



Interannual variability in the zooplankton community and its relationship with environmental variables in the Bohai Bay, China

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S6 Interannual variability in marine ecosystems and its
coupling with climate projections

INTRODUCTION

Zooplankton Community

Important linkage between primary producers and upper trophic levels

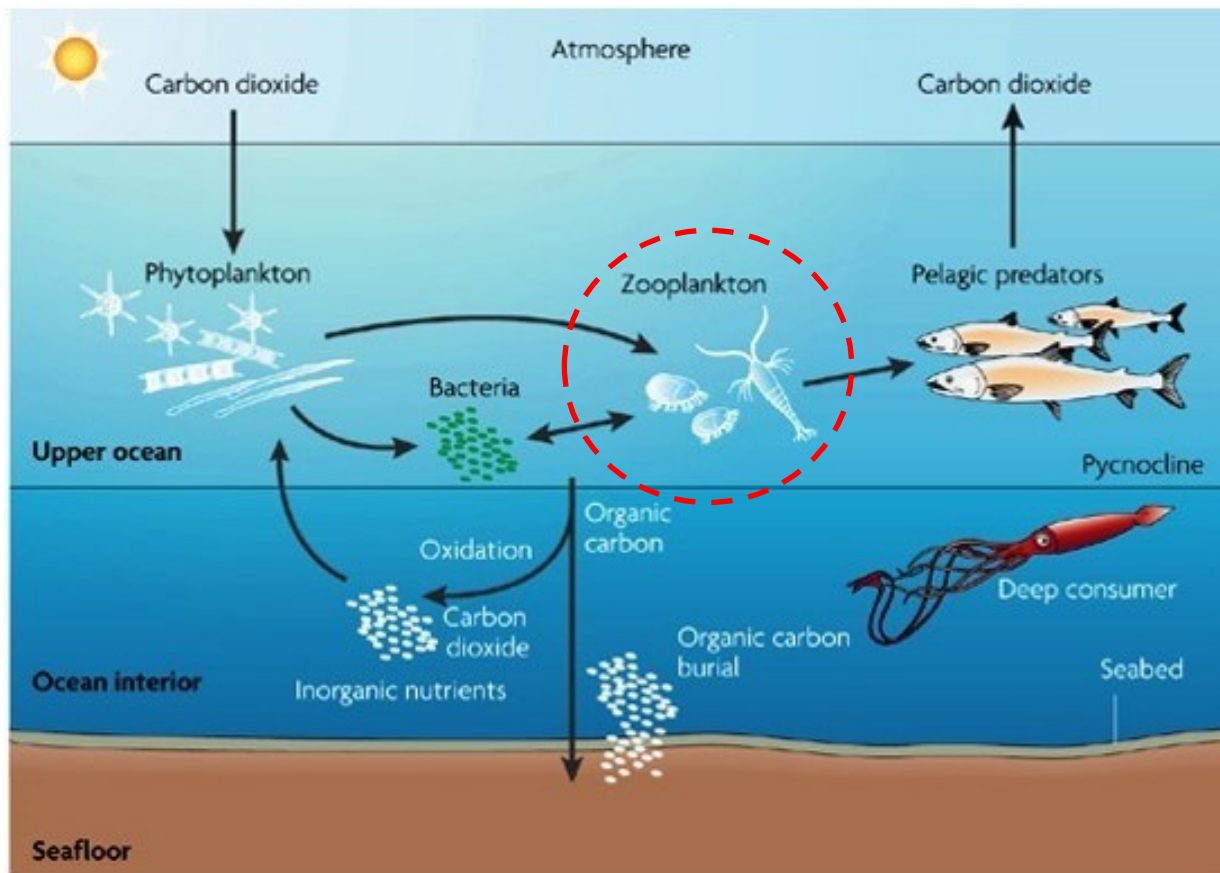


Fig.1 Representation of the marine food web.

Zooplankton Community

Important linkage between primary producers and upper trophic levels

Important role in biogeochemical cycles

Fast response to stressors through climate change or anthropogenic disturbances

Excellent sentinels for the study of relationships between biotic and abiotic environment

Zooplankton Community vs Climate Change

□ Changes in organism distribution

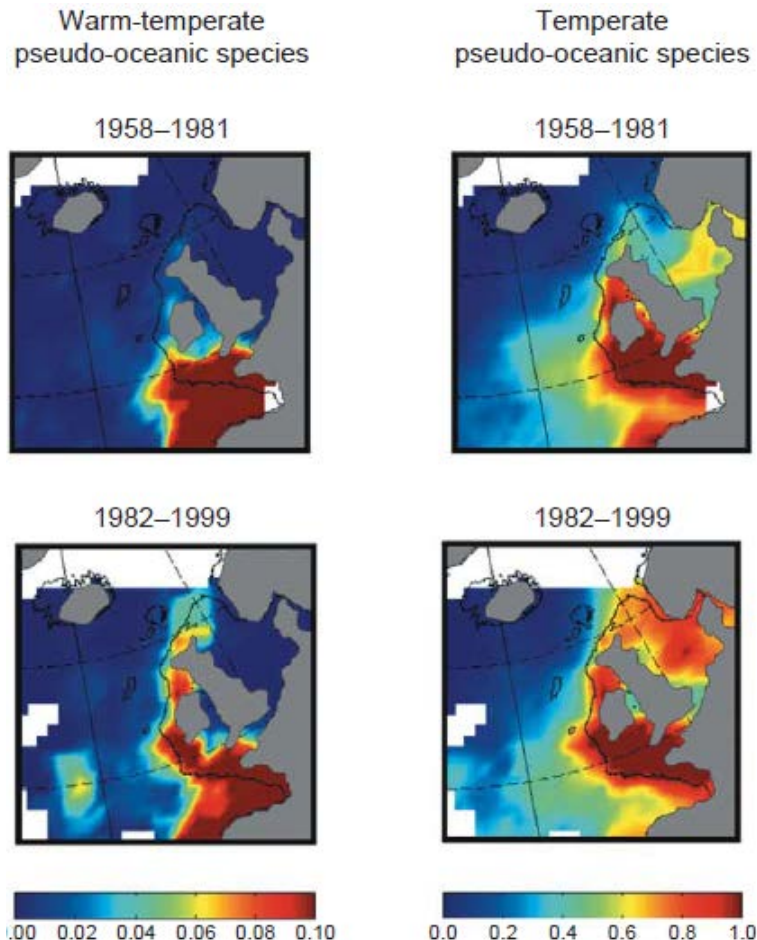


Fig.2 The northerly shift of mesozooplankton assemblages in the Northeast Atlantic.

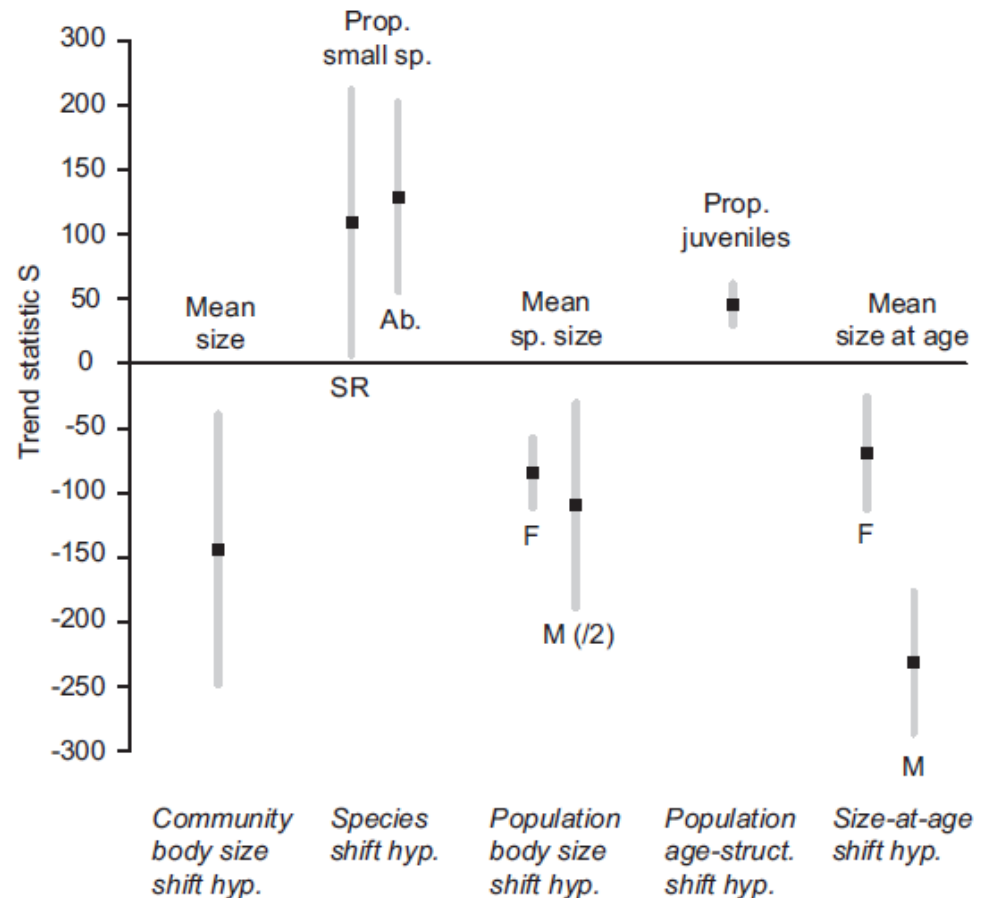
- Analysis of assemblages based on a cluster analyses of calanoid copepod taxa from the CPR survey over broad spatial scales.
- Scale is the mean number of species per assemblage, which provides an index of abundance.

Zooplankton Community vs Climate Change

Changes in mean body size

Fig.3 Mean effect sizes (i.e., mean weighted temporal trend statistic S ; $\pm 95\%$ confidence intervals).

- Negative or positive trend values indicate temporal decrease or increase, respectively.
- Mean temporal trends are significant if their 95% confidence intervals did not contain 0.



OBJECTIVES

Reveal variability in abiotic environment



Reveal variability in zooplankton community



Analyze changes in major species of
zooplankton



Discuss correlations between community and
environmental variables

MATERIALS & METHODS

Study Area

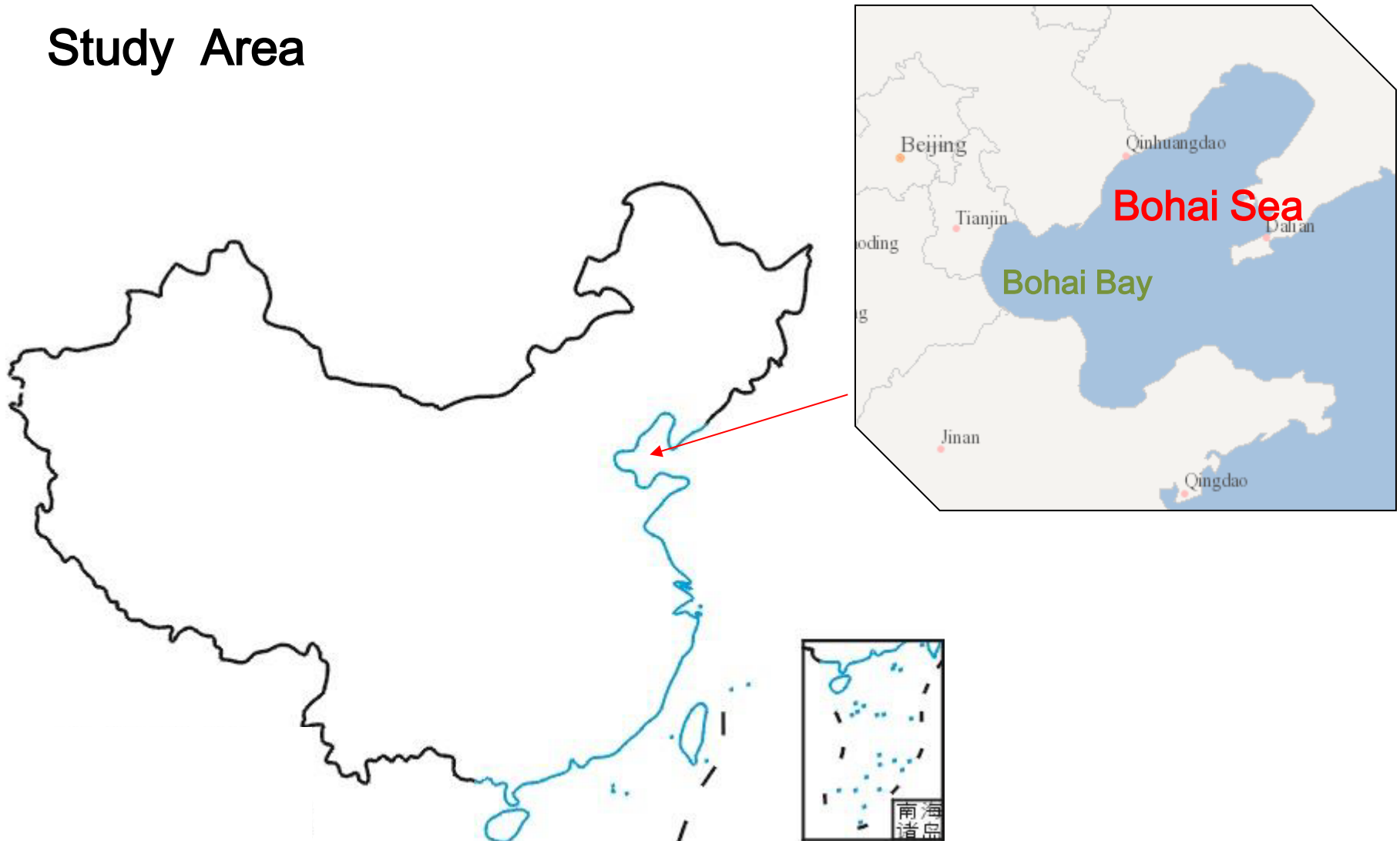


Fig.4 Location of study area.

MATERIALS & METHODS

Sampling Site

- Bohai Bay, Tianjin, China
- $117^{\circ}39'-118^{\circ}4'E$, $38^{\circ}37'-39^{\circ}6'N$
- Every August from 2004-2015, 12 years in total
- 30 stations from 2004 to 2007, 21 stations in 2008, 24 stations in 2009, 20 stations from 2010 to 2015

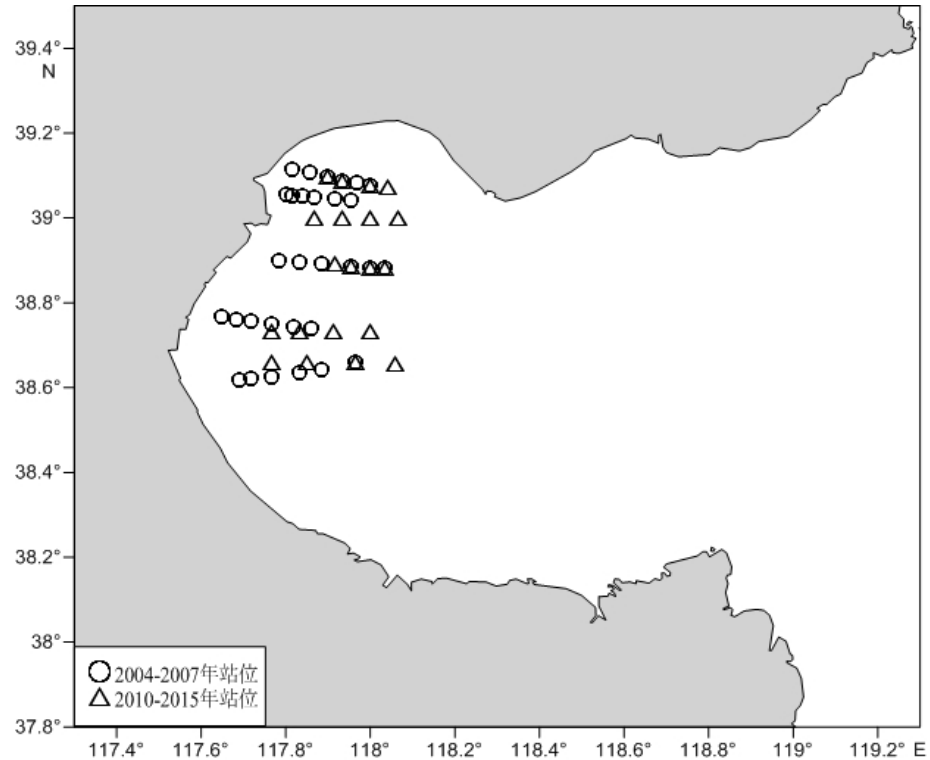
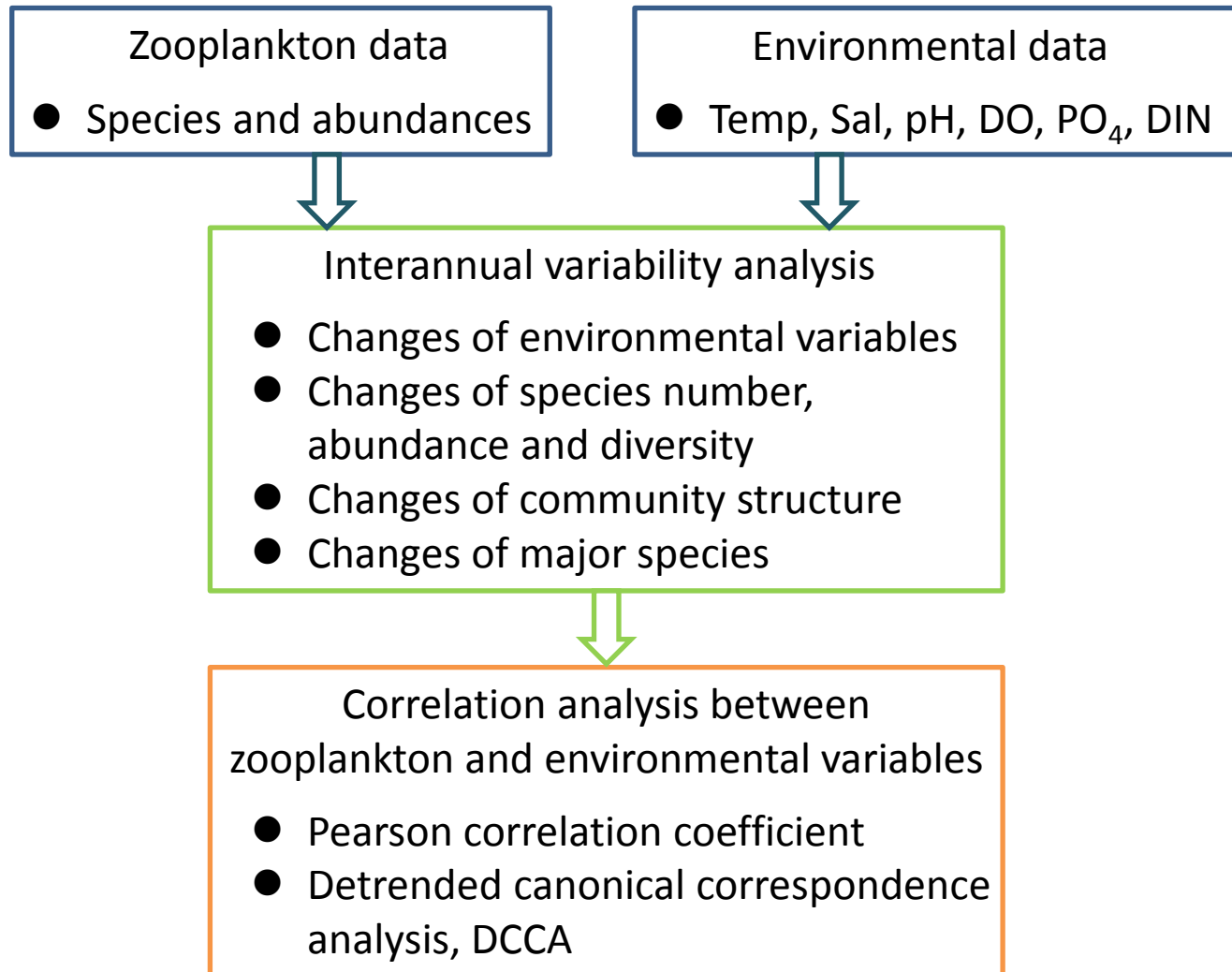


Fig.5 Sampling sites from 2004 to 2015.

MATERIALS & METHODS



RESULTS & DISCUSSION

Environmental Variations

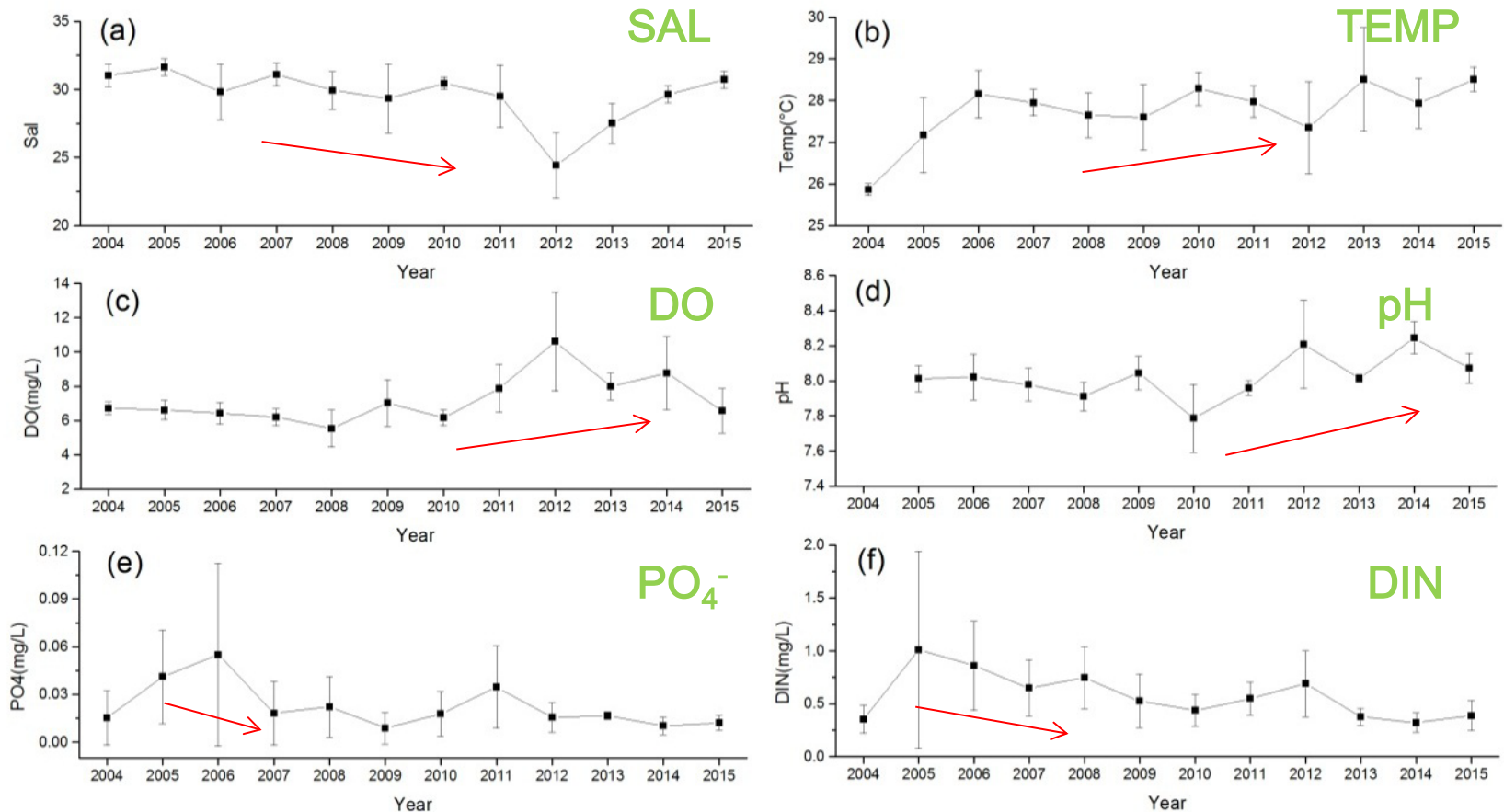


Fig.6 Environmental variations at the surface in Bohai Bay during the summer of 2004-2015

RESULTS & DISCUSSION

Zooplankton community variations

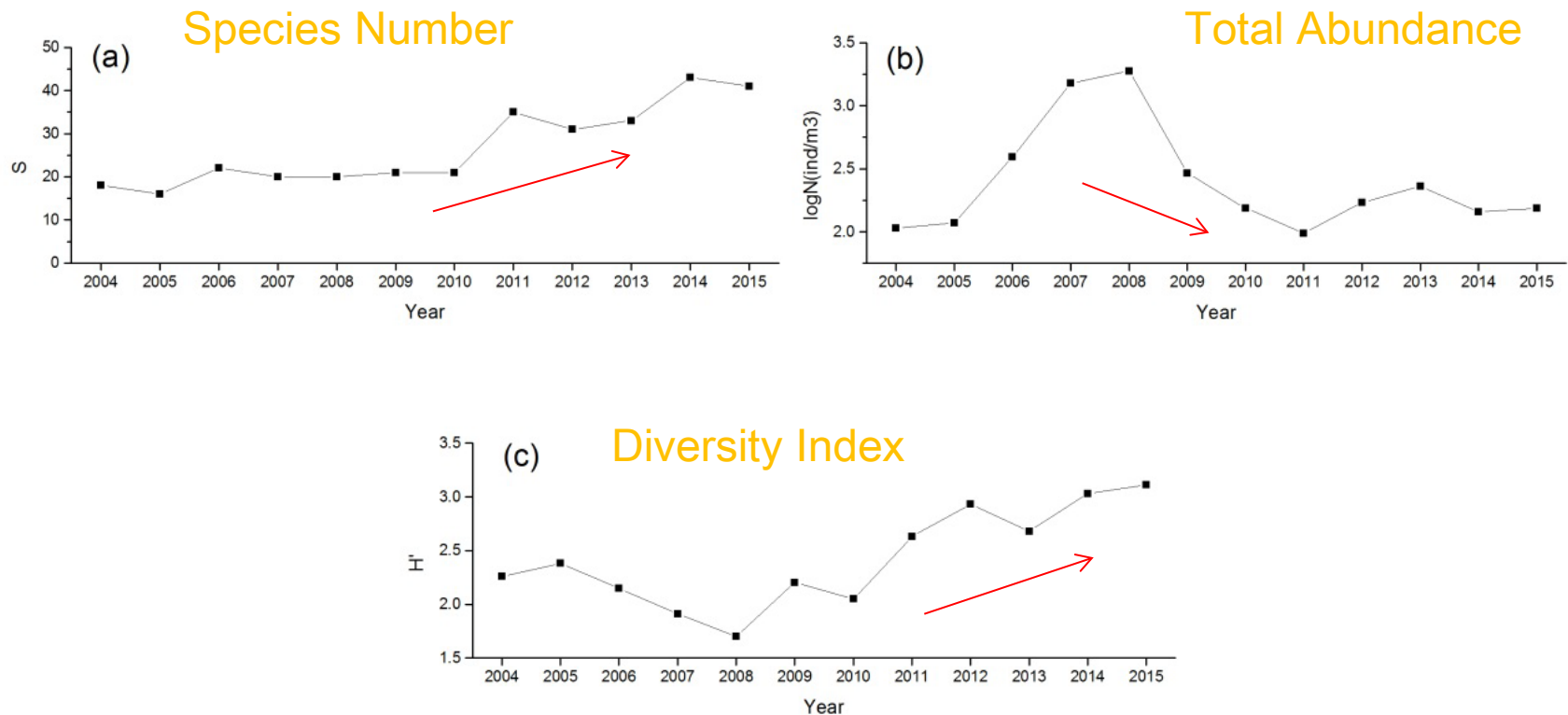


Fig.7 Changes of zooplankton community in Bohai Bay during the summer of 2004-2015. (a)Total number of zooplankton species, (b)Total abundance of zooplankton community (ind/m³) by log-transformed (c)Shannon-Wiener diversity index (H')

Community Structure

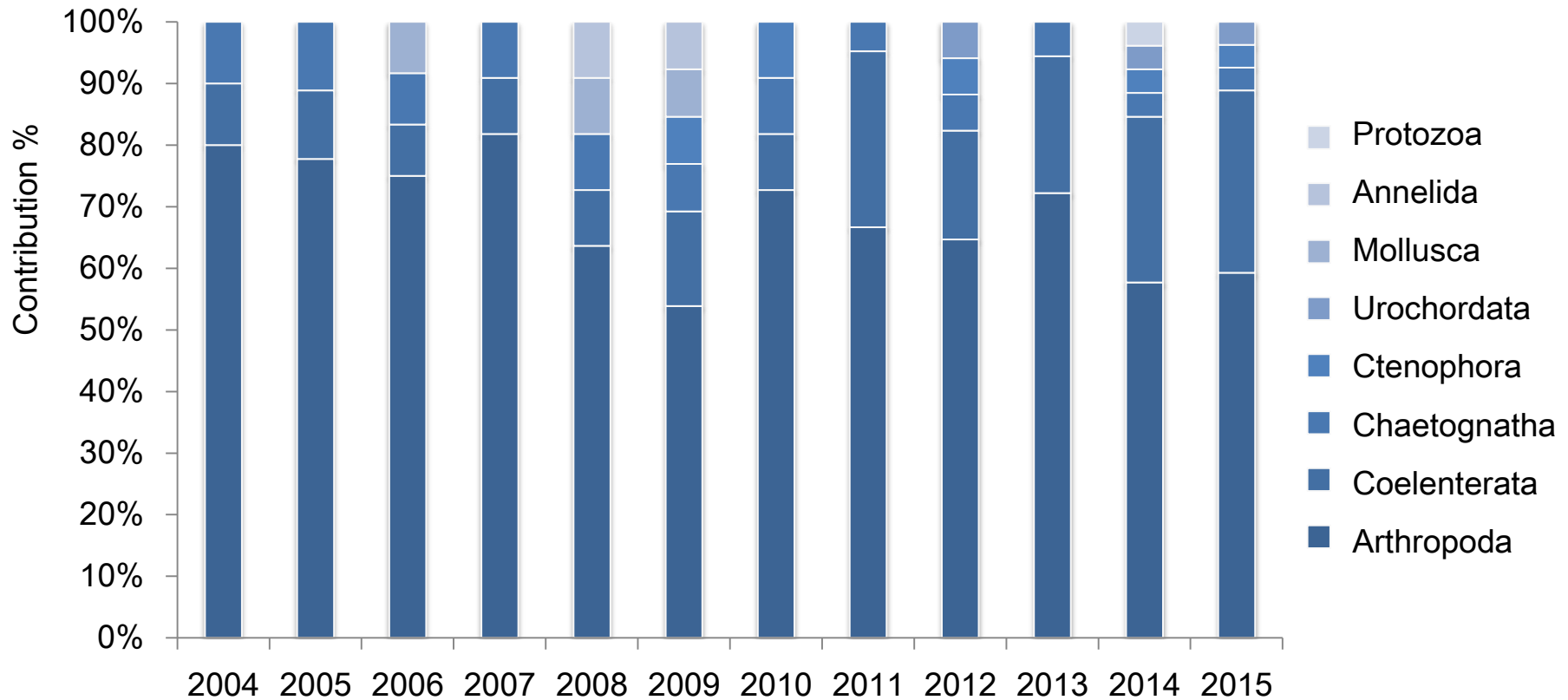


Fig.8 Contributions of different zooplankton taxa to total species number during the summer of 2004-2015 in Bohai Bay (without pelagic larvae)

RESULTS & DISCUSSION

Dominated groups to increased species number

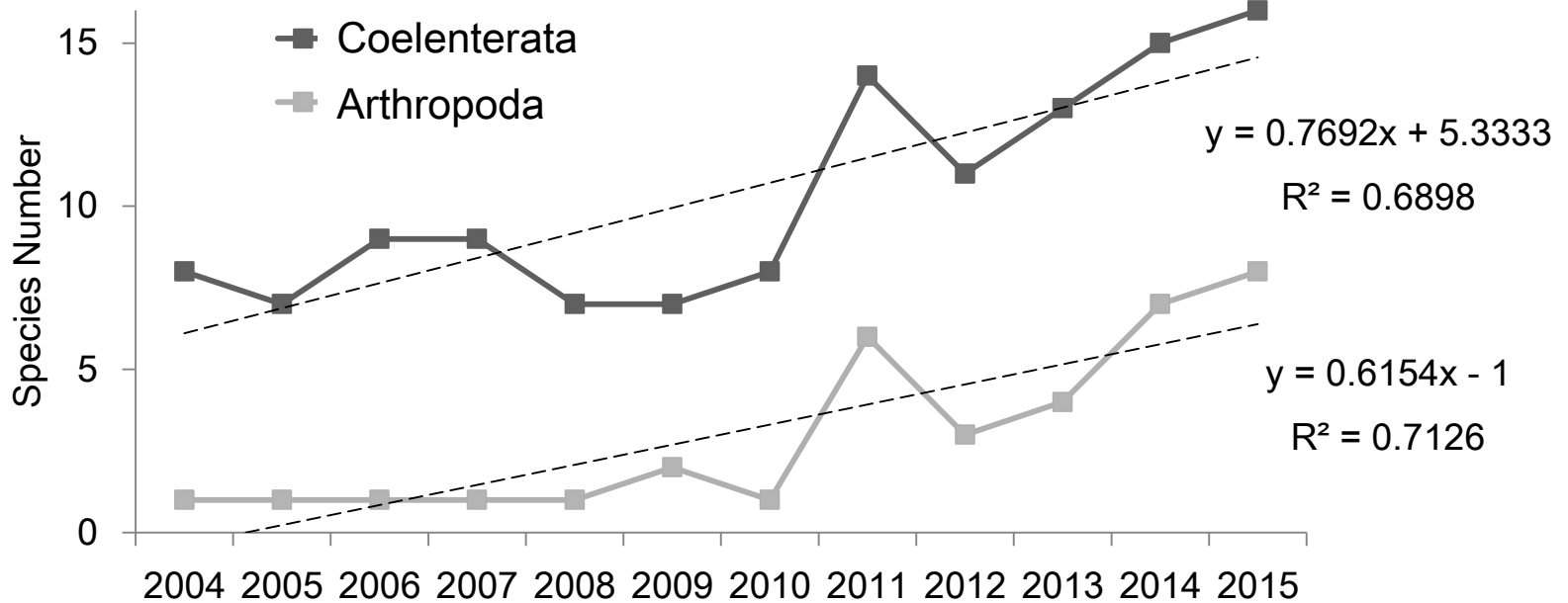
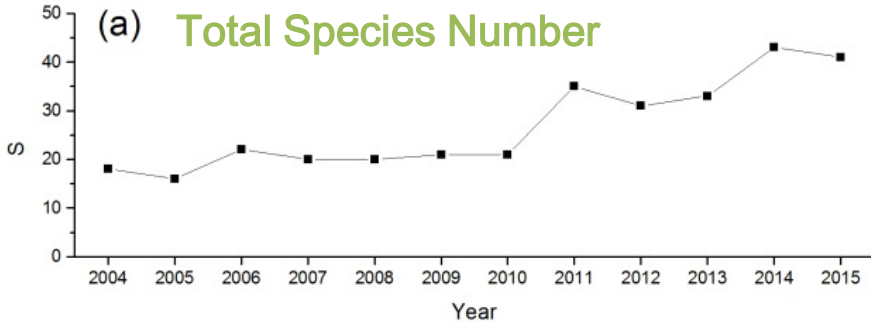


Fig.9 Changes of species number of Arthropoda and Coelenterata during the summer of 2004-2015 in Bohai Bay

RESULTS & DISCUSSION

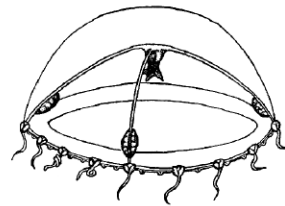
New identified species

- *Centropages tenuiremis*
- *Centropages dorsispinatus*
- *Clytia hemisphaerica*
- *Pleurobrachia globosa*
-

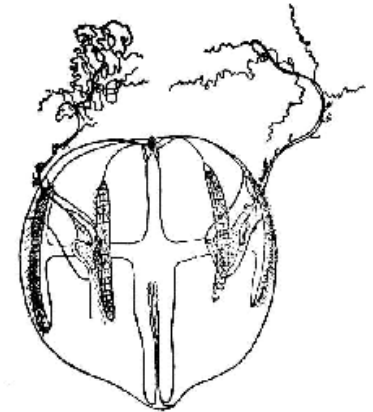
Warm-water species



● *Centropages tenuiremis*



● *Clytia hemisphaerica*



● *Pleurobrachia globosa*

RESULTS & DISCUSSION

Dominant pattern of zooplankton community

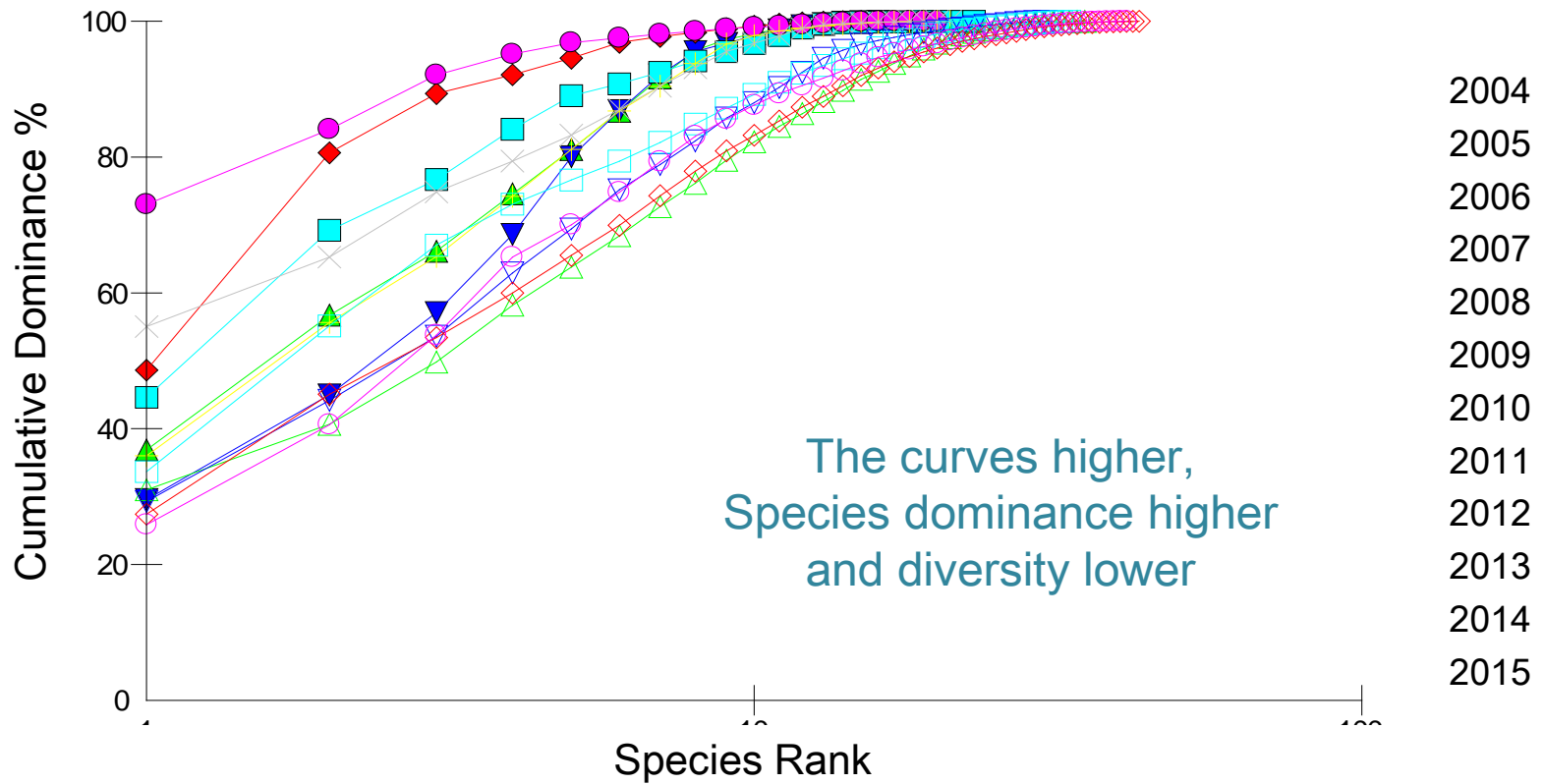


Fig.10 K-dominance curves for zooplankton community during the summer of 2004-2015 in Bohai Bay

RESULTS & DISCUSSION

Dominant pattern of zooplankton community

Year	Species Number with Cumulative Abundance >90%	Of total species number %	Species of the most abundance	
			Species	Abundance Percentage %
2004	7	38.9	<i>Calanus sinicus</i>	36.9
2005	7	43.8	<i>Sagitta crassa</i>	29.6
2006	6	27.3	<i>Acartia bifilosa</i>	44.6
2007	4	20.0	<i>Paracalanus parvus</i>	48.6
2008	3	15.0	<i>Acartia bifilosa</i>	73.0
2009	7	33.3	<i>Pleurobrachia globosa</i>	36.0
2010	7	33.3	<i>Sagitta crassa</i>	55.0
2011	15	42.9	<i>Sagitta crassa</i>	31.0
2012	11	35.5	<i>Sagitta crassa</i>	29.3
2013	11	33.3	<i>Sagitta crassa</i>	33.7
2014	14	32.6	<i>Oikopleura dioica</i>	27.4
2015	12	29.3	<i>Sagitta crassa</i>	25.9

RESULTS & DISCUSSION

Major Species Variability

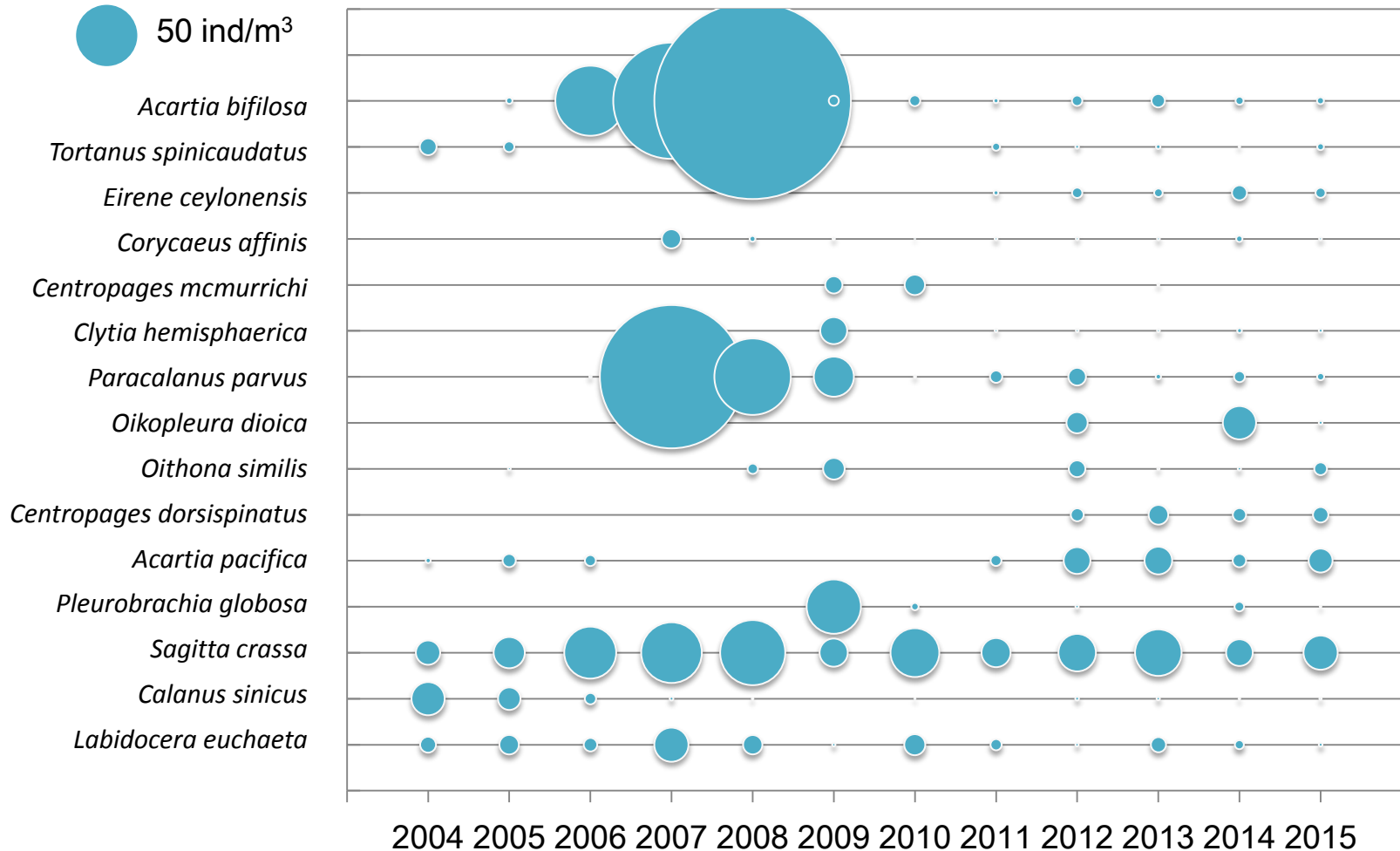


Fig.11 Mean abundances of 15 major zooplankton species during the summer of 2004-2015 in Bohai Bay

RESULTS & DISCUSSION

Major Species Variability

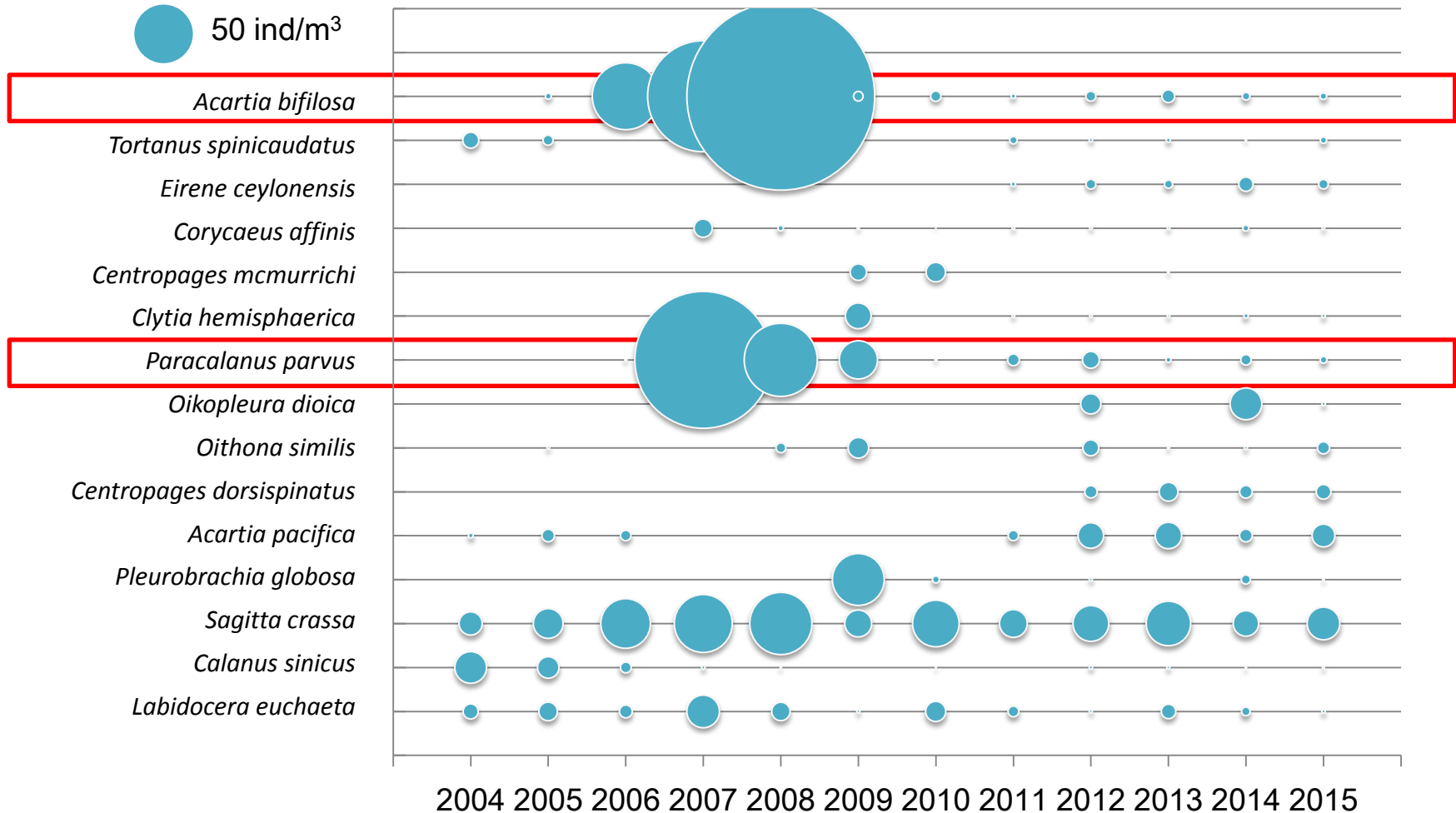


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RESULTS & DISCUSSION

Major Species Variability

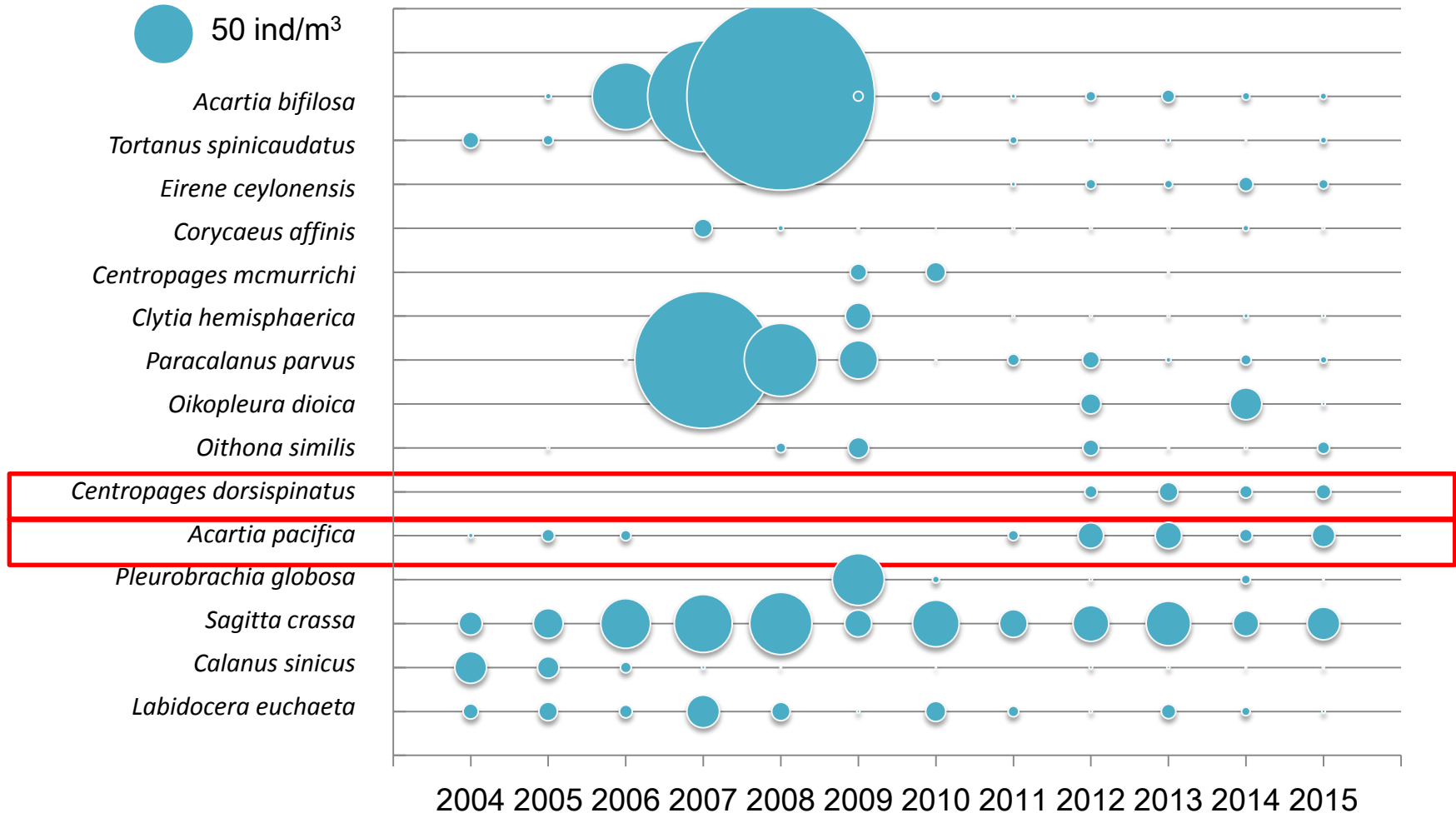


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RESULTS & DISCUSSION

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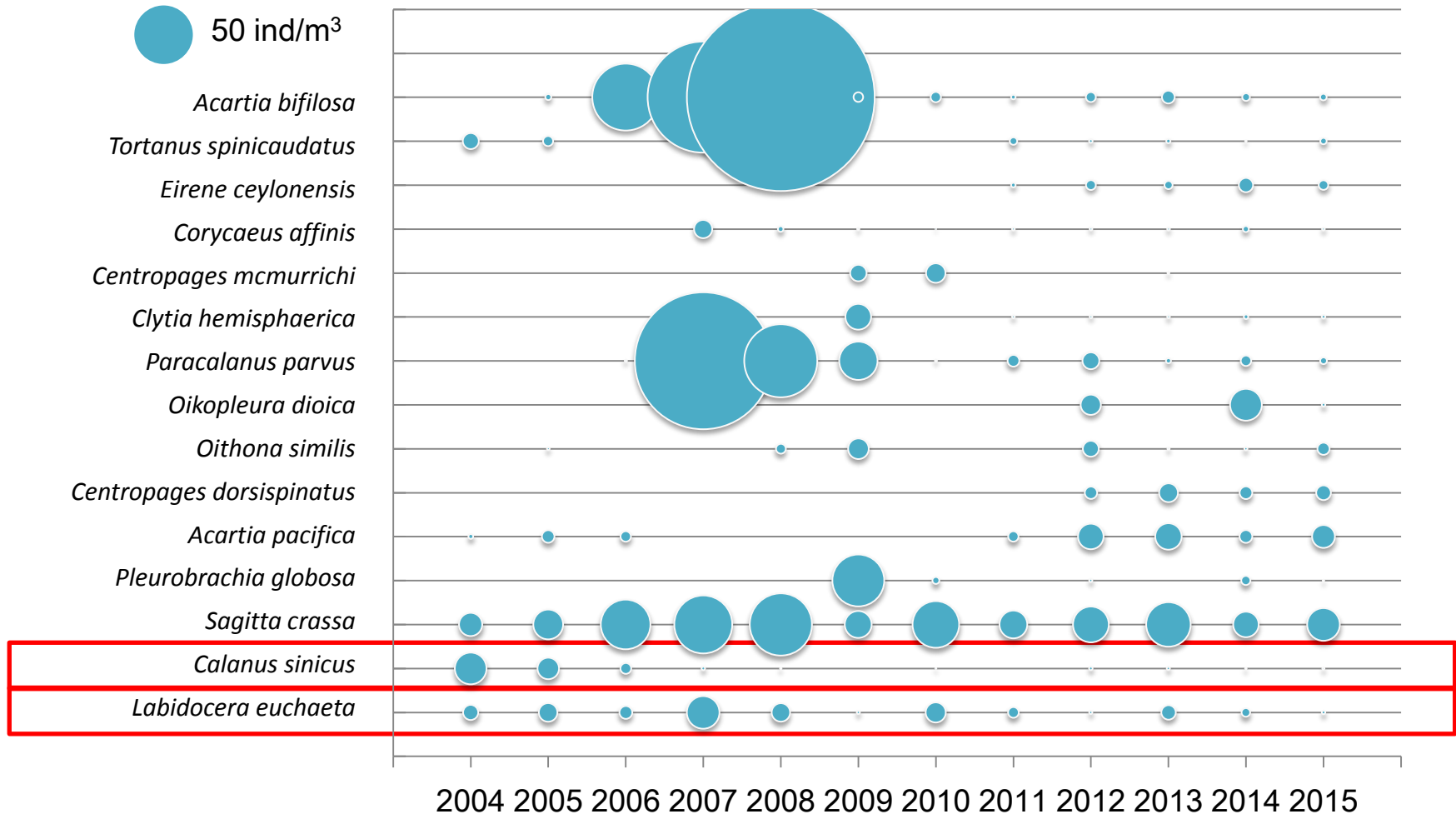


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RESULTS & DISCUSSION

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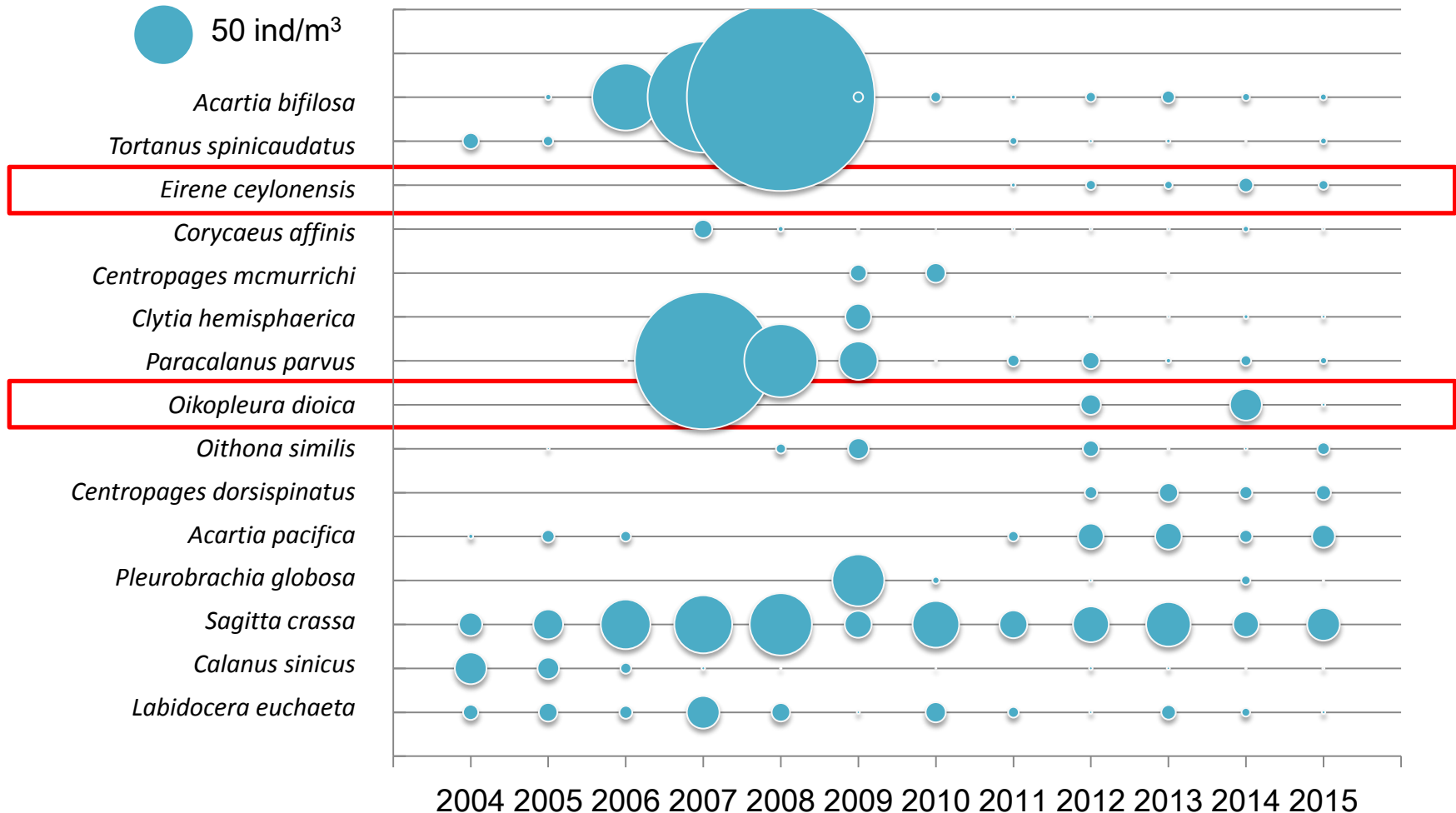


Fig.11 Mean abundances of 15 major zooplankton species during the summer of 2004-2015 in Bohai Bay

RESULTS & DISCUSSION

Correlation Analysis

Tab. Pearson correlation analysis between zooplankton community and environmental variables in Bohai Bay

	Tem	Sal	pH	DO	PO ₄	DIN
Species Number	0.486**	0.321**	0.027	0.377**	-0.056	-0.167**
Total Abundance	0.188**	0.138*	-0.331**	-0.032	-0.032	-0.006

**indicates significant correlation ($p < 0.01$)

RESULTS & DISCUSSION

Correlation Analysis

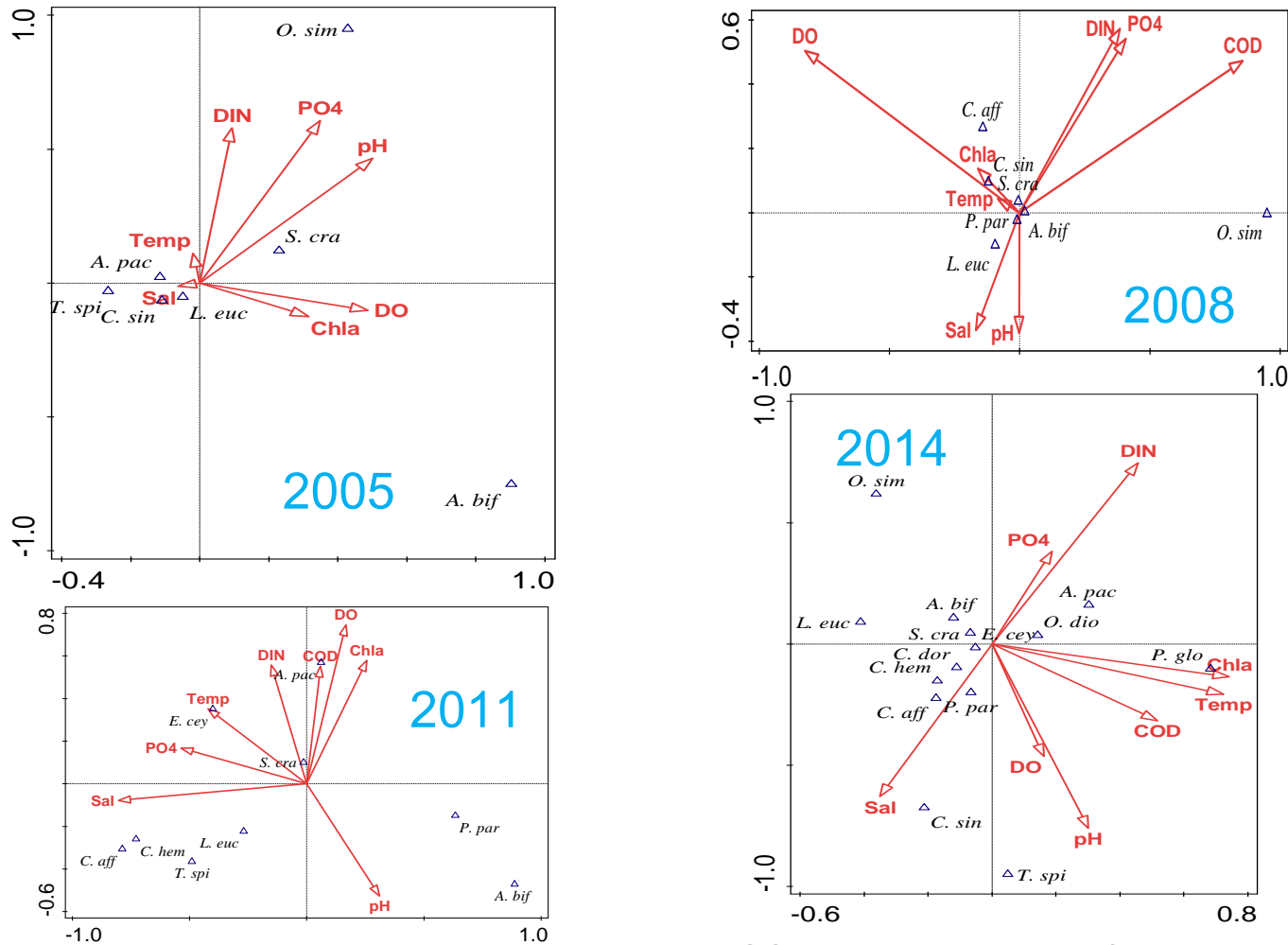


Fig.12 DCCA ordination graph of major zooplankton species and environmental variables in Bohai Bay

CONCLUSIONS

- ❑ In general, the species number and biodiversity of zooplankton community in Bohai Bay showed an increasing trend in summer from 2004 to 2015.
- ❑ In early years, fewer species dominated the zooplankton, and the biodiversity was relatively poor.
- ❑ In recent years, the zooplankton community has changed significantly. Large-sized copepods decreased while small-sized copepods and gelatinous species increased continuously. The biodiversity of zooplankton became higher.
- ❑ The zooplankton community in Bohai Bay was strongly correlated with environmental variables such as temperature and salinity, and their impacts are becoming more and more important in recent years.



THANK YOU!