Comparison of the Short-term and Long-term Climate Change on the Catch Fluctuation of Pacific Cod, *Gadus macrocephalus*, in the Yellow Sea

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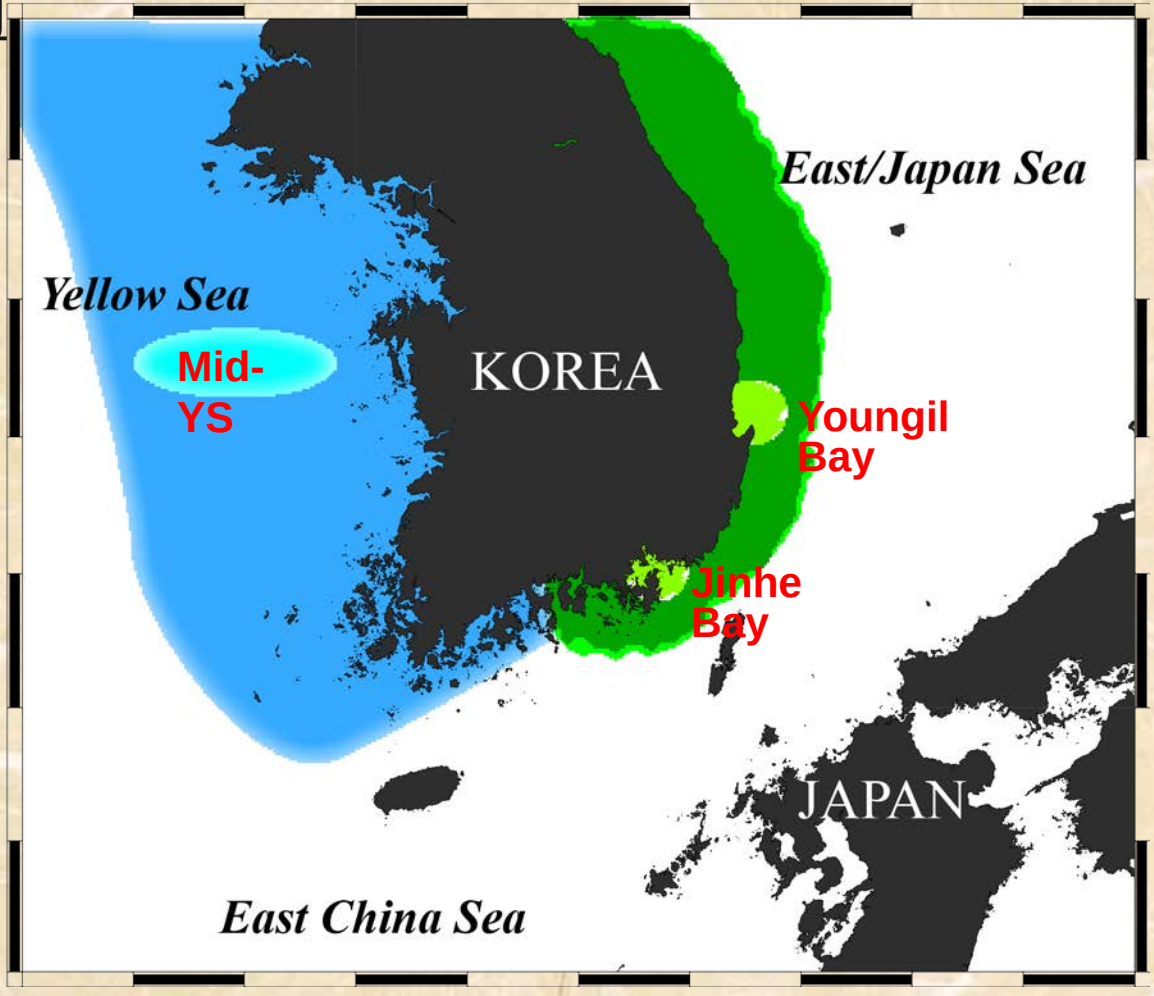
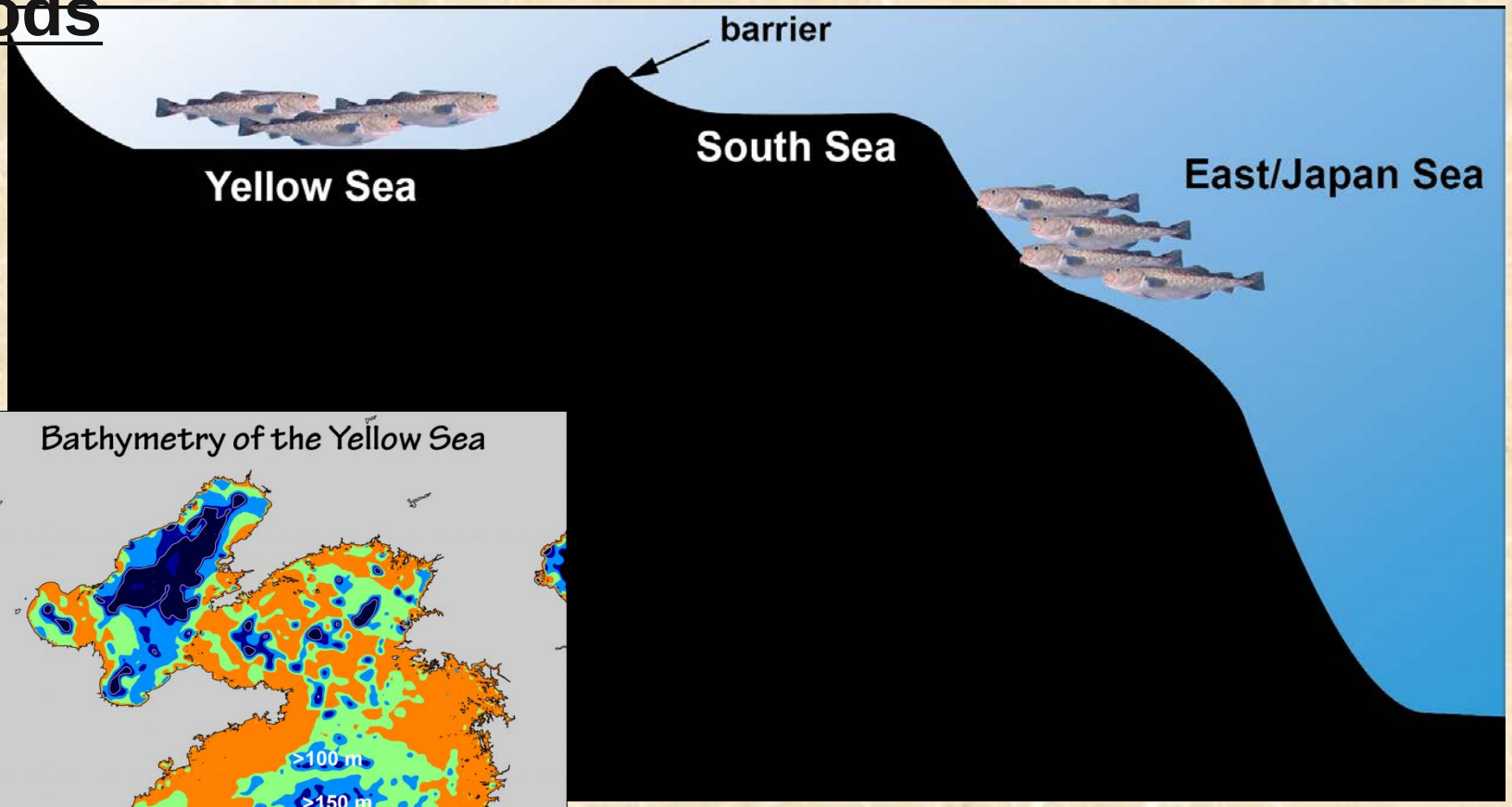
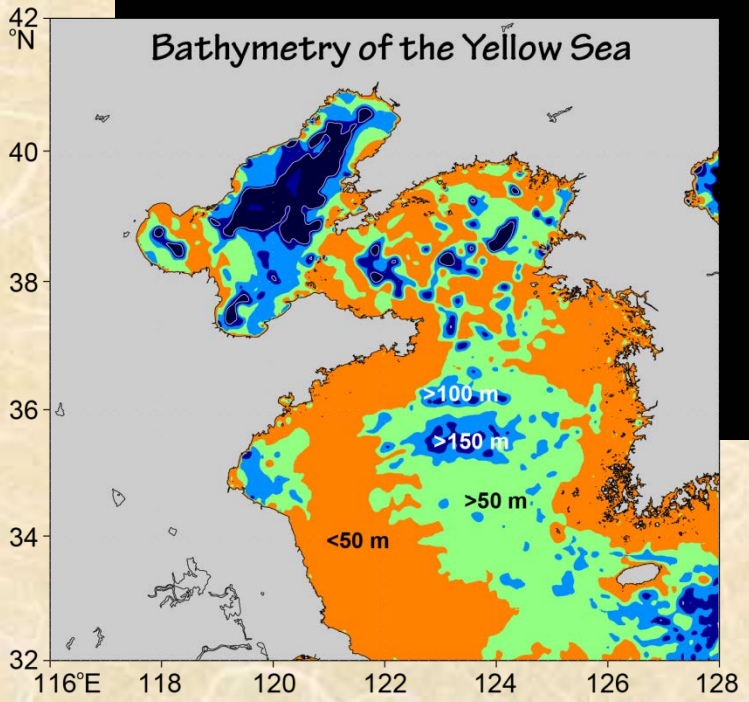
Distribution & spawning

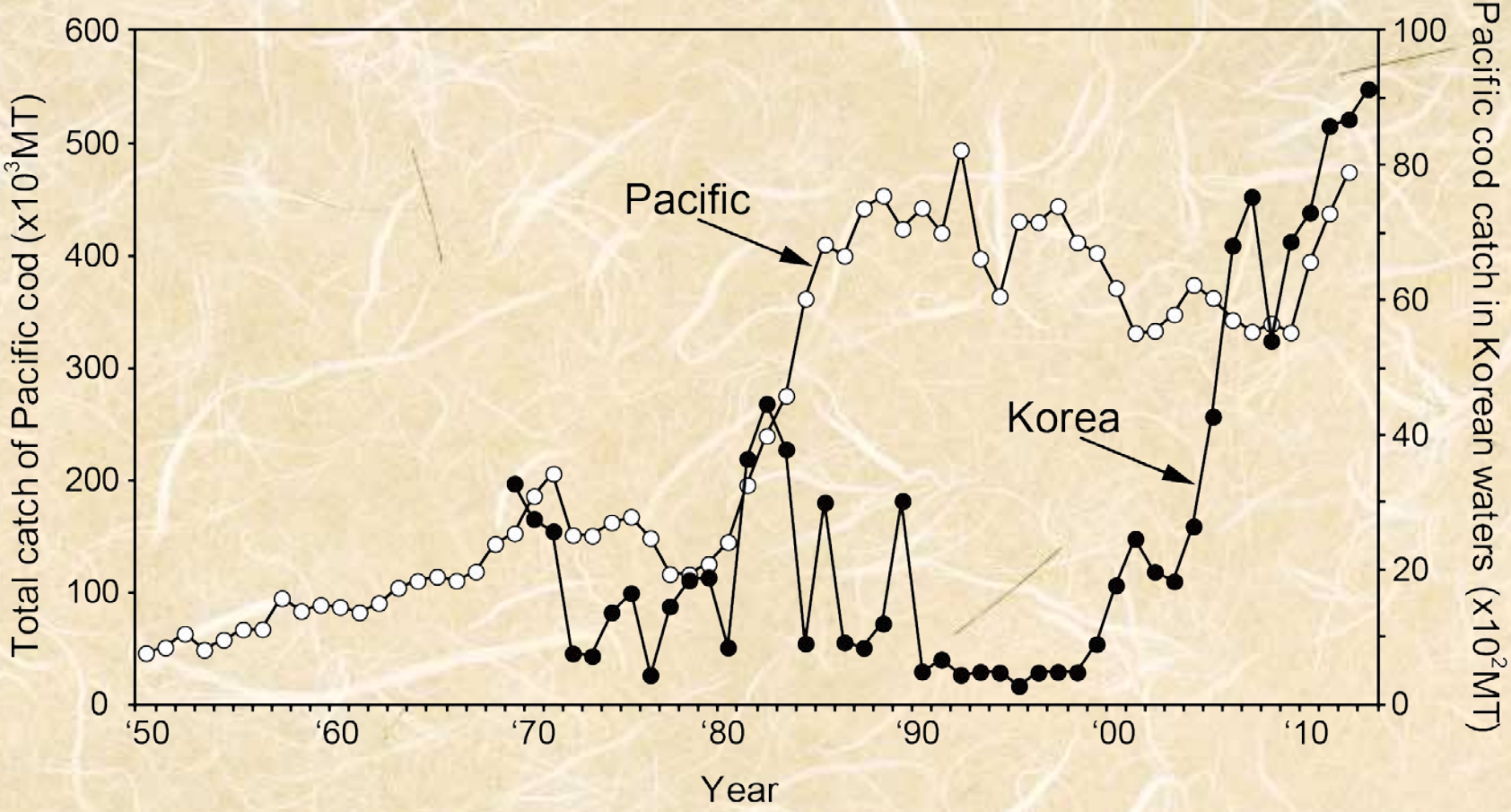


Separation of Korean cods





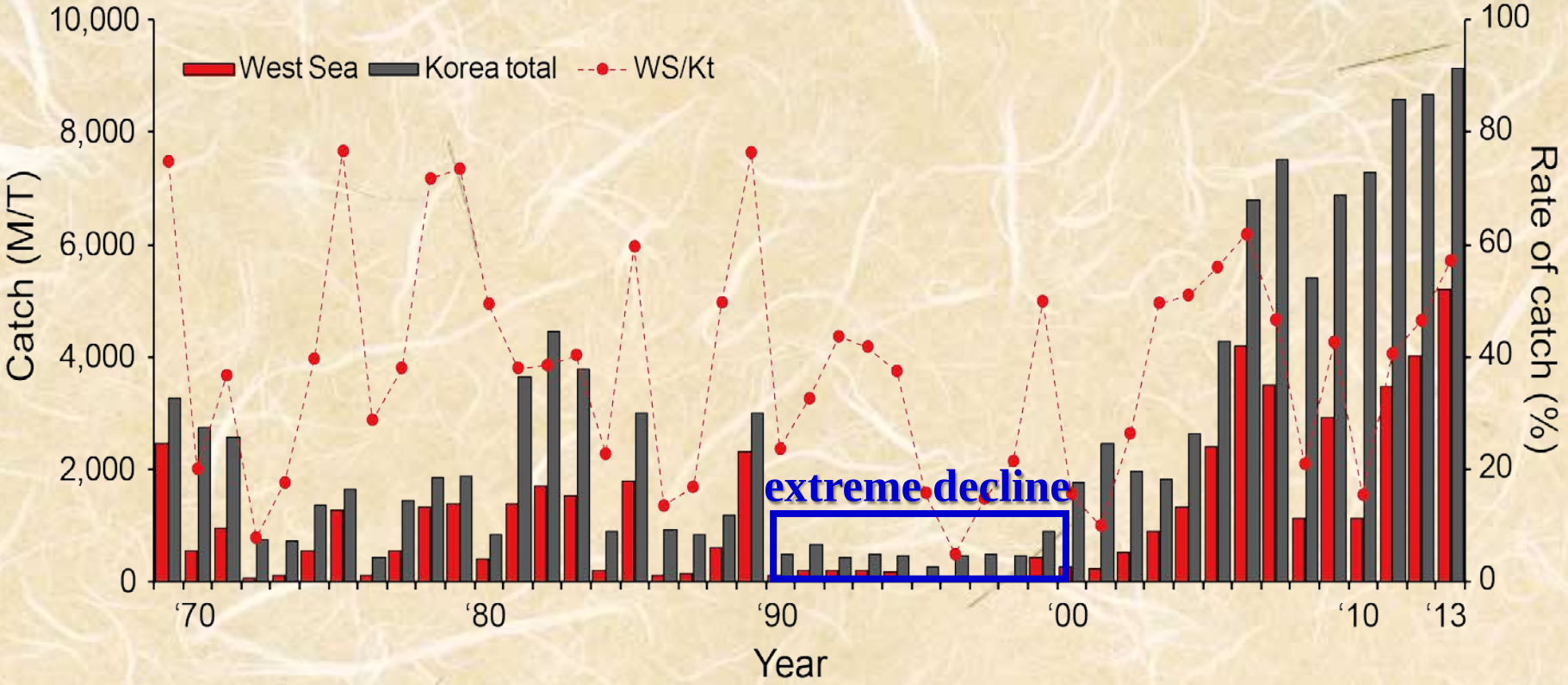
Catch fluctuation (1)



Regional disparity

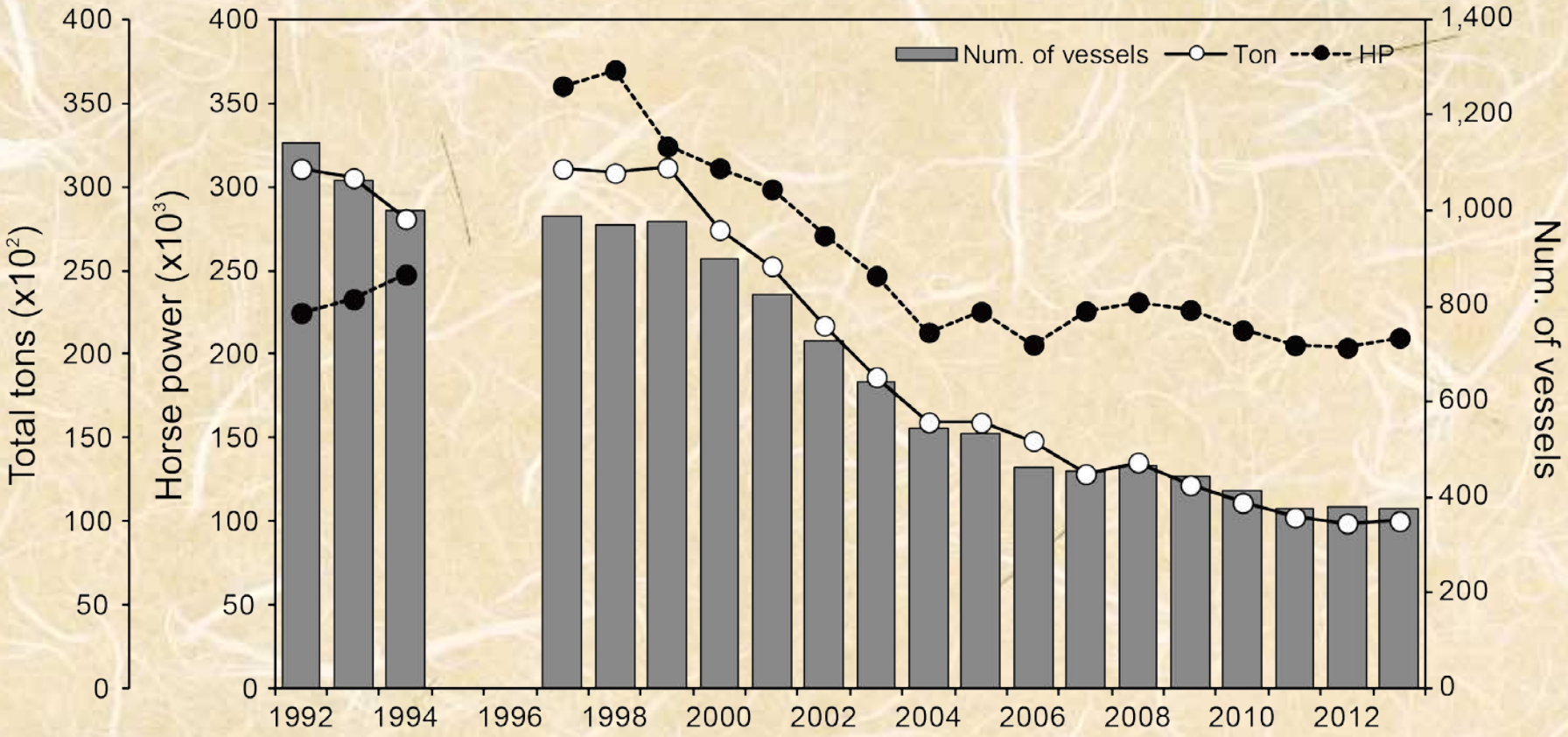
Discordance of fluctuation pattern of Pacific cod catch ?

Catch fluctuation (2)

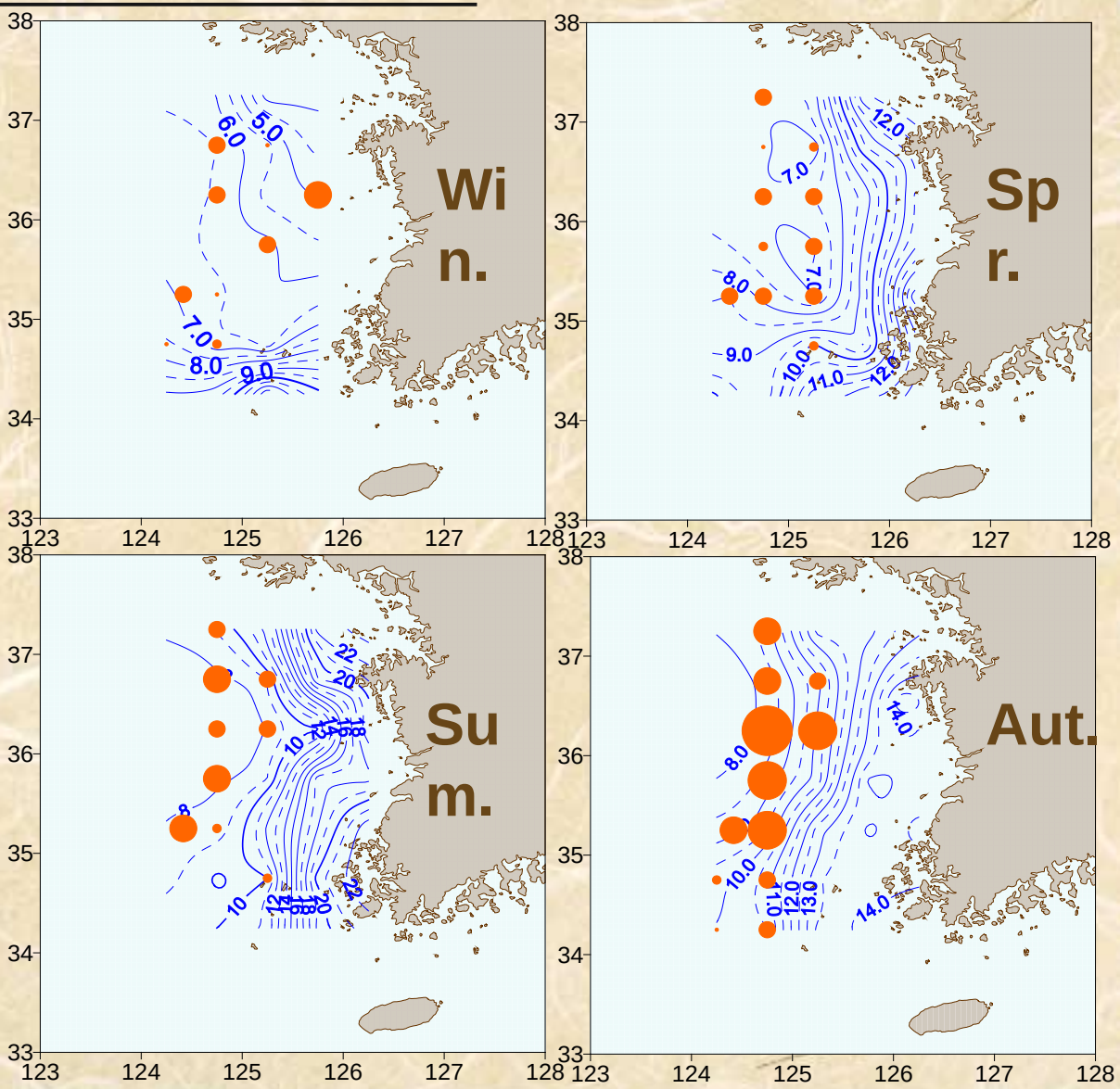


Dominance of the Yellow Sea catch in Korean waters

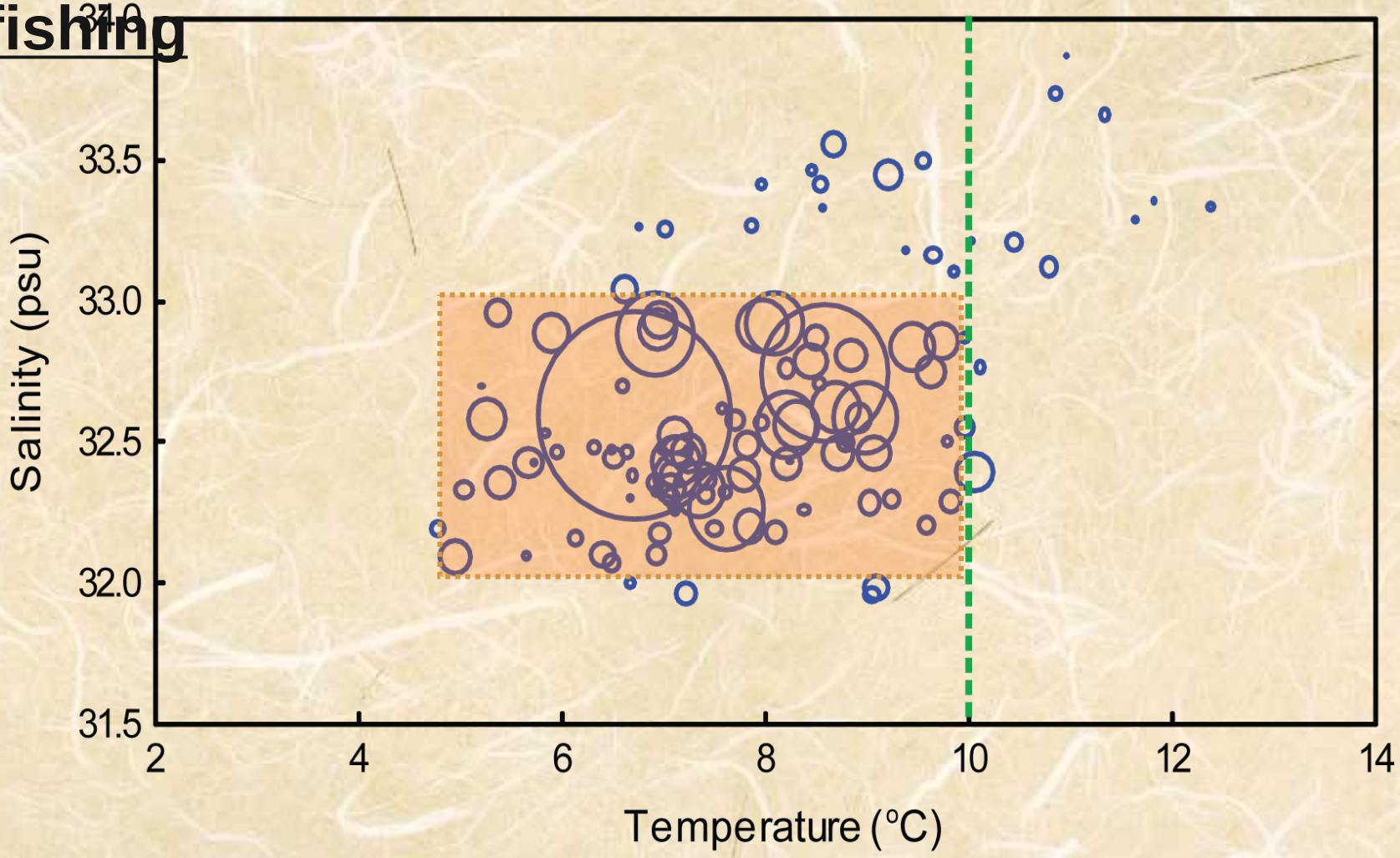
Catch effect



Seasonal distribution



Optimal temp. for fishing



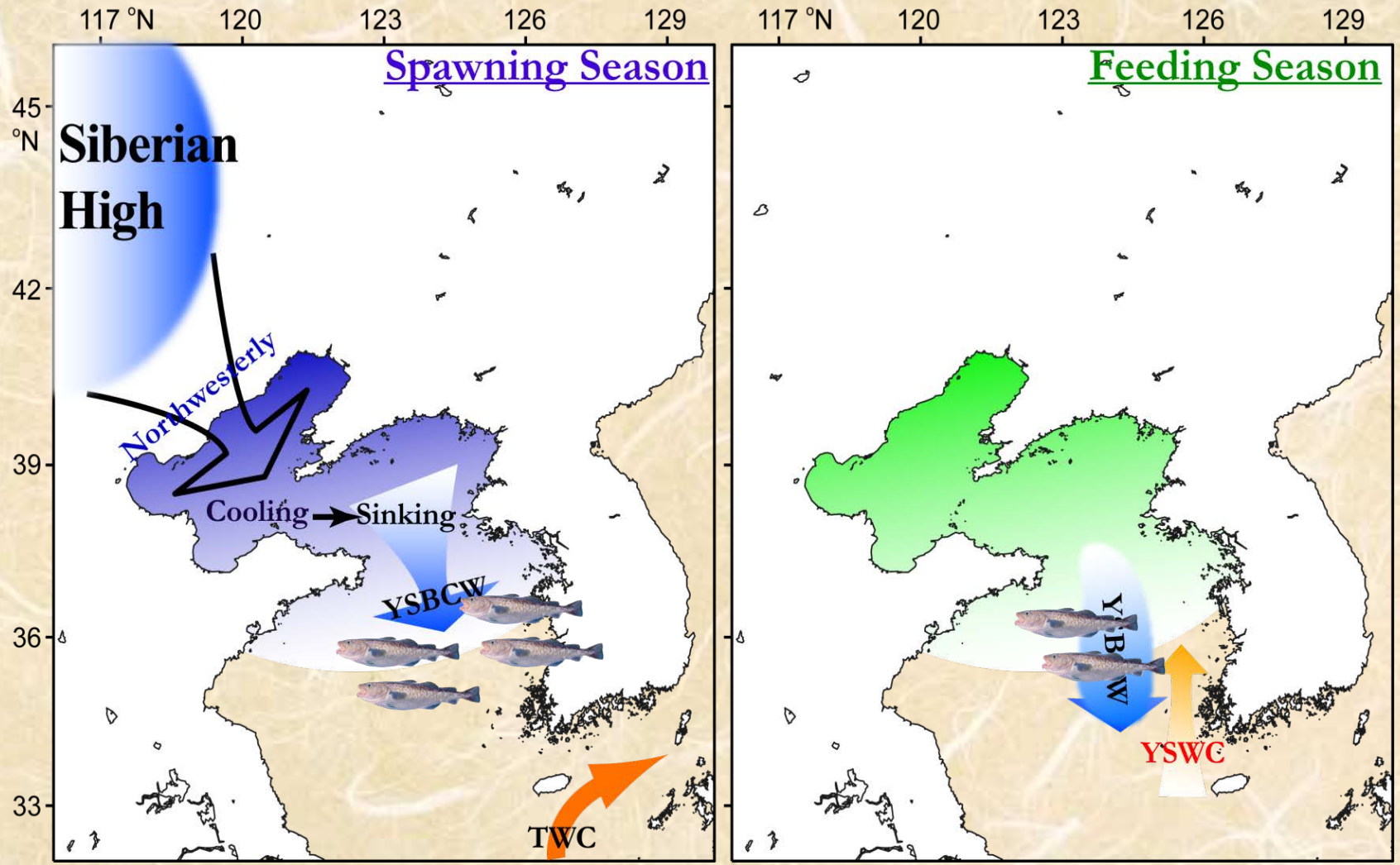
Environmental factors for the Yellow Sea cod

- ✓ The influence of temperature on egg and larval development (Tyler and Crawford, 1991)
- ✓ The influence of temperature on the distribution of adult cod
- ✓ Importance of Climate change in determining the productivity of cod (Drinkwater et al., 2003)

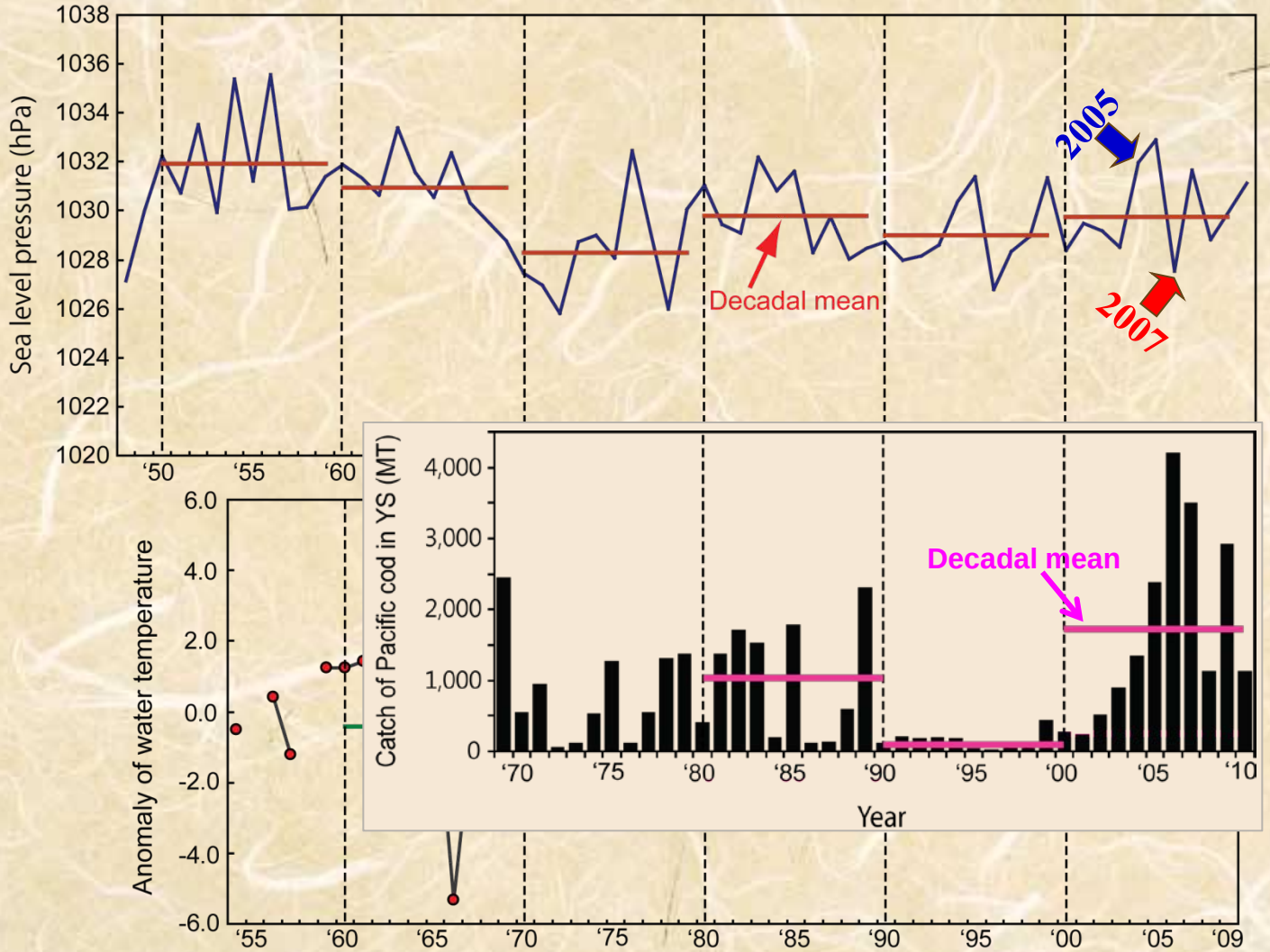
Environmental factors determining hydrographic in the Yellow Sea

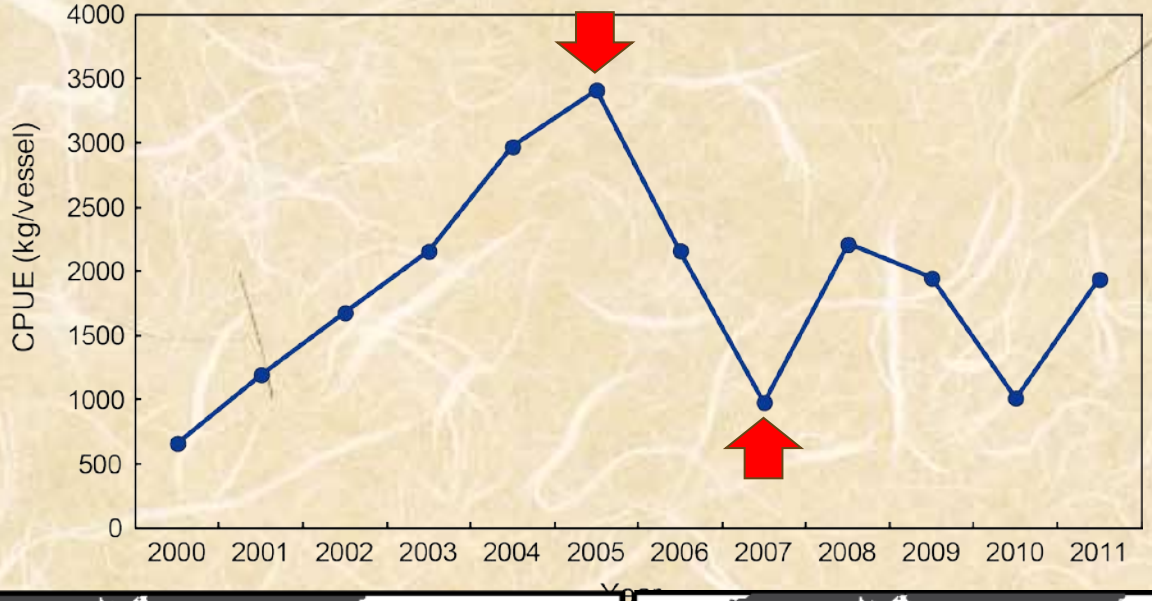
1. Siberian High (Winter season, Monsoon region)
2. Yellow Sea Bottom Cold Water (YSBCW)
3. Yellow Sea Warm Current (YSWC)

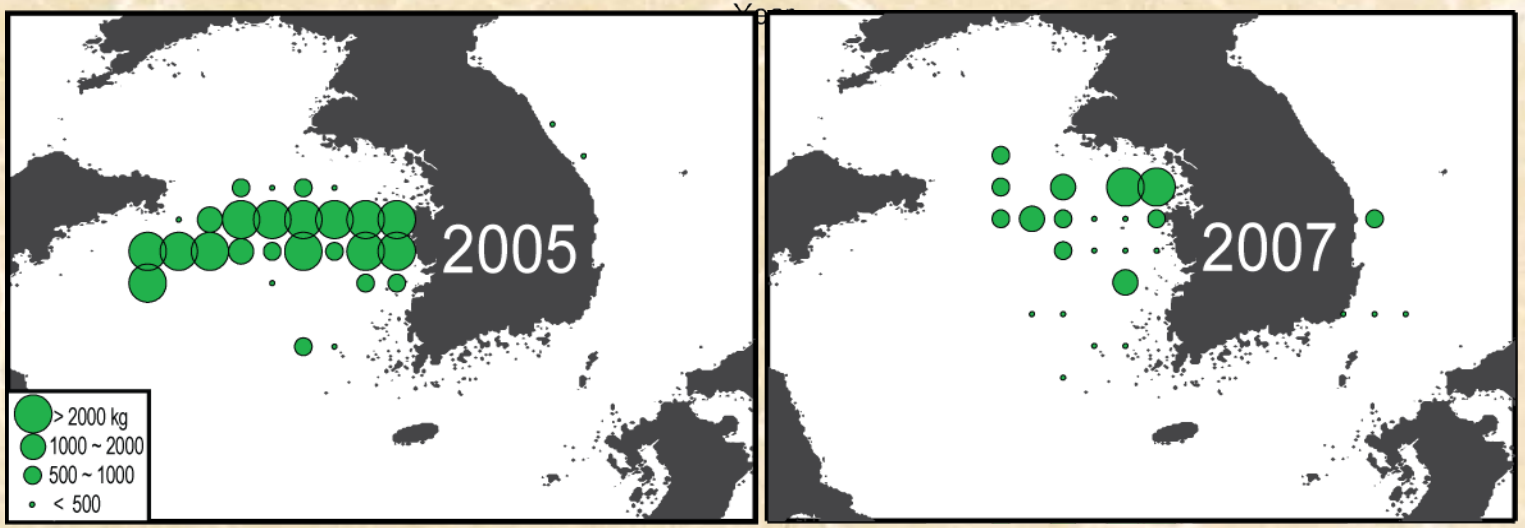
Seasonal migration



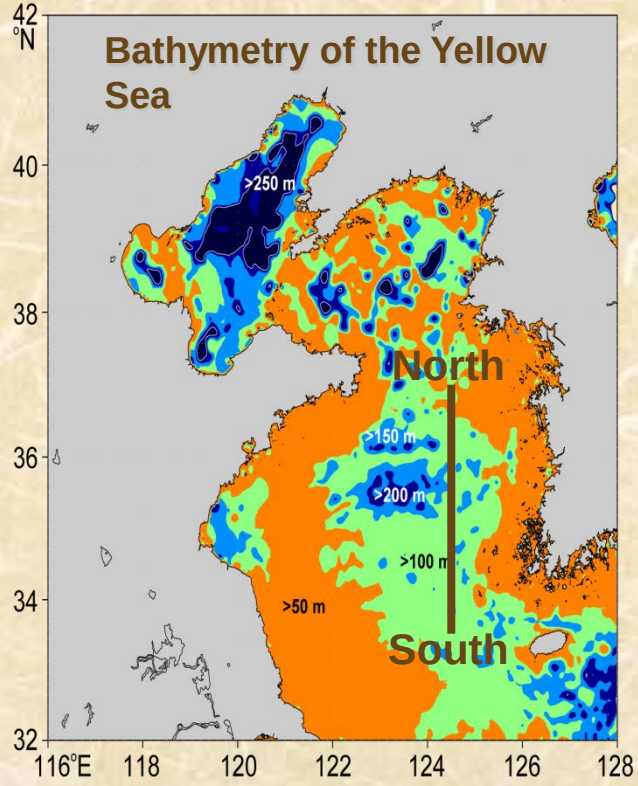
Siberian High & WT

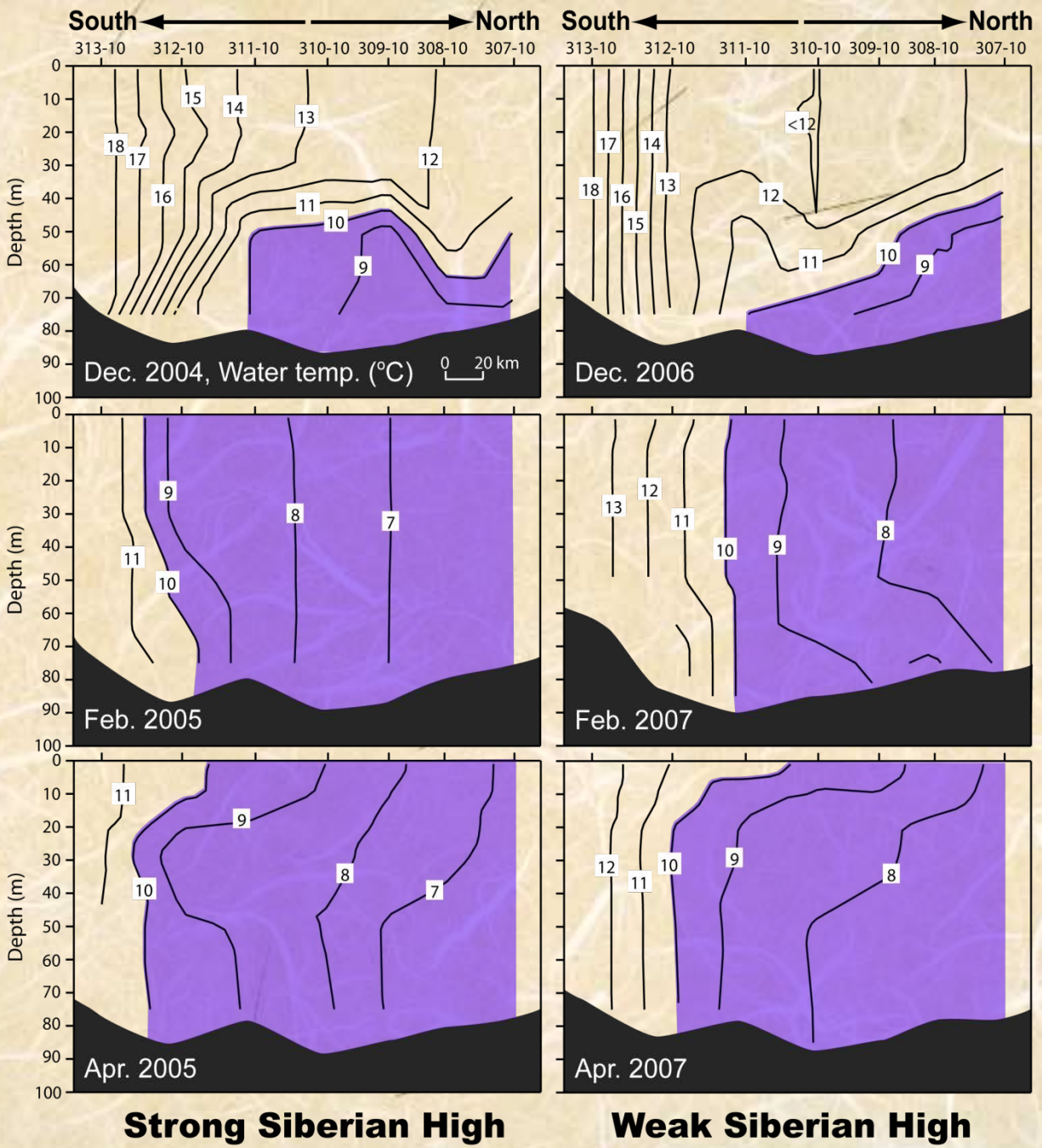



CPUE (kg/vessel)
4000
3500
3000
2500
2000
1500
1000
500
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

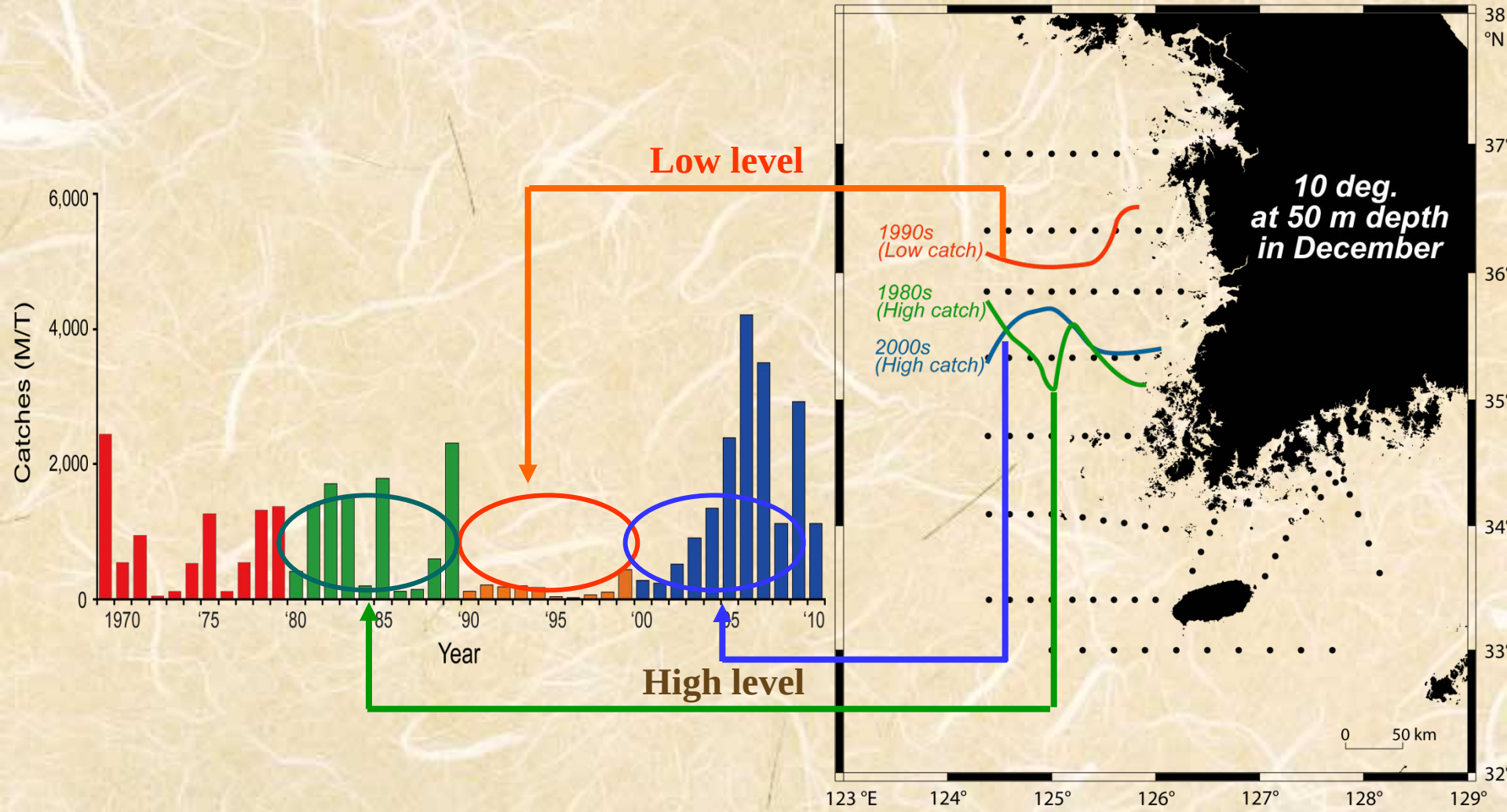

2005
2007
> 2000 kg
1000 ~ 2000
500 ~ 1000
< 500

YSBCW by the SH





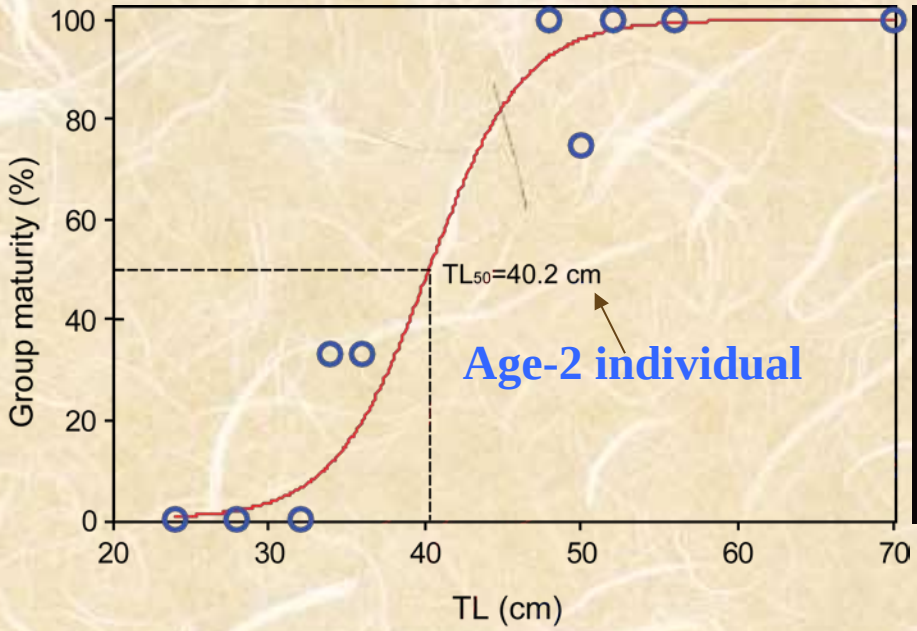
Optimal temperature & Catch in the Yellow Sea

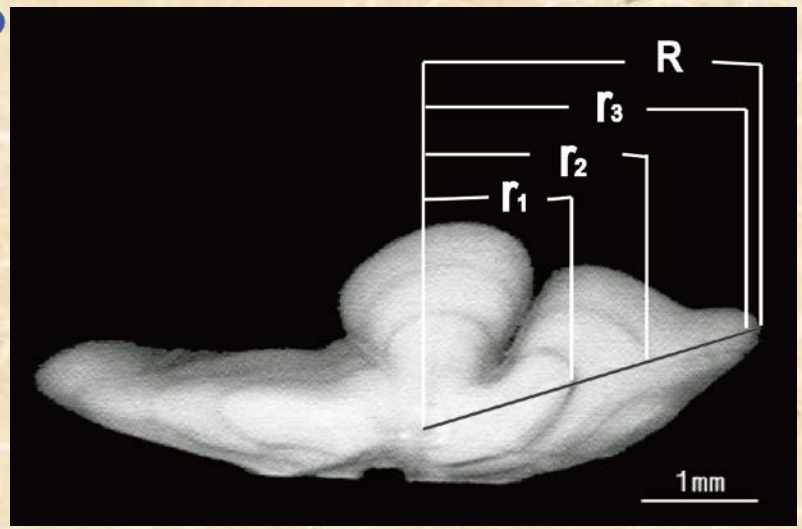


Hatching conditions

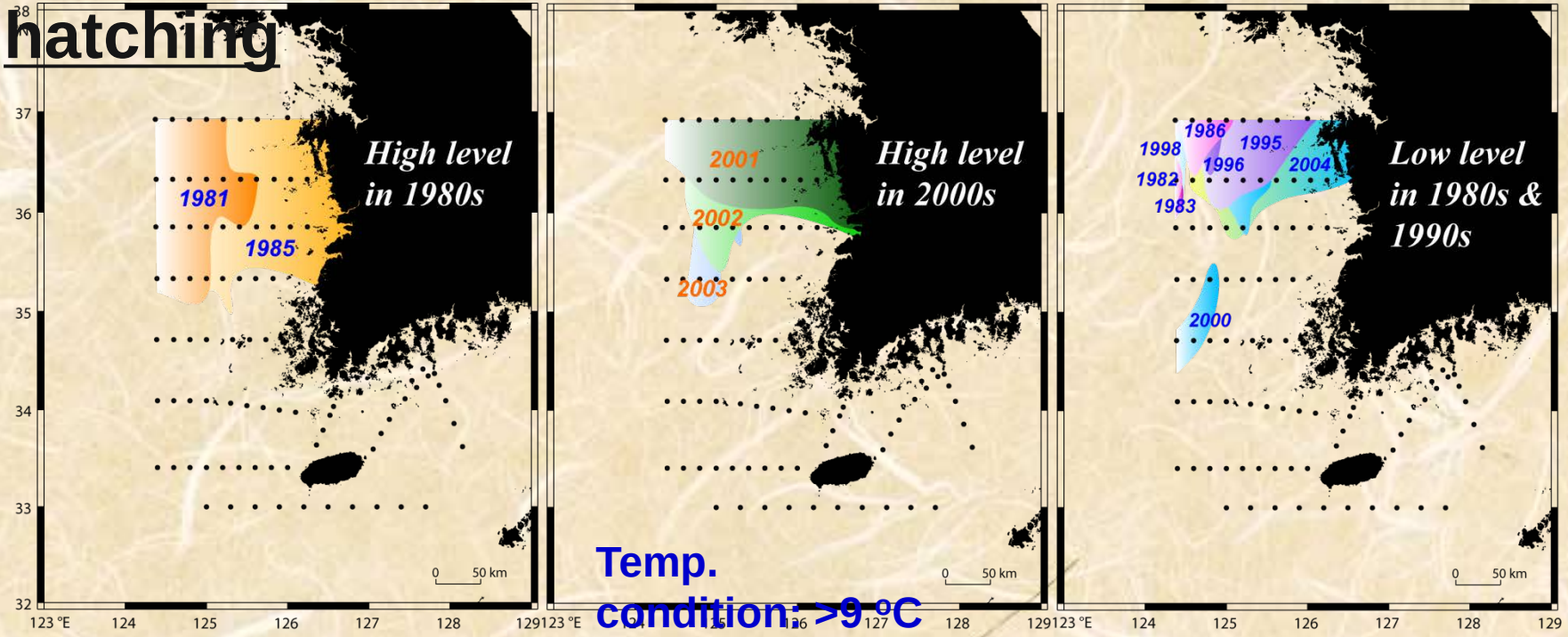
Developmental stage	Water temperature (°C)				
Seo et al., 2007	3	6	9	12	15
4-cell	9 hours	7	6	5	Dead
Morula	27	18	14	12	Dead
Formation of embryo	168	96	72	60	Dead
Heart beat	360	216	144	120	Dead
Hatching	600	360	240	192	Dead
Lee et al., 2007	4	7	10	13	16
4-cell	8	7	5	4	3
Morula	48	24	18	12	8
kupffer's vesicle	120	96	48	Dead	Dead
Hatching	Dead	288	192	Dead	Dead

※ 5-9 °C in the Yellow Sea (Yamamoto, 1939)

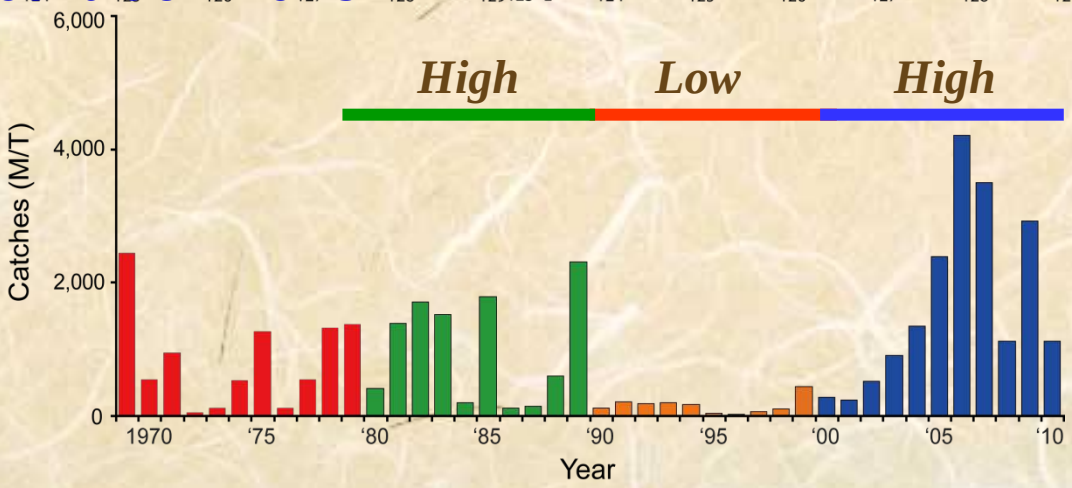

100
80
60
40
20
0
Group maturity (%)
20
30
40
50
60
70
TL (cm)
TL50=40.2 cm
Age-2 individual


R
r3
r2
r1
1mm

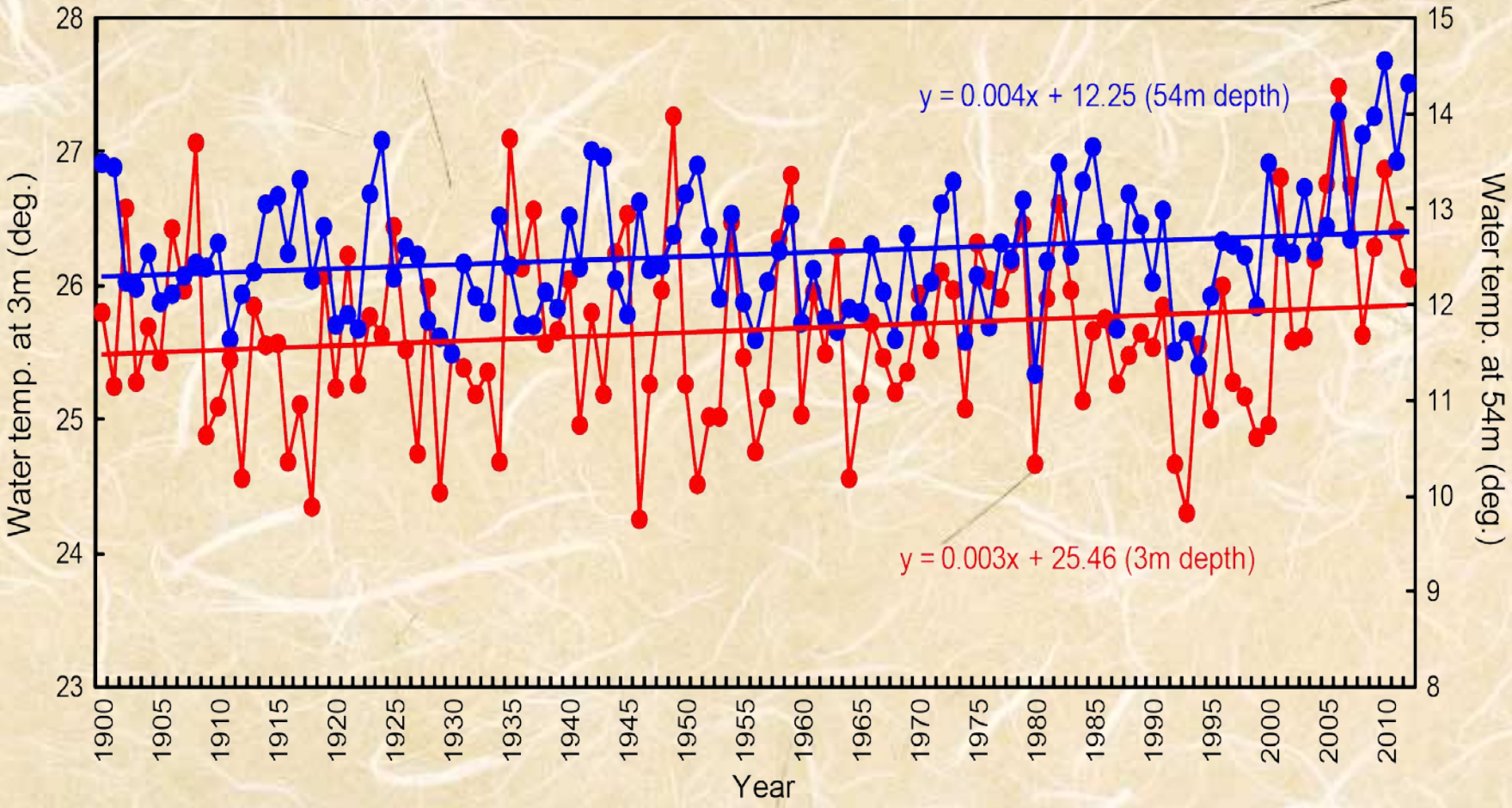
Optimal temp. for hatching

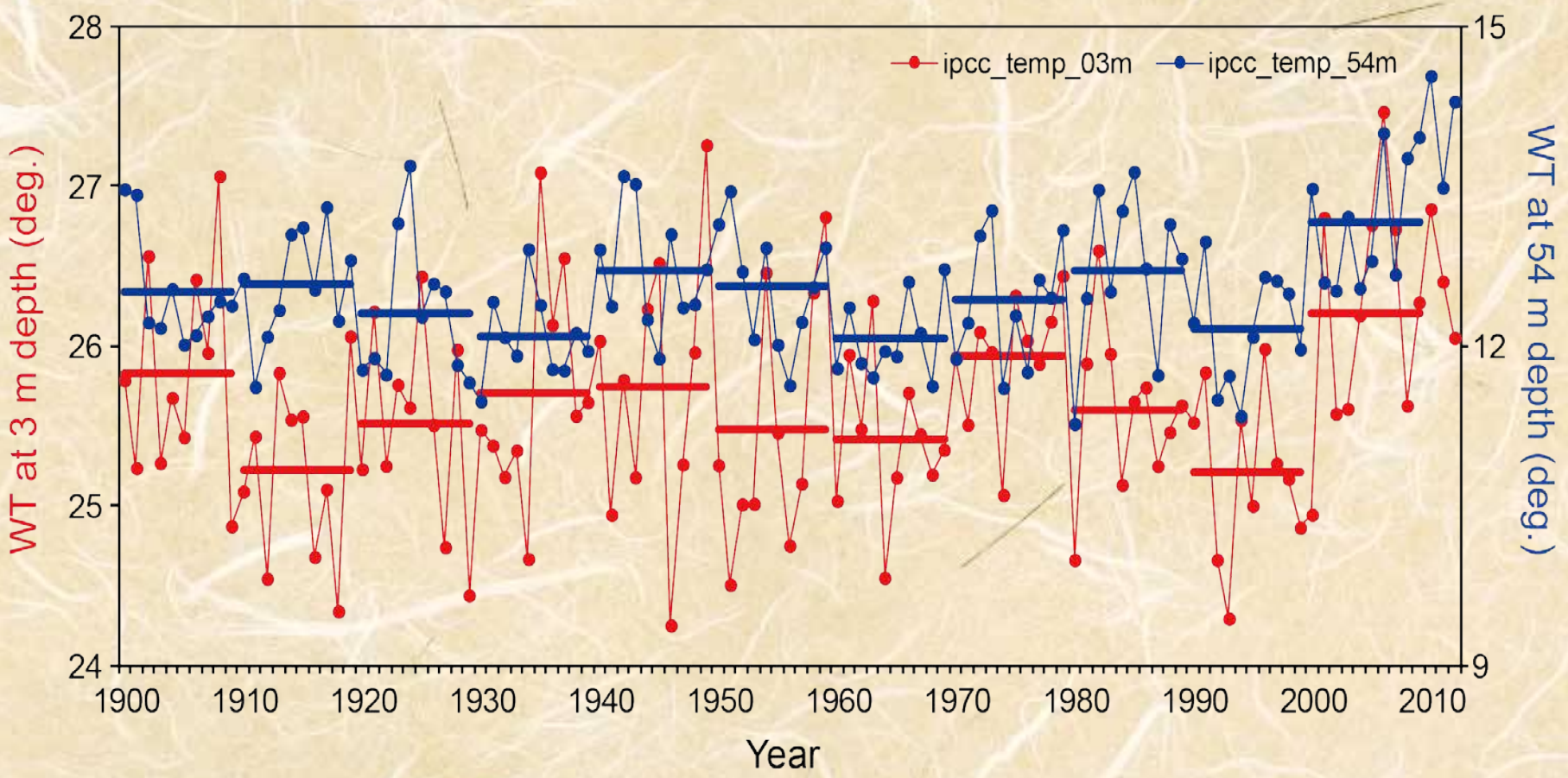


Temp. condition: >9 ºC

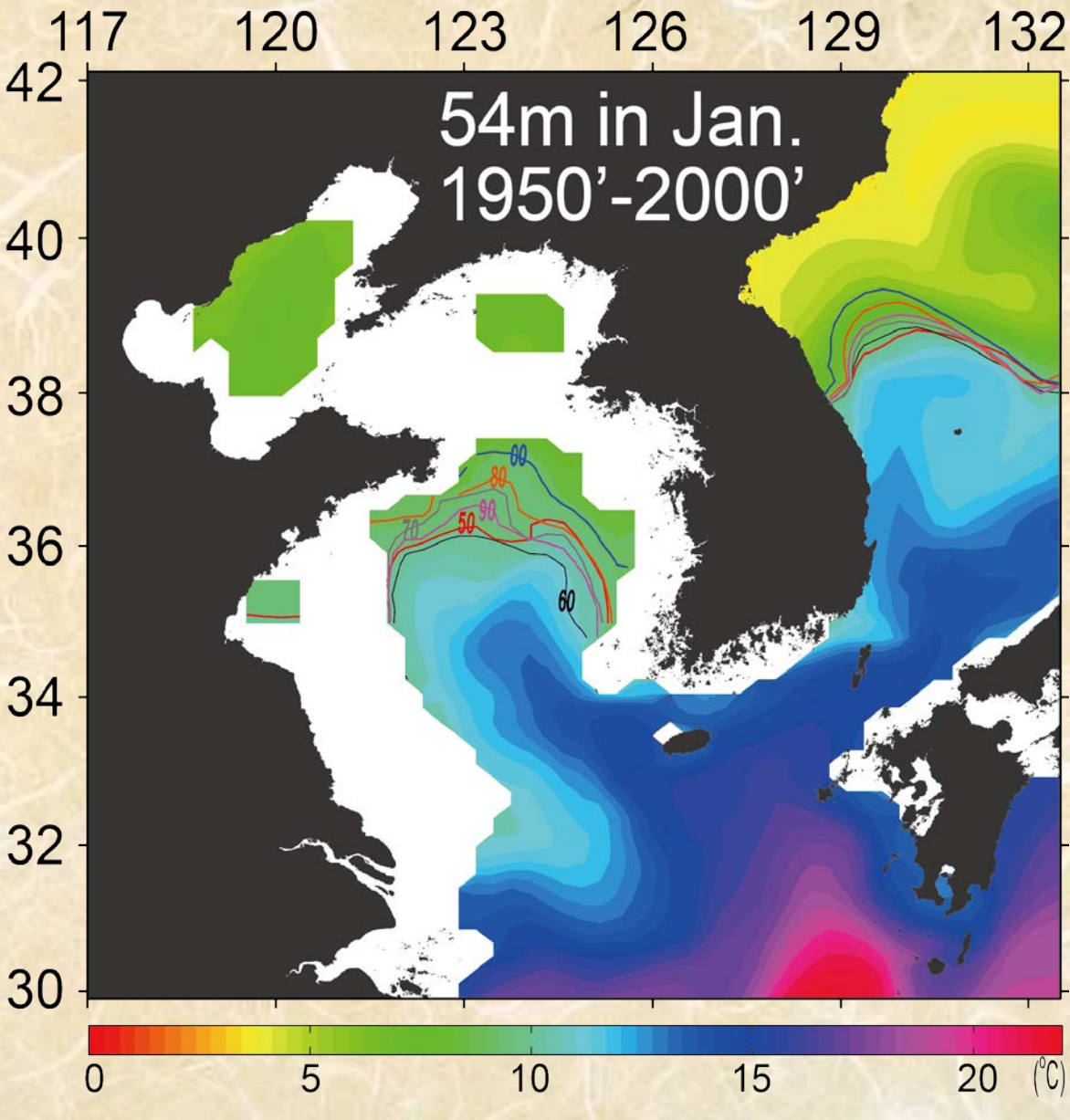


Long-term climate change (MiROC 3.2)

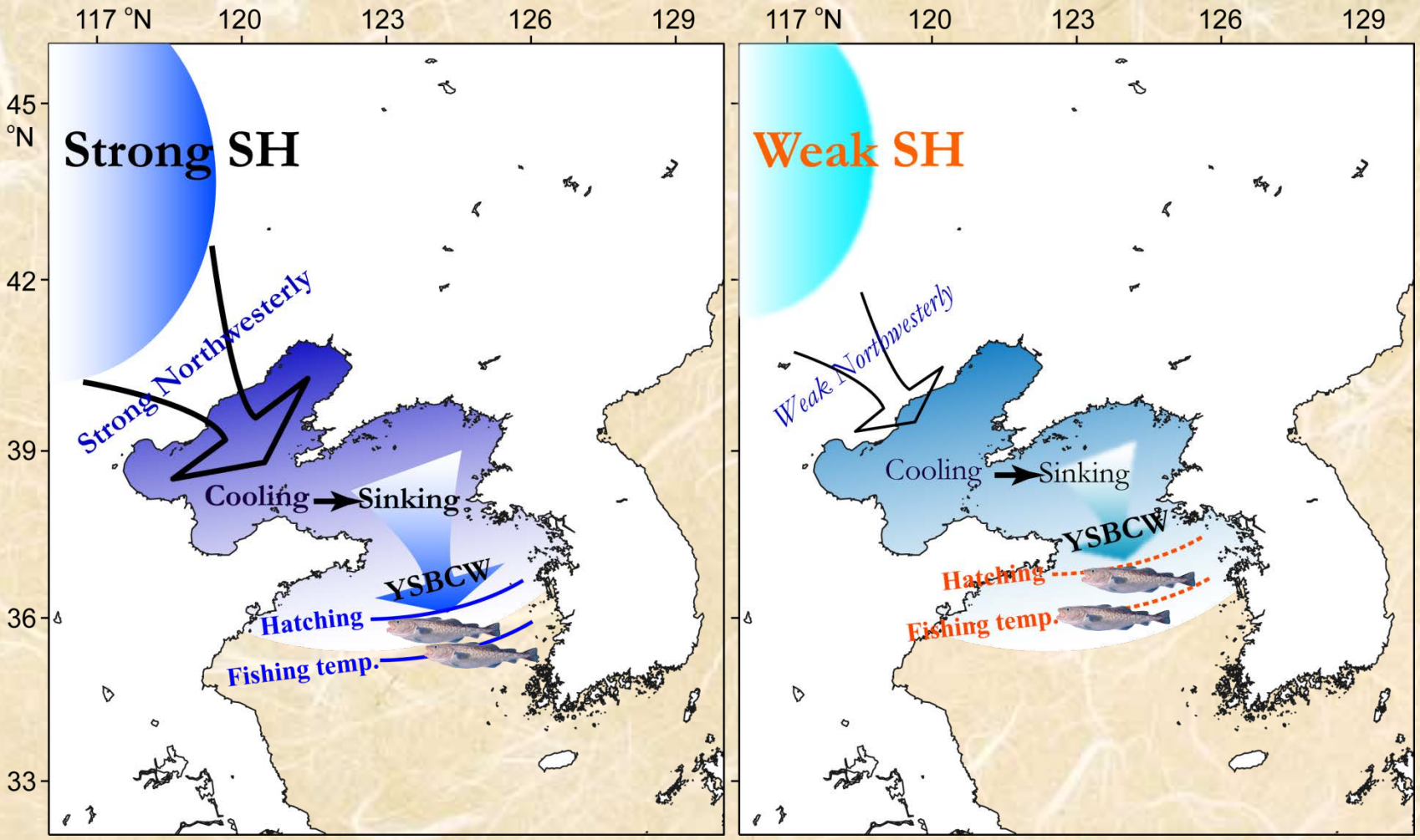



ipcc_temp_03m
ipcc_temp_54m
WT at 3 m depth (deg.)
WT at 54 m depth (deg.)
Year
28
27
26
25
24
15
12
9
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

Long-term climate change



Summary



Increasing catch

Decreasing catch

Thank you for your attention !