Session 1:
Environmental control of spatio-temporal changes in population size, distribution and migration of small pelagic fish in the ecosystem context

Variations in the catches of small pelagic fishes from China seas and its responses to climatic regime shifts

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Outline

I. SPF in the over-exploited China Seas

II. Catch variation trends and step changes in SPF

III. Climatic regime shifts in China Seas and the responses of SPF

IV. Summary

China seas and currents

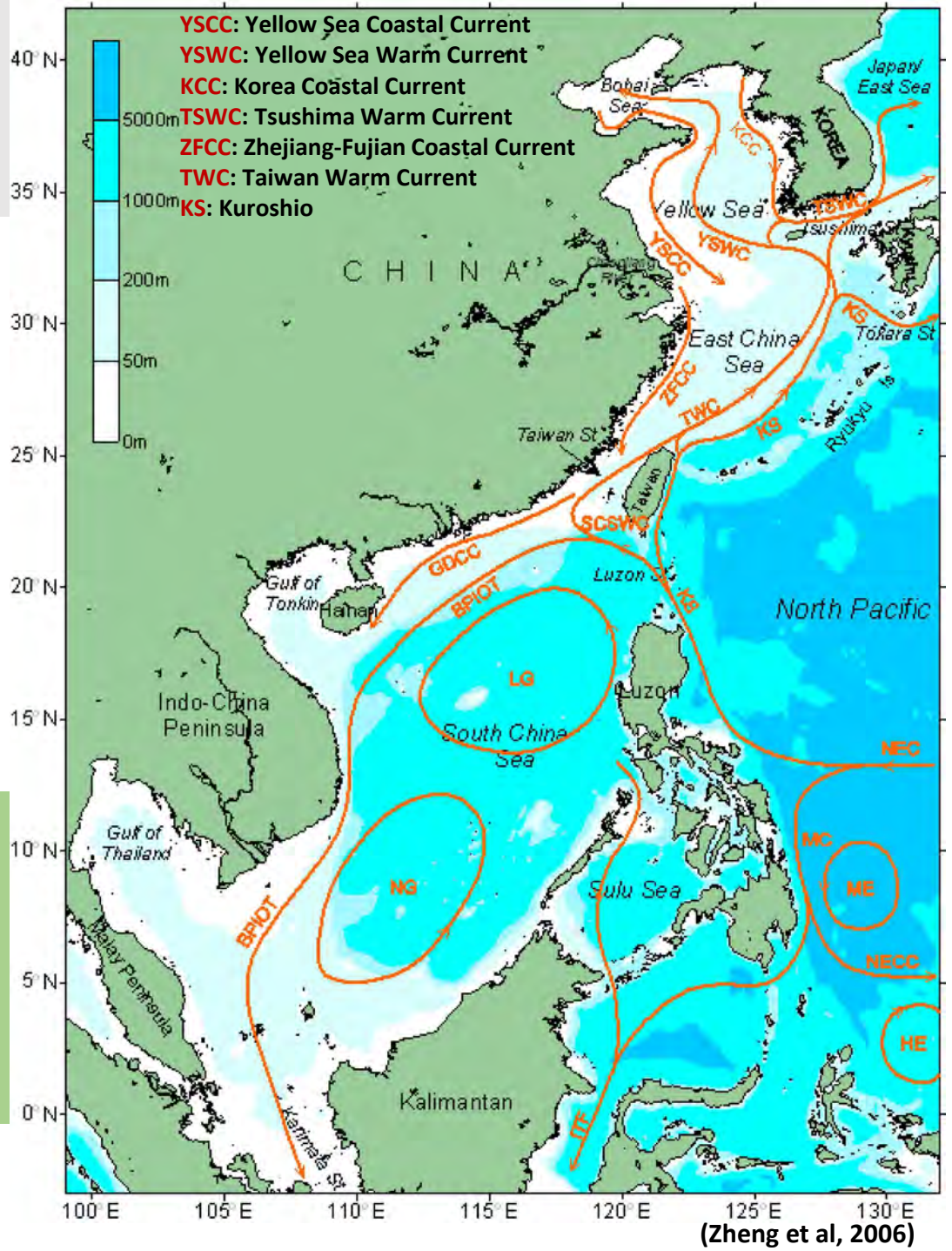
Components

- Bohai Sea, Yellow Sea,
  East China Sea, South China Sea

Current system (except South China Sea)

- **Warm: YSWC, TWC, KS**
- **Cold: YSCC, KCC, ZFCC**

China seas as marginal seas, are largely influenced by West Boundary Current, and have significant environmental changes which will have important effects on SPF.



(Zheng et al, 2006)

Chinese catch under over-exploitation

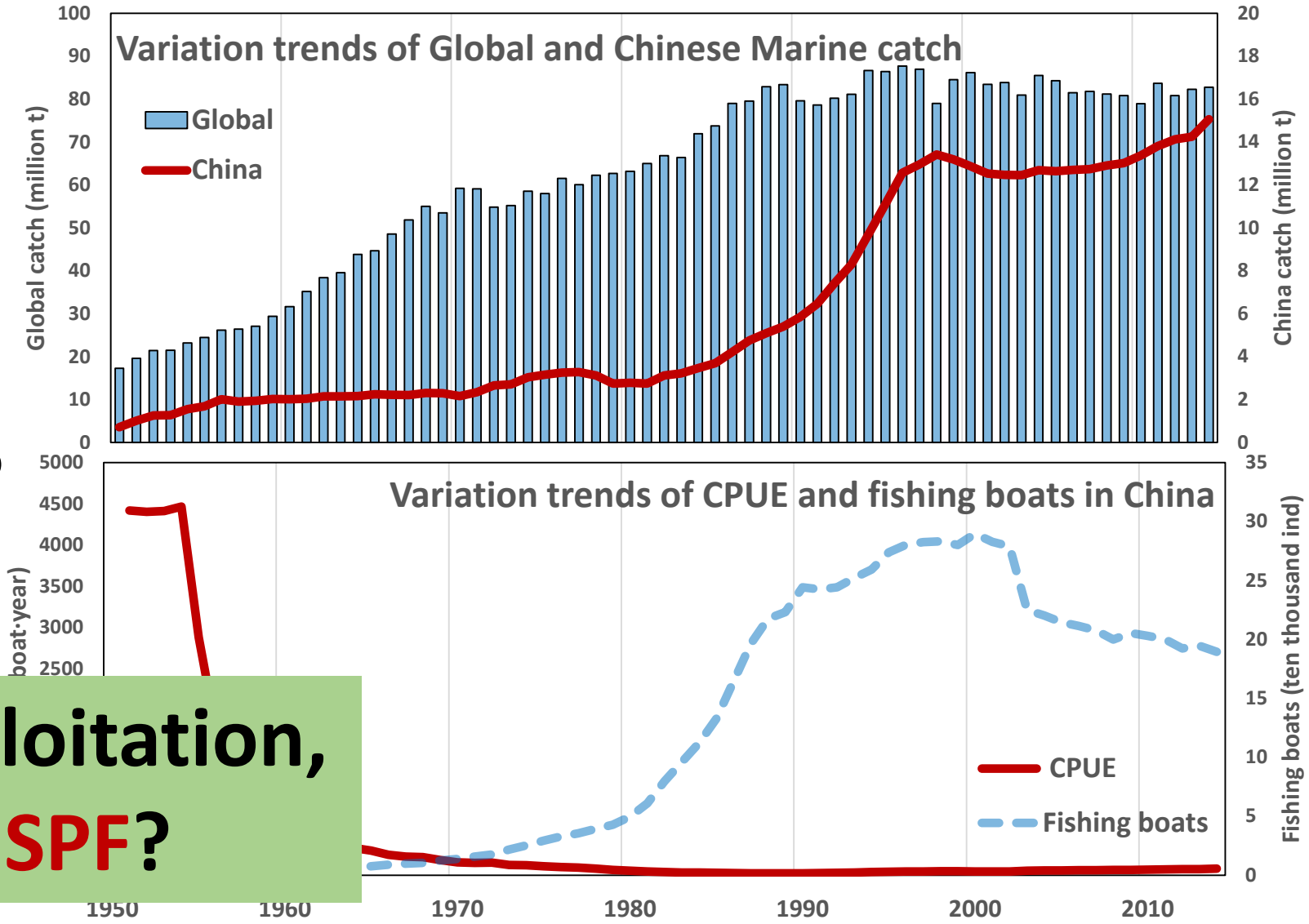
Global:

- Increasing trend since **1950**, remain stable after **1990**
- **18.2%** was from China in 2014

China:

- Increasing rapidly since **1980** to **2000**, then remained stable
- CPUE reduced sharply in the 1950s and kept low-level

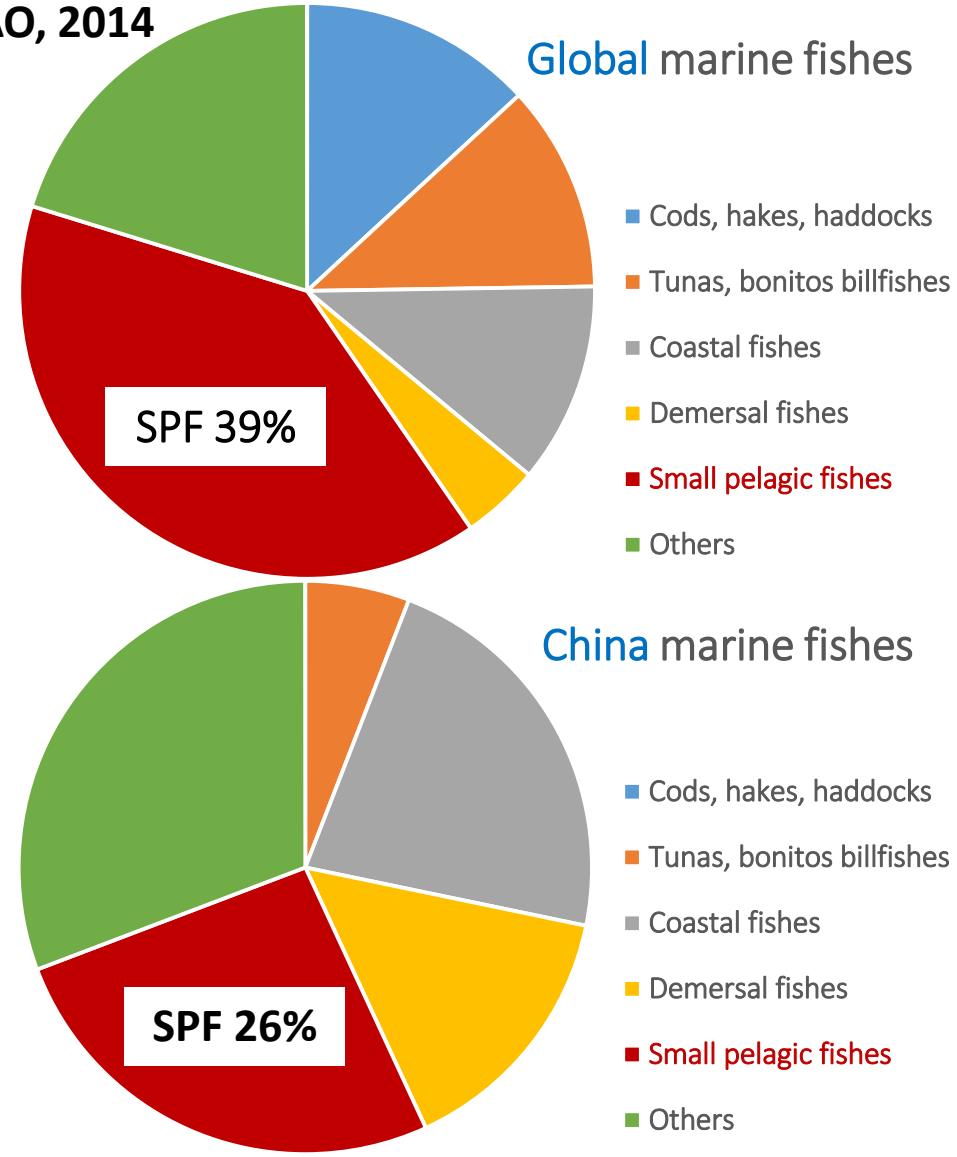
Under the over-exploitation, how about the SPF?

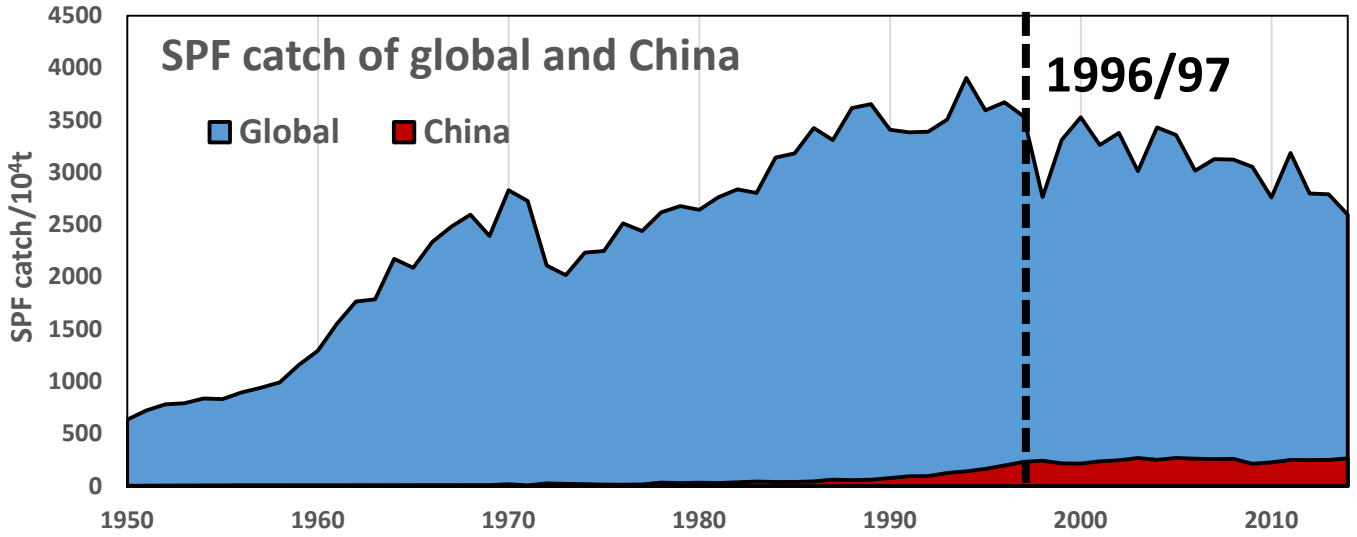


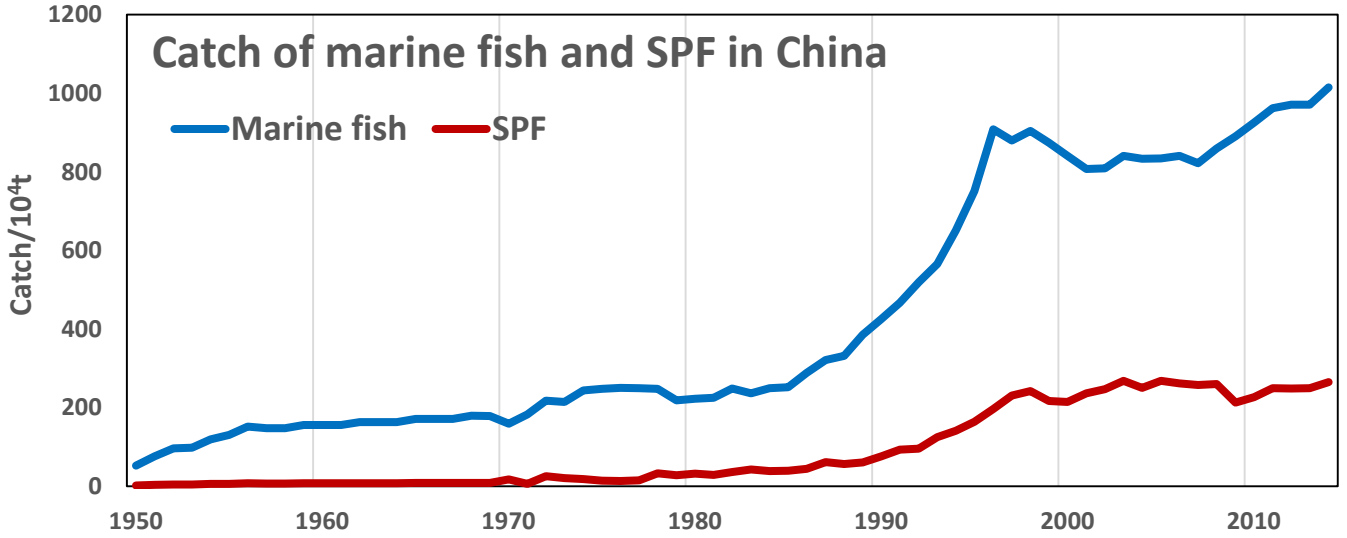
Data from Global Capture Production 1950-2014, FAO

SPF catch — From global to China

FAO, 2014







Data from Global Capture Production 1950-2014, FAO

Focus

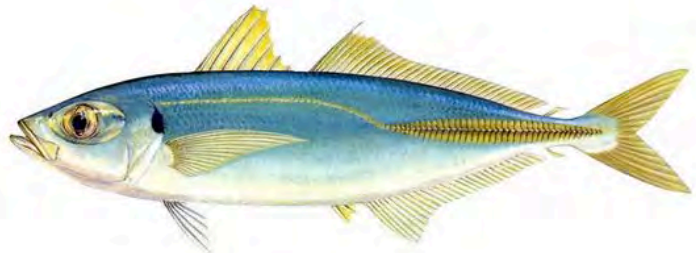
- ☐ Clarify the trends of SPF in China seas
- ☐ Identify the responses of SPF to climate change

Chub mackerel
Scomber japonicas

Pacific herring
Clupea pallasi

Japanese anchovy
Engraulis japonicus

Japanese sardine
Sardinops melanostictus



Japanese scad
Decapterus maruadsi

Horse mackerel
Trachurus japonicus

Data and analyses

Catch

Chinese Fishery Statistics 1950-2014
FAO Global Capture Production 1950-2014
Tsushima Stock Assessment Reports 2015

Sea Surface Temperature

Grid data with resolution of 1°×1°

Climatic indices

Pacific Decadal Oscillation (PDO)
Southern Oscillation (SOI)
Arctic Oscillation Index (AOI)
North Pacific Index (NPI)
Asian Monsoon Index (MOI)

Regime Shift Detection

Cumulative Sum

Get the variation trends and step changes of data

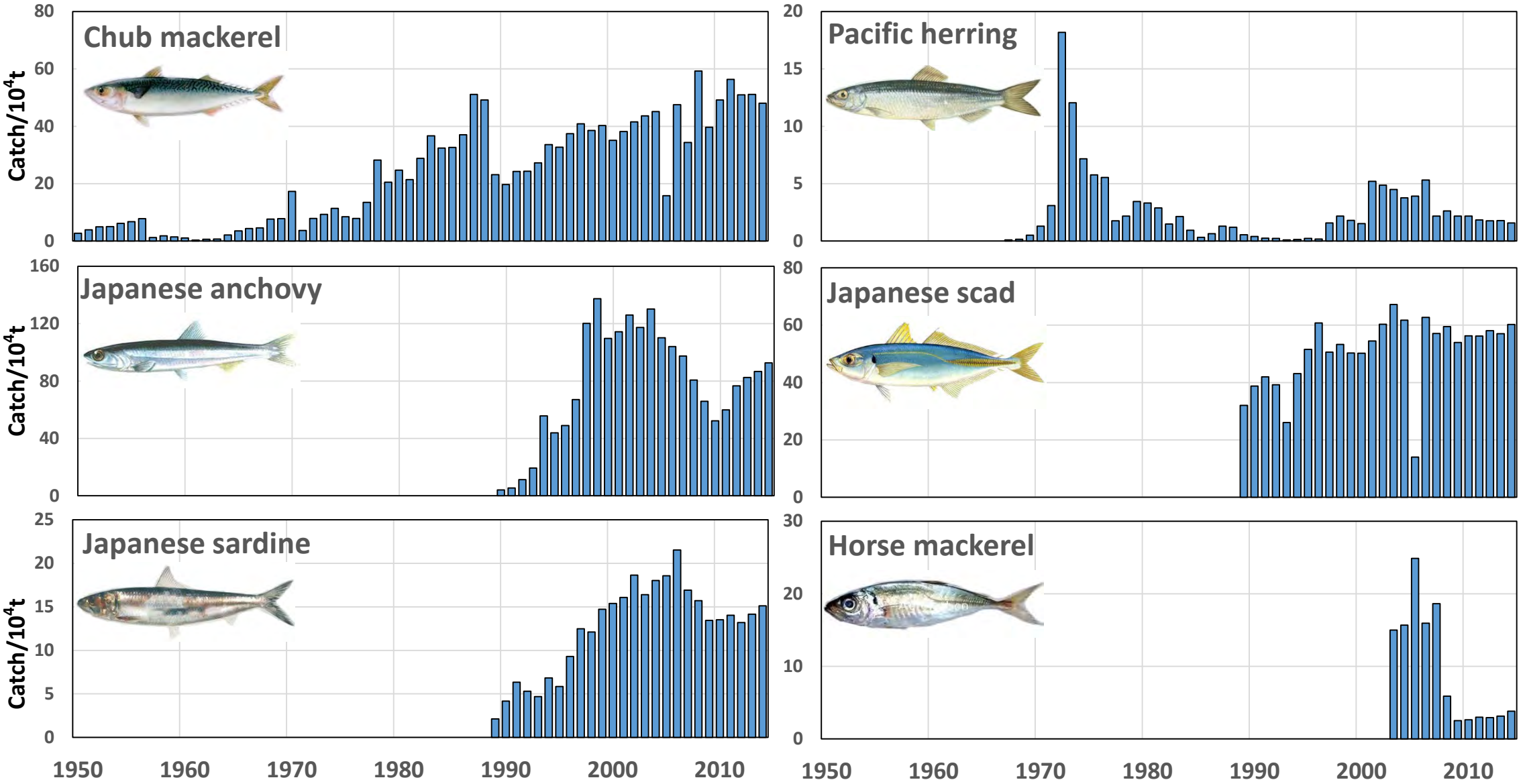
Principal Component Analysis

Calculate the pc1 of SST in summer and winter then get the changing pattern

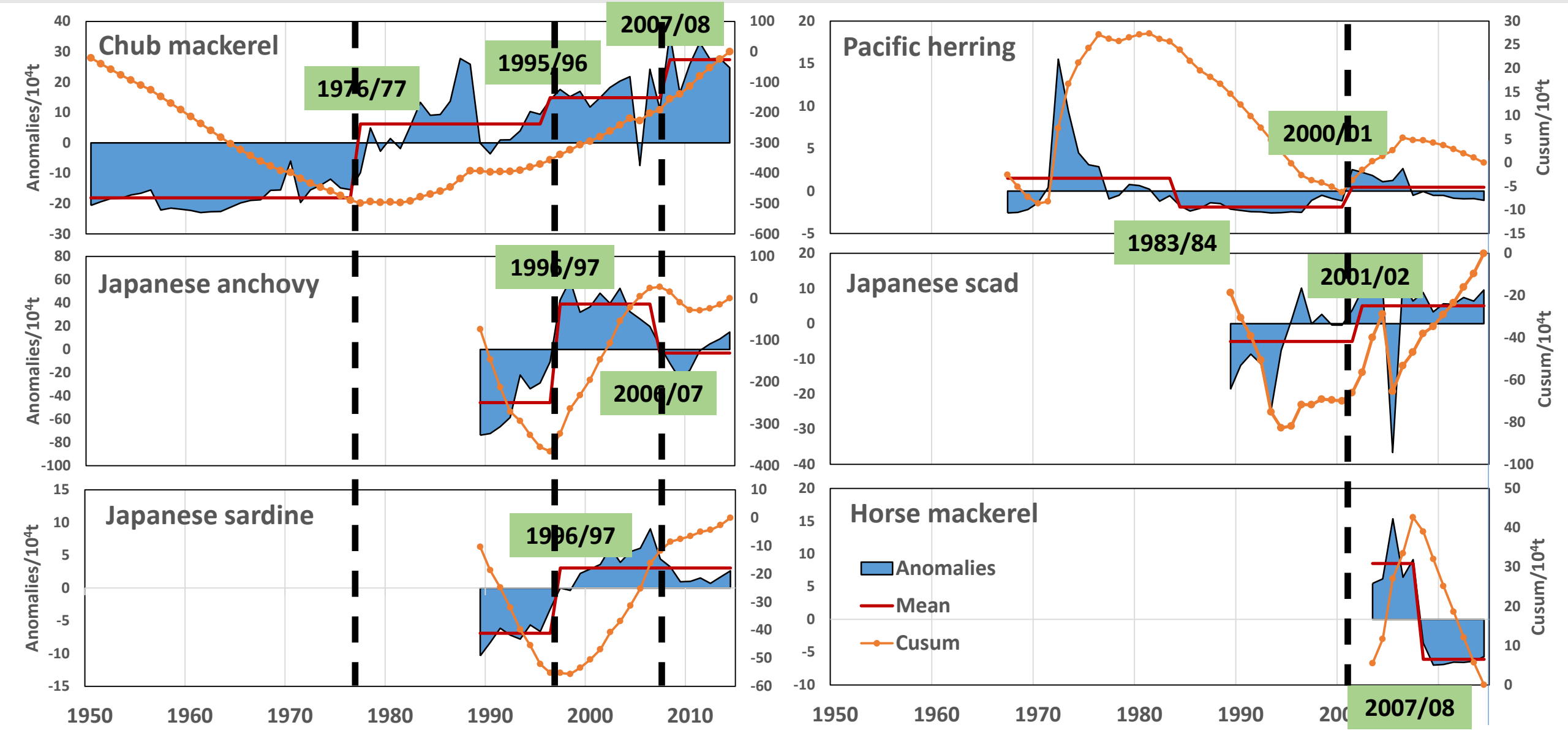
Correlation Analysis

Explore the relationships between catch and environmental indicators

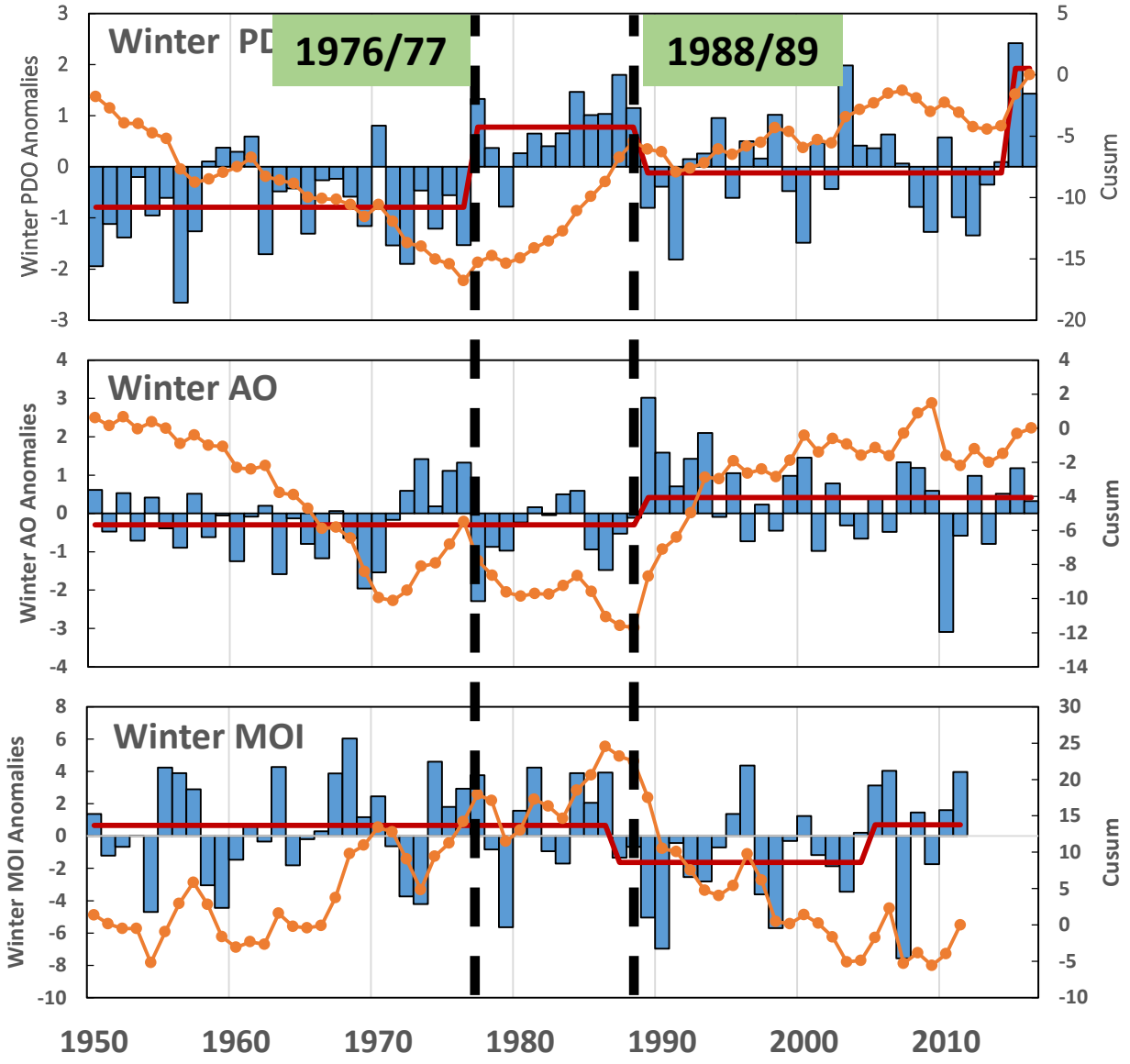
Variation trends in SPF catch

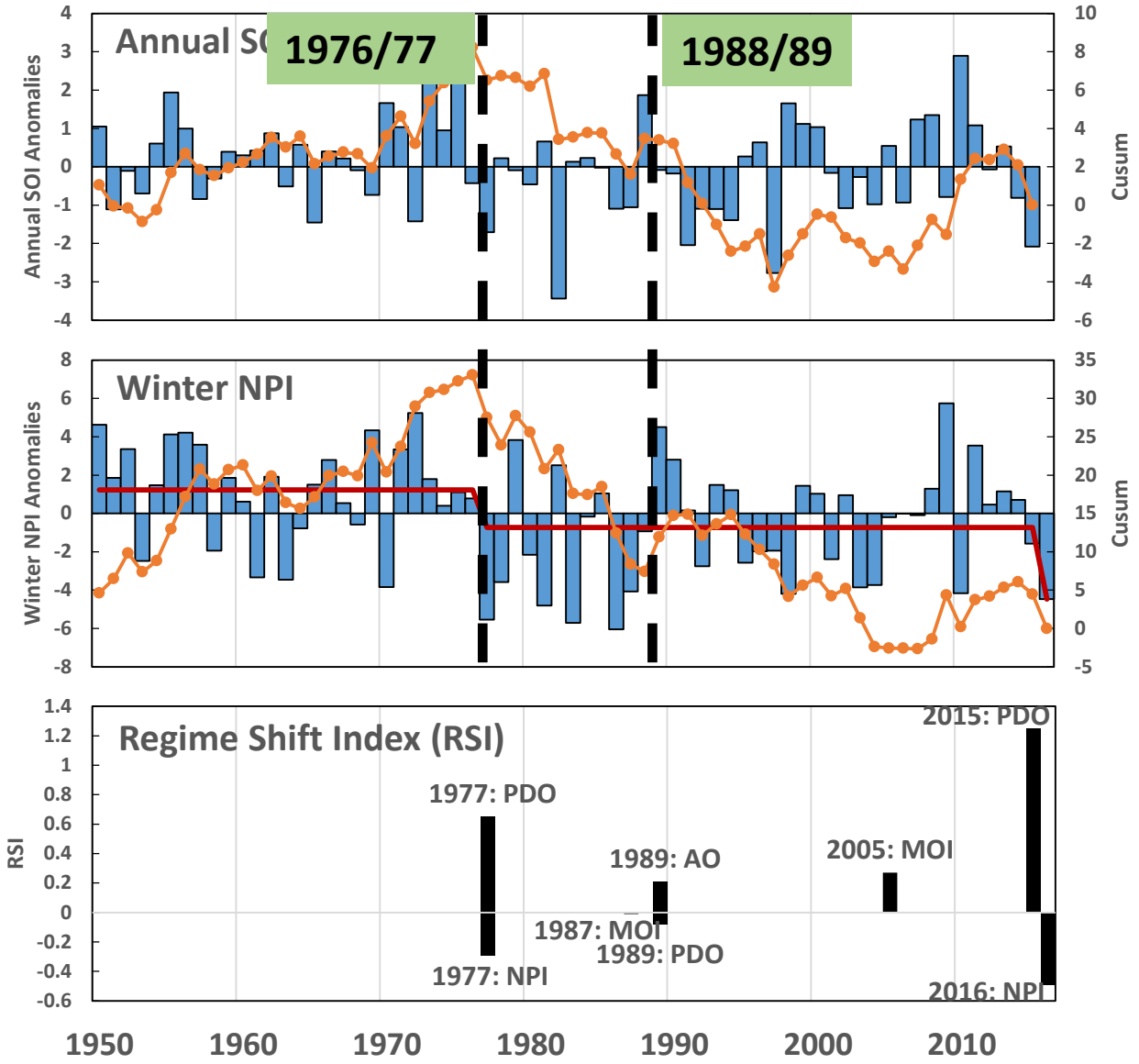


Step changes in SPF catch

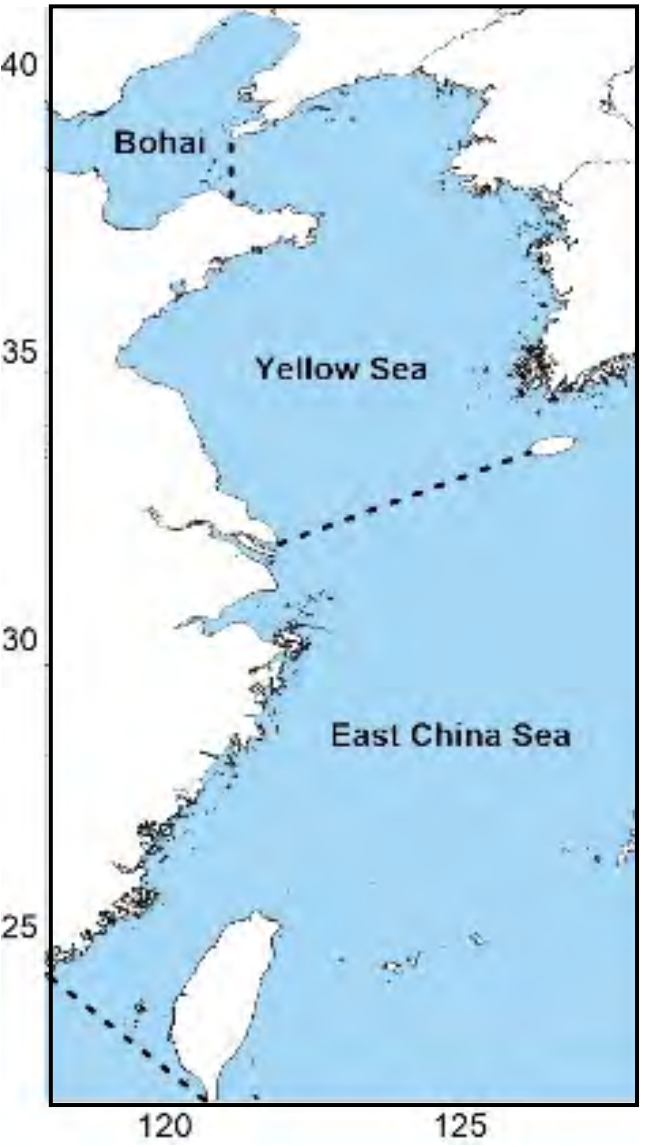


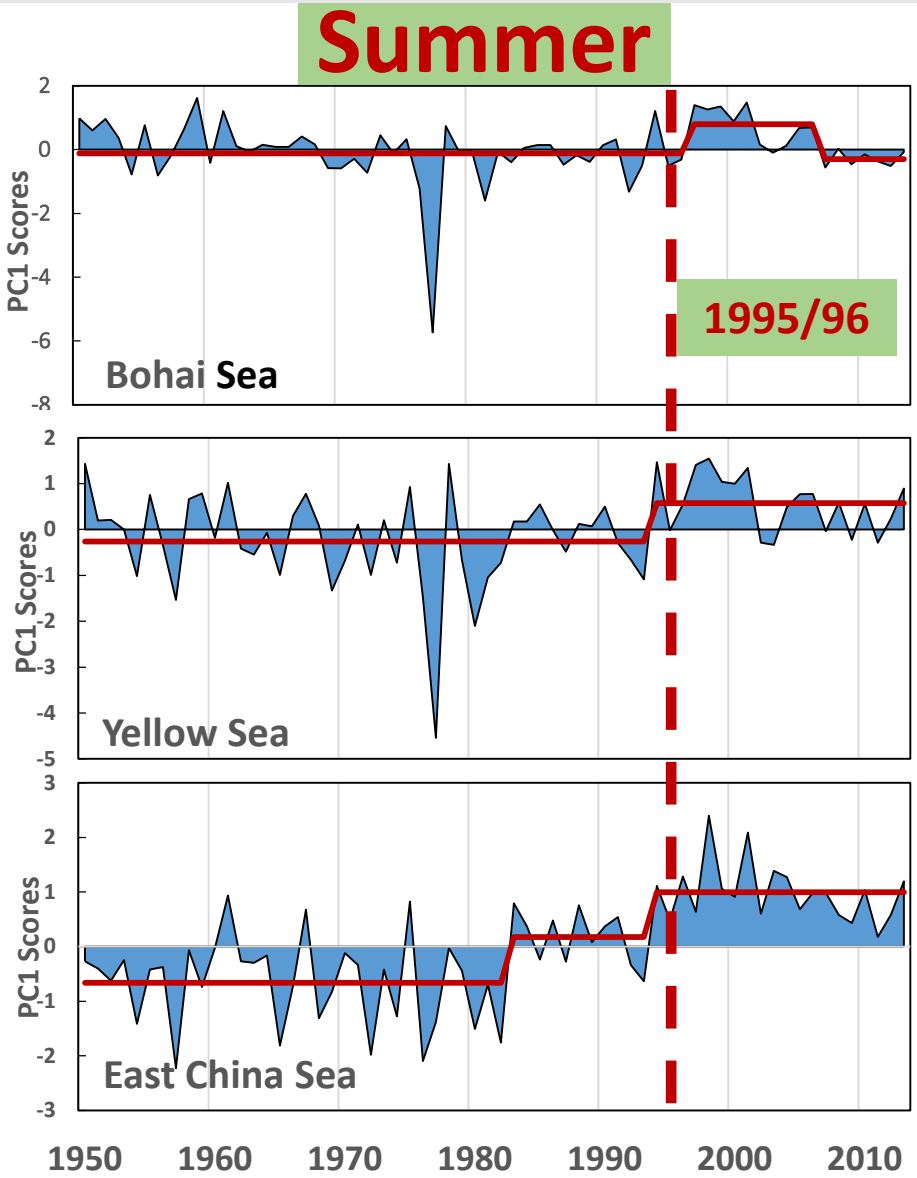
Variation pattern in Climatic indices

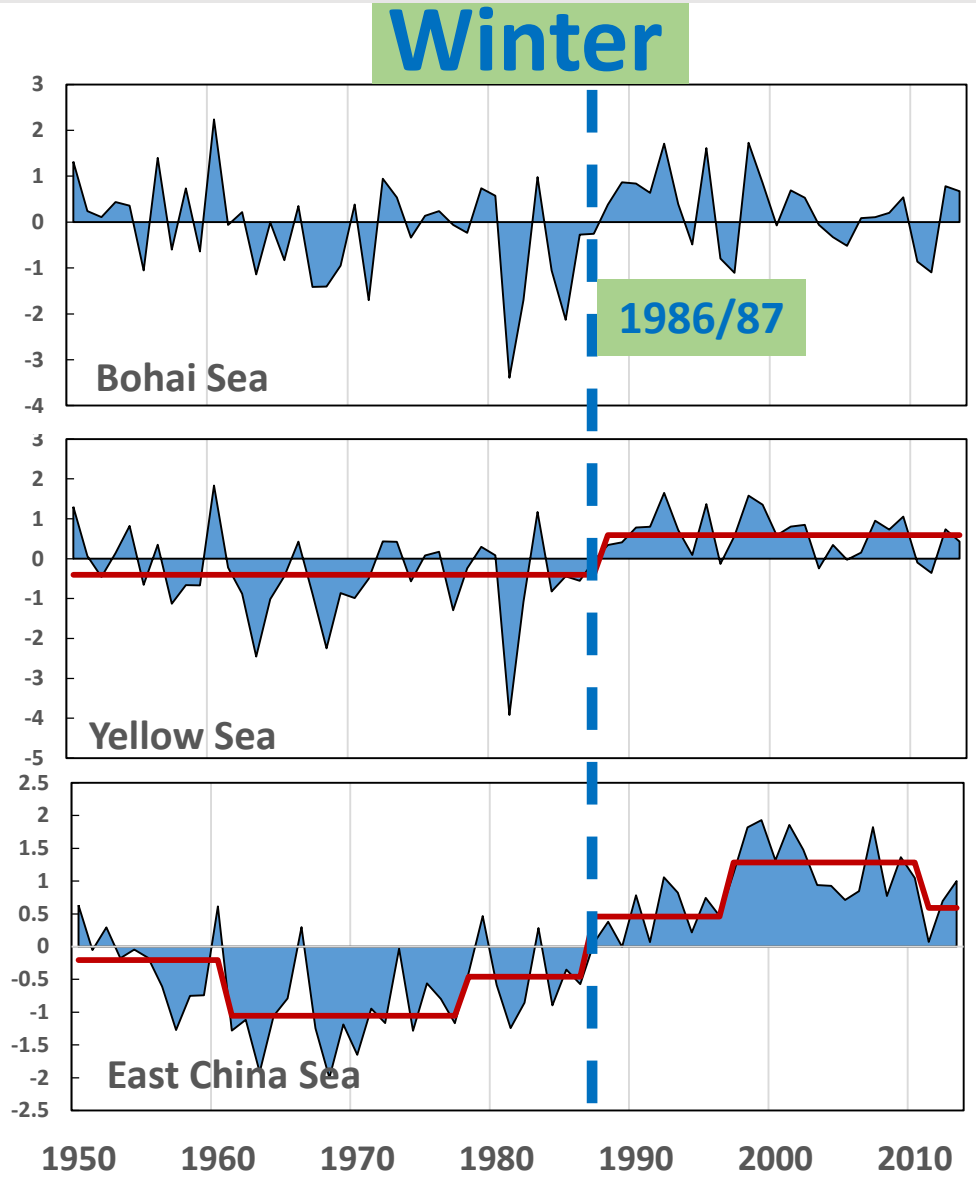




Variation pattern in SST In China Seas







Response of SPF to climate change

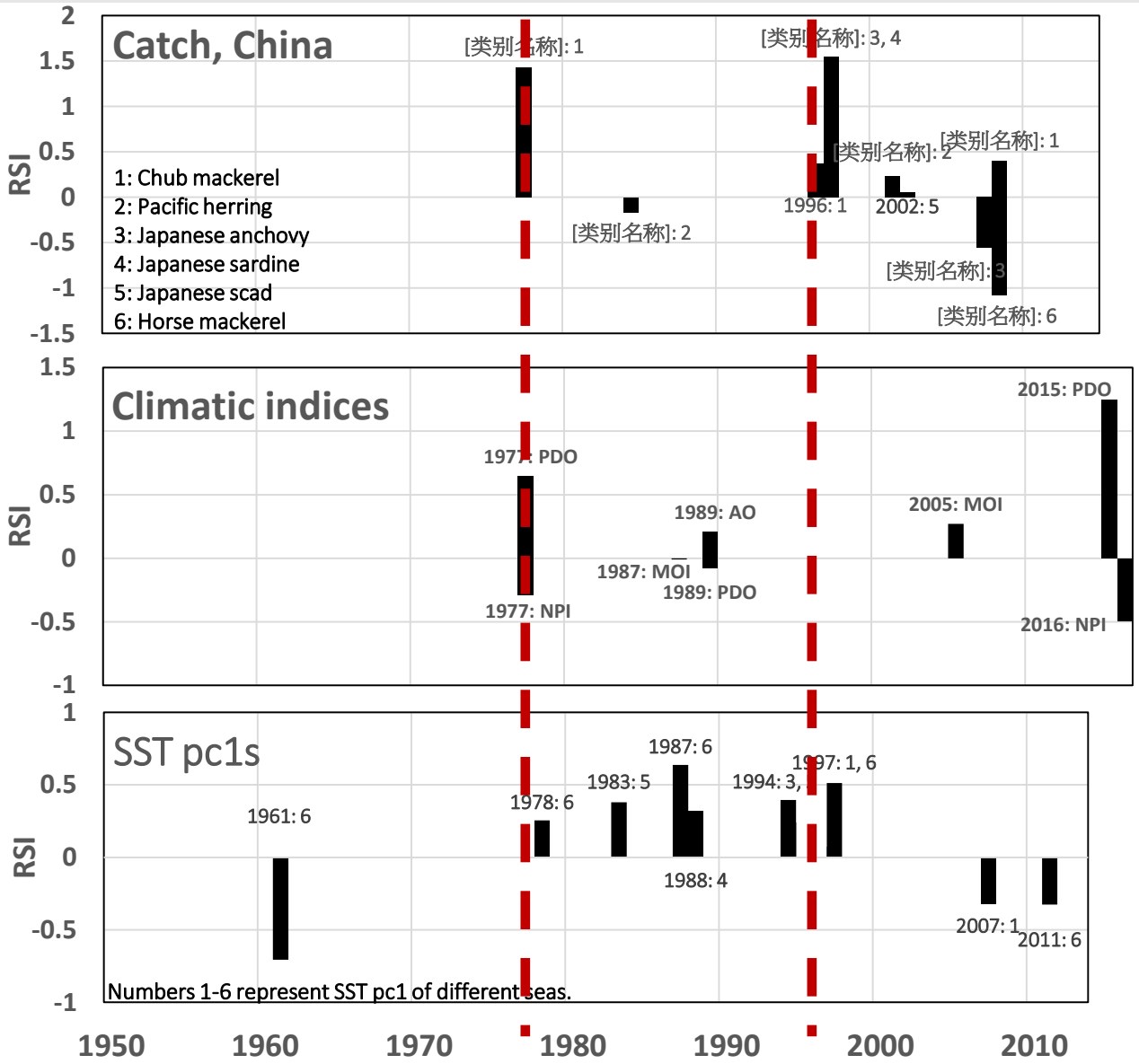
Catch step changes

- 1976/77
- 1996/97
- 2007/08

Climatic regime shifts

- 1976/77
- 1988/89
- 1995/96 (step change in SST)

Chinese SPF catch responded well to the climatic regime shifts in 1976/77 and 1995/96, but no response to the shift in 1988/89.



Impact of environmental indices on SPF

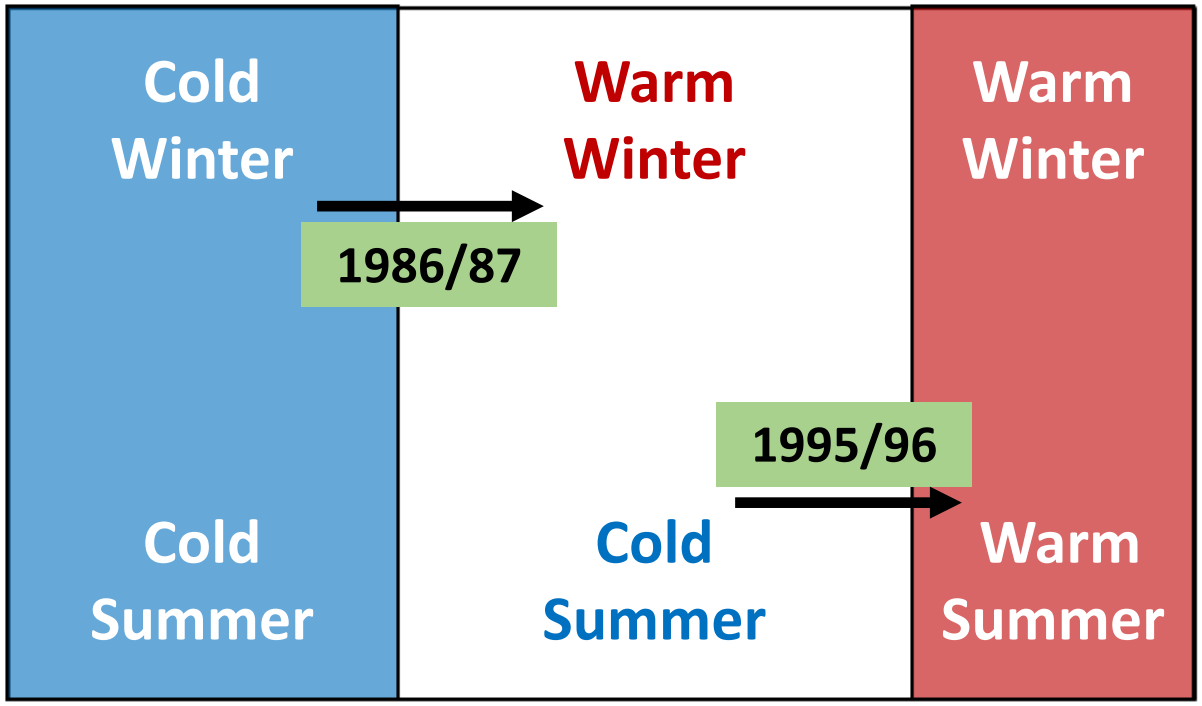
Table 1 Correlation analysis between climatic indices, SST pc1s and SPF catch anomalies in China.

Climate indices and SST pc1s	Chub mackerel	Pacific herring	Japanese anchovy	Japanese sardine	Japanese scad	Horse mackerel
PDO	0.45**	-0.3*	0.42*			
SOI						
AO				-0.45*		
NPI	-0.3*		-0.43*			
MOI						
Bohai Summer PC1			0.56*			
Bohai Winter PC1						
Yellow Sea Summer PC1			0.44*			
Yellow Sea Winter PC1	0.3*					
East China Sea Summer PC1	0.57**		0.64**	0.48**	0.5*	
East China Sea Winter PC1	0.62**		0.61**	0.47**		

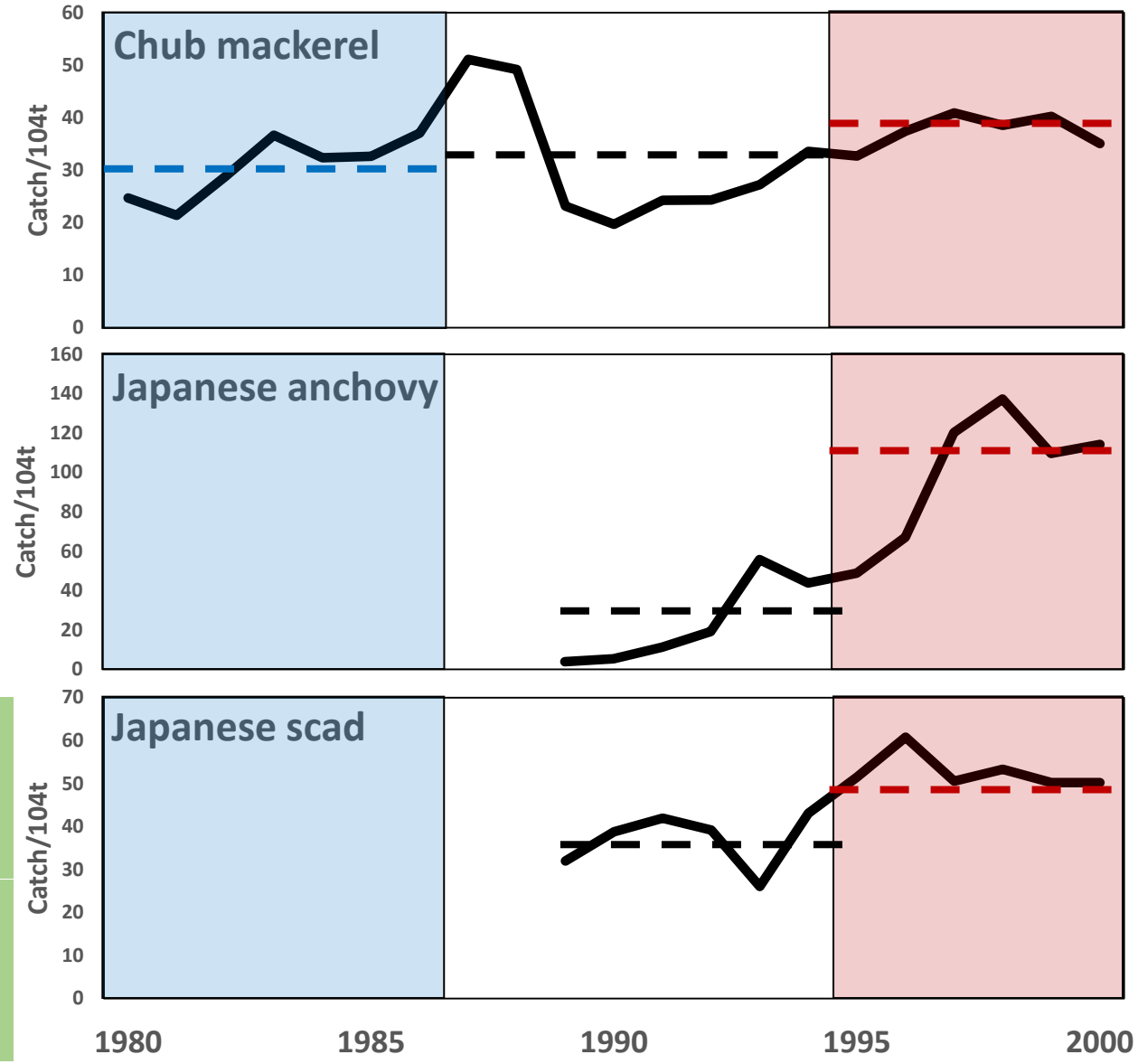
Asterisks denote significance at the following alpha levels: * 0.05>p>0.01, ** 0.01>p

Variation in SPF catches are driven by climatic regime shifts, particularly the thermal regime shifts.

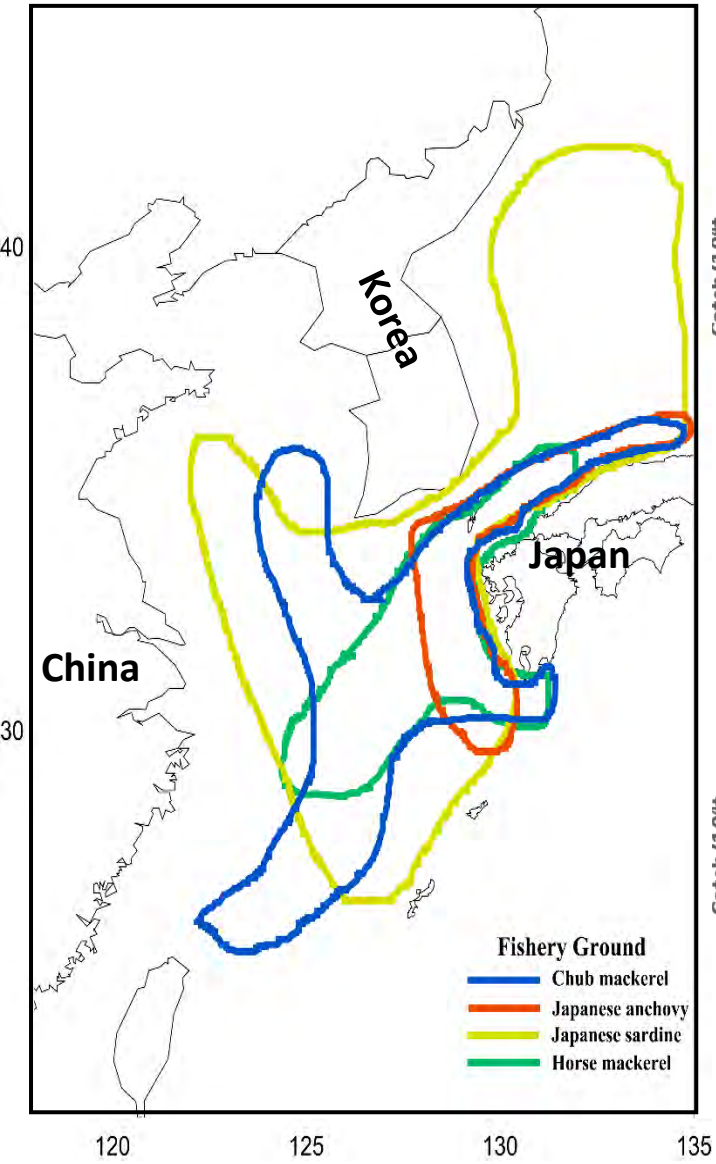
Responses of SPF to SST variation pattern

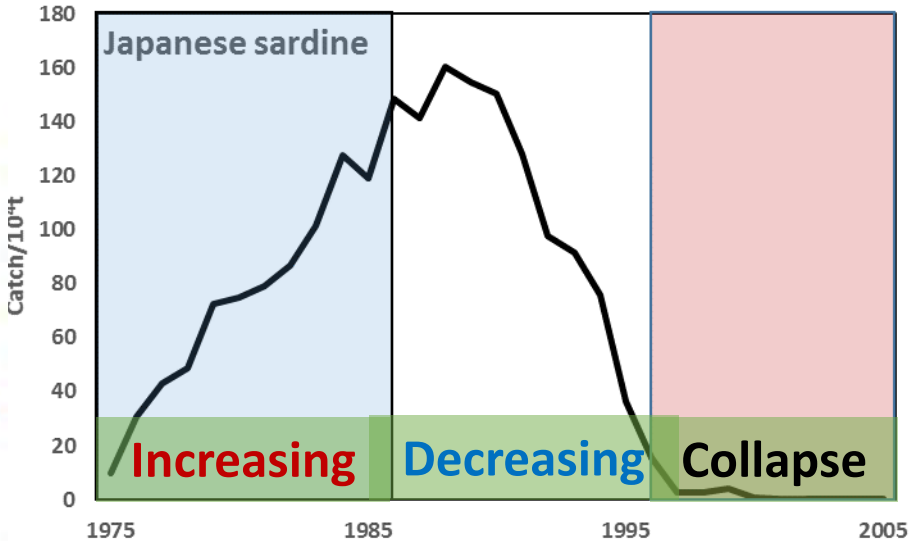


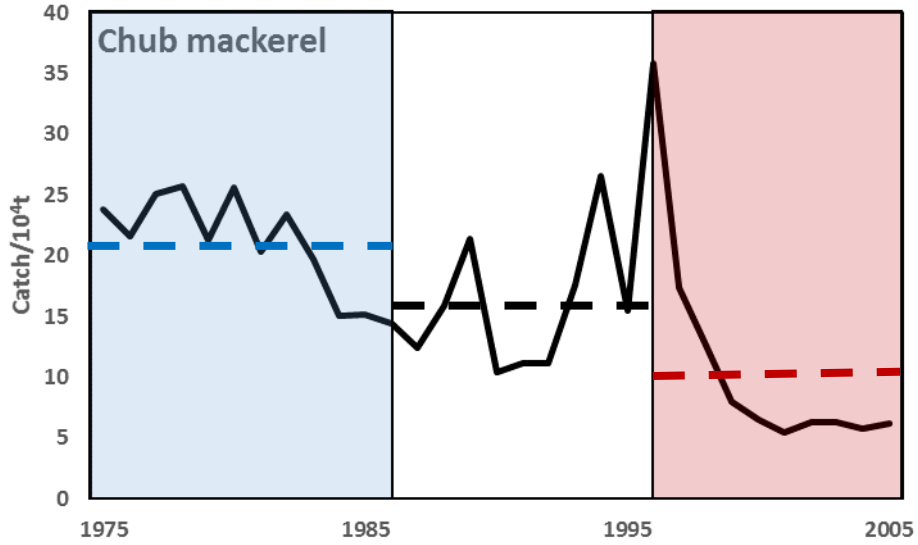
- Rising trend with time lag between winter and summer.
- Catch trends responded well to the SST variation pattern.

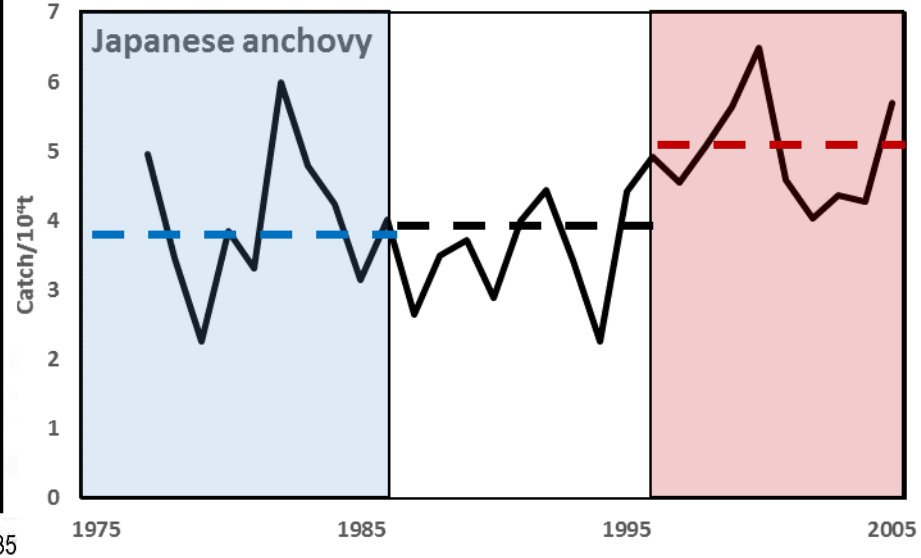


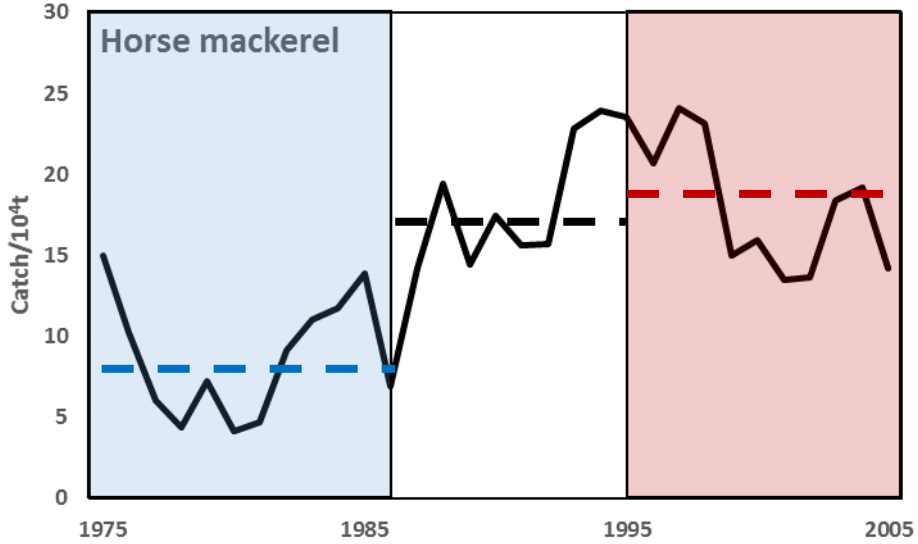
Responses of Tsushima catch to the changing SST











Summary

I. SPF catch in China showed decadal variations with step changes around 1976/77, 1996/97 and 2007/08.

II. SPF catch in China responded well to the climatic regime shifts, particularly the thermal regime shifts, occurred in 1976/77 and 1995/96, but no significant response to the shift in 1988/89.

III. SST variation pattern with regime shift occurred in winter in 1986/87 and in summer in 1995/96 had important effects on SPF catch.

Future works

Based on data collection such as life history traits by species, to verify the effects of the SST variation pattern on SPF.