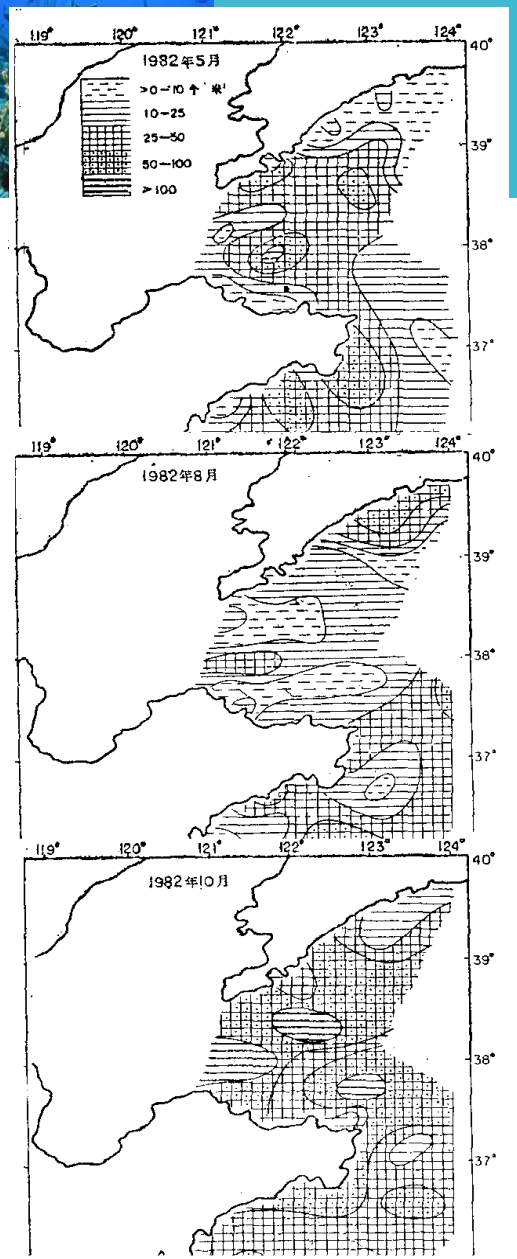
Species	Year	Mean abundance (ind/m^3)	Highest abundance (ind/m^3)
Doliolum denticulatum	1982	62.38	571.42
	2009	81.00	817.50
Sagitta enflata	1982	0.01	0.39
	2009	0.24	2.50

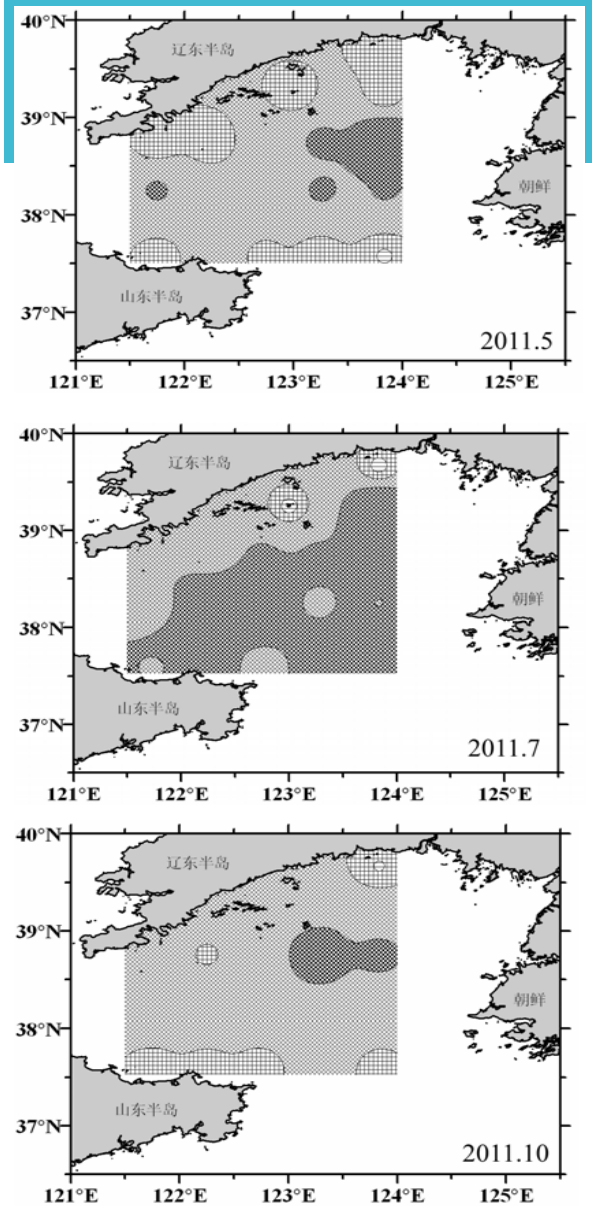


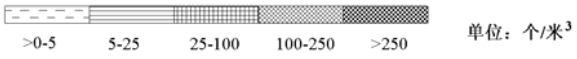
- Dominant species in 1959, 1982 and 2009:



Abundance of *Calanus sinicus* in 1959, 1982 and 2009.



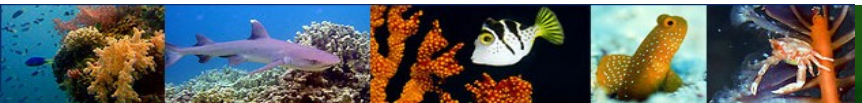




Spatial and temporal distribution of *Calanus sinicus* in 1982 and 2011.

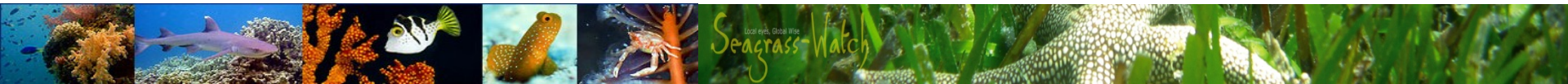
Possible causes

- Climate change (warming)
- Fishing presure
- Pollution input
- Invasion of alien species

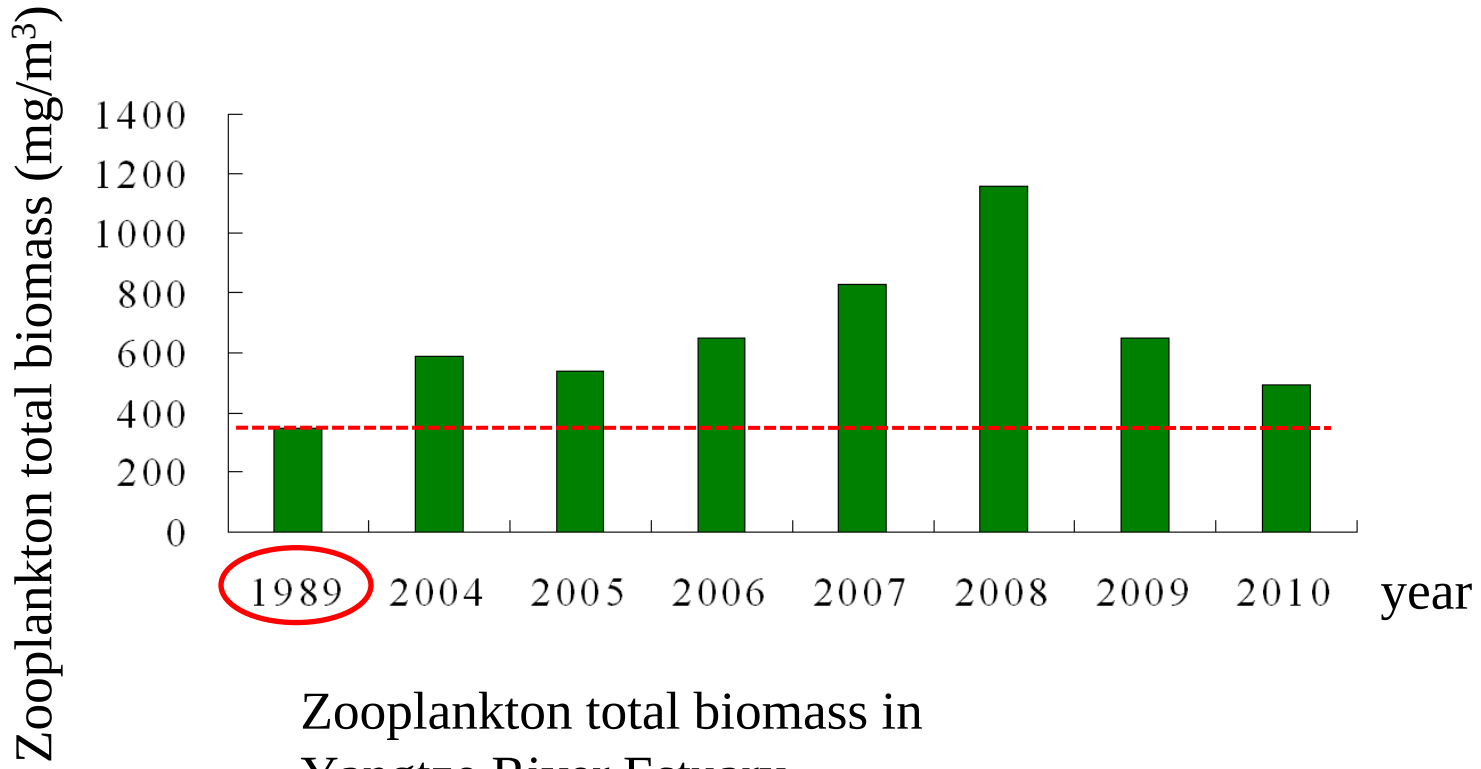


Evidence from East Sea

- **In the past 50 year, the total biomass of zooplankton in the Yangtze River Estuary increased in response to climate change; zooplankton community structure changed, with warm water species abundance increased and warm temperate species abundance reduced; replacement of main group and dominant species is not obvious; copepods percentage showed a downward trend, while medusa percentage increased; zooplankton community structure and ecological patterns changed significantly.**

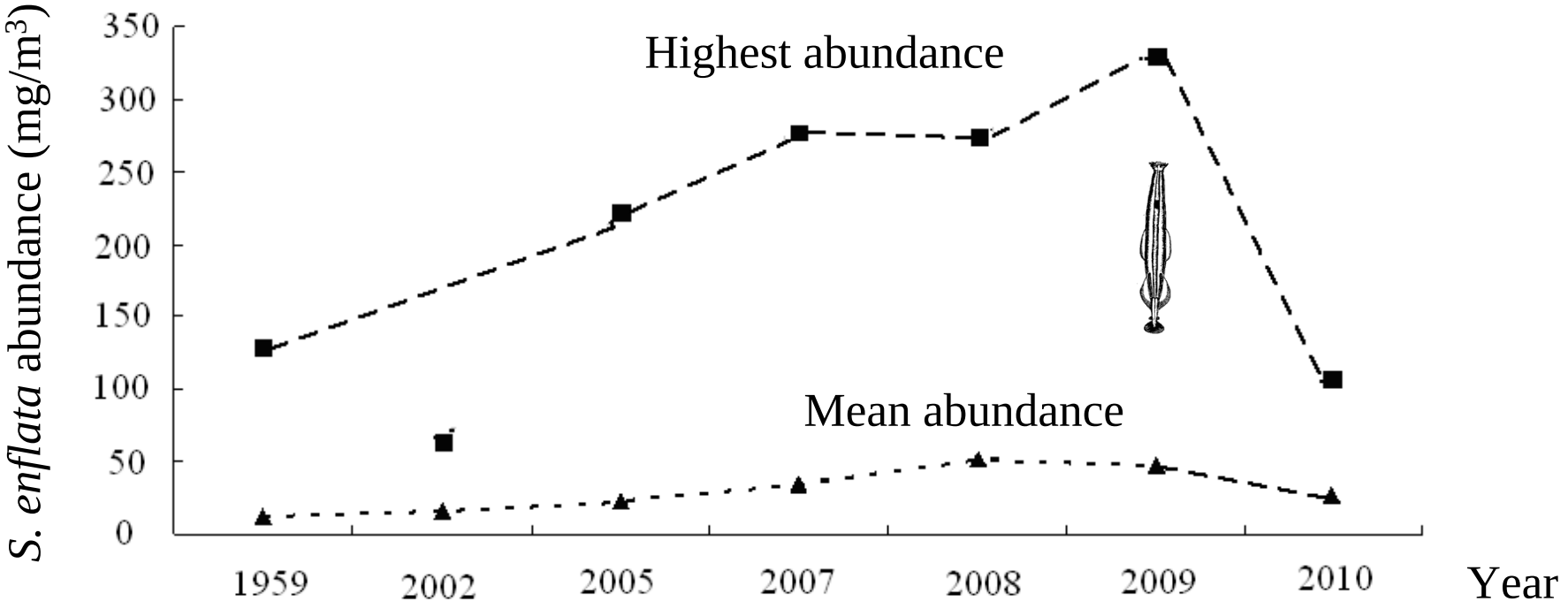


Zooplankton total biomass increased



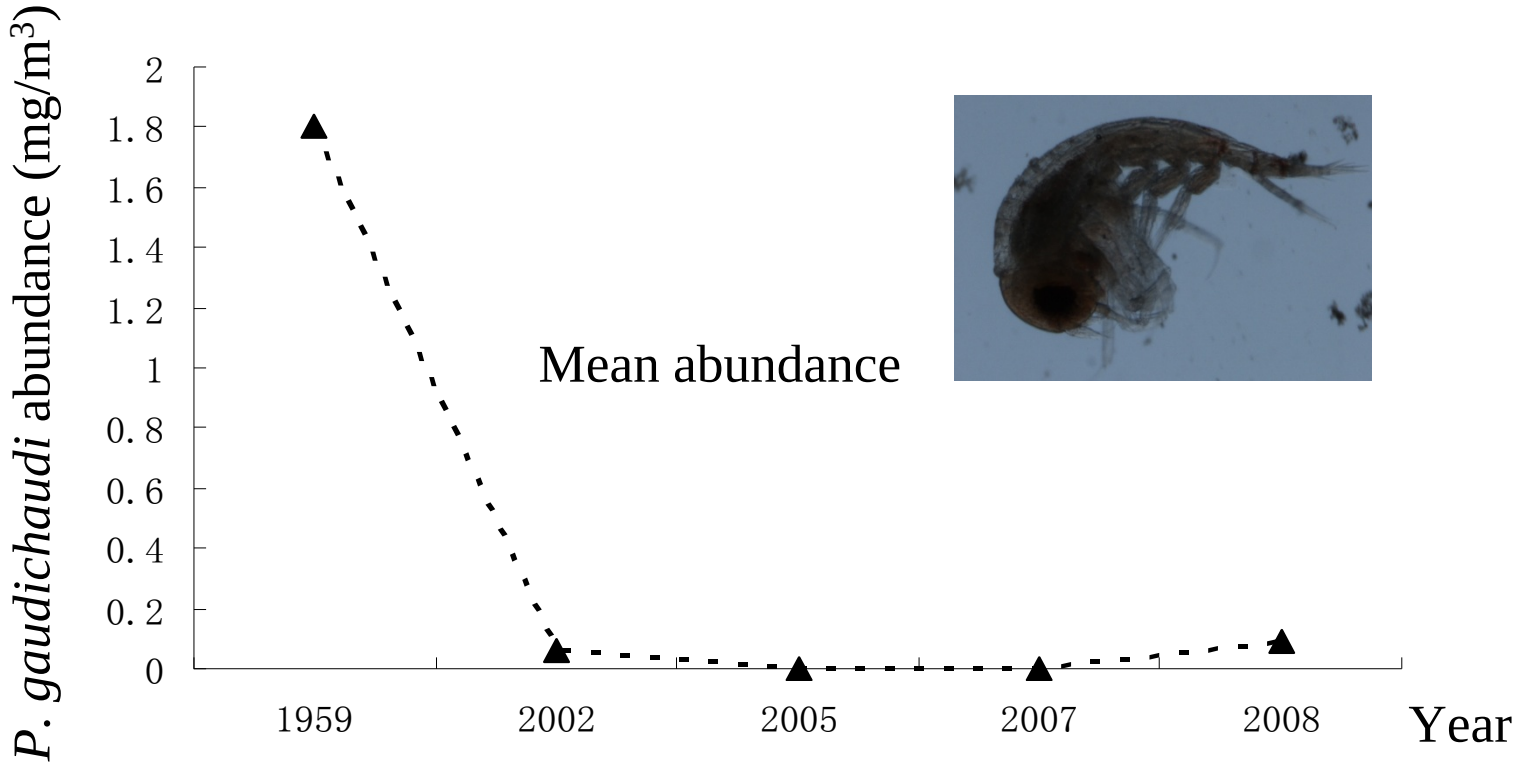
Zooplankton total biomass in
Yangtze River Estuary

Warm water species abundance increased



Sagitta enflata abundance in summer

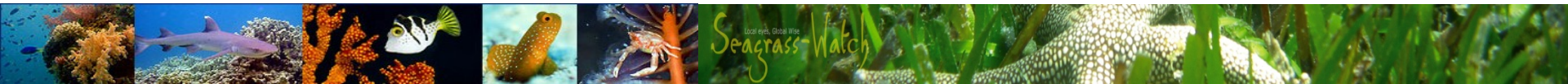
Warm-temperate species abundance reduced



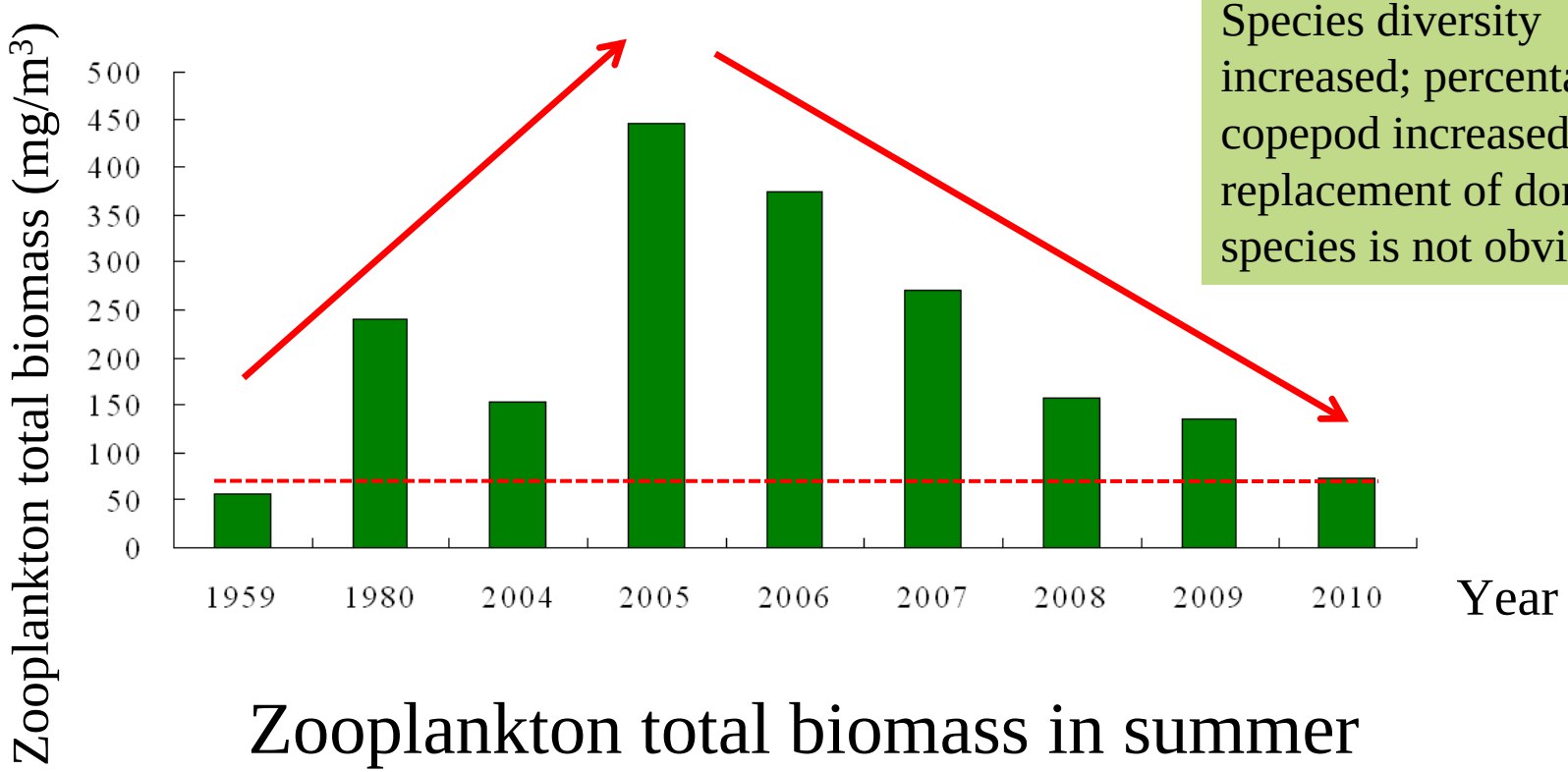
Parathemisto gaudichaudi abundance in summer

Evidence from South Sea

- In the past 50 years, zooplankton total biomass first increased and then decreased to the level of 1959 in 2009;
- Zooplankton species diversity in spring and summer showed an upward trend;
- The percentage of copepod showed an increasing trend;
- The replacement of dominant species has not occurred.

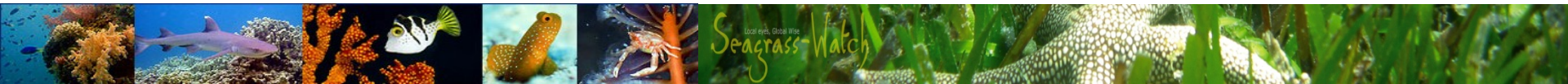


Zooplankton total biomass first increased and then decreased



Species diversity increased; percentage of copepod increased; the replacement of dominant species is not obvious.

Zooplankton total biomass in summer



Thank you

for your attention!