ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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The Economics of Adapting Fisheries to Climate Change
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The Impact of Climate Change on Coastal Fisheries of Chinese Taipei

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Outline of the talk

- Change in physical element
- Impact on fishery production
- Impact on fishery ecosystem
- Future impact and adaptation

I. Change in physical elements

SST

- Average SST risings during 1980~2008 in the waters adjacent to Pacific, E. China Sea and TW Strait were 0.65˚C, 0.71˚C and 0.75˚C

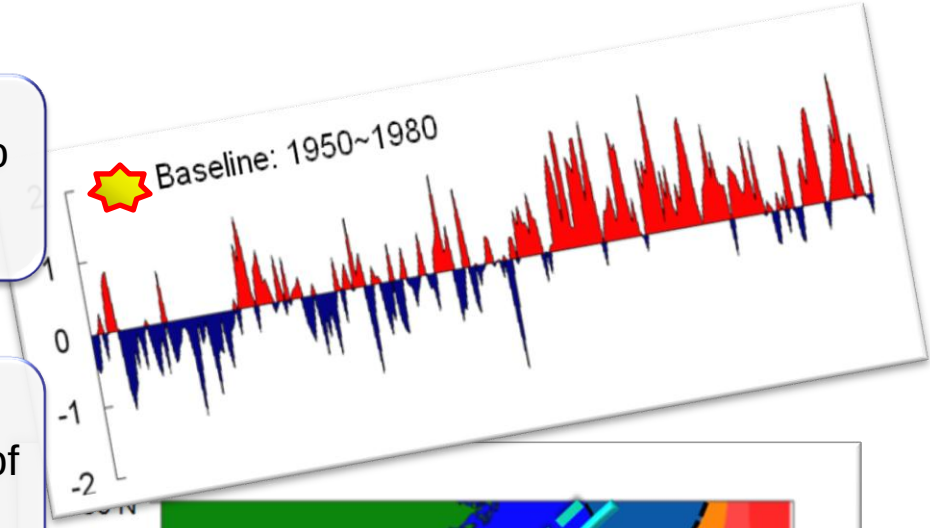
Current

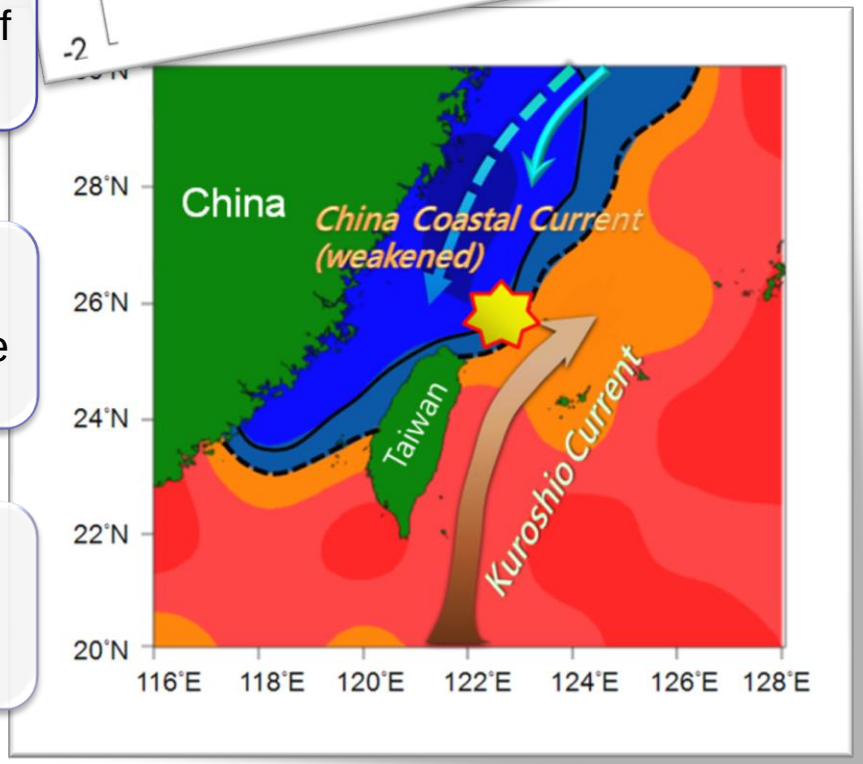
- A trend of diminishing of China Coastal Current and enhancement of Kuroshio Current.

Extreme

- In average, it occurs 3-5 times annually over the last 100 years, but the 10 strongest typhoons took place in the last 10 years.

- Cold extreme: exceptional intrusion of China Coastal Current into the Taiwan Strait in 2008.





II. Impact to fishery production

Distribution

- Range shifts of migratory pelagic fish

Abundance

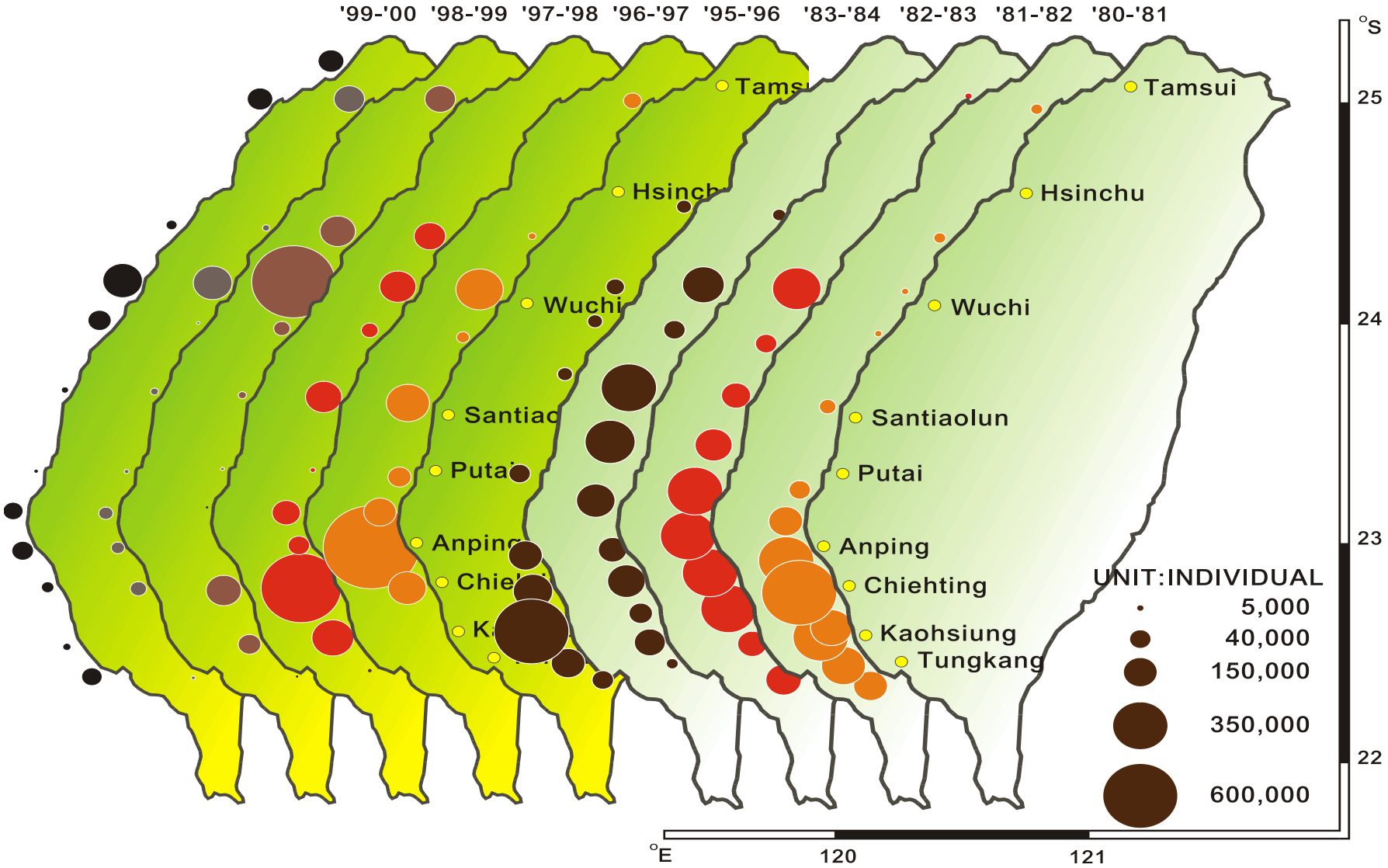
- Wintering fish stock abundance diminished

Fishery activities

- Mullet fishery
- Mackerel fishery
- Torch-light bet fishery
- Set net fishery

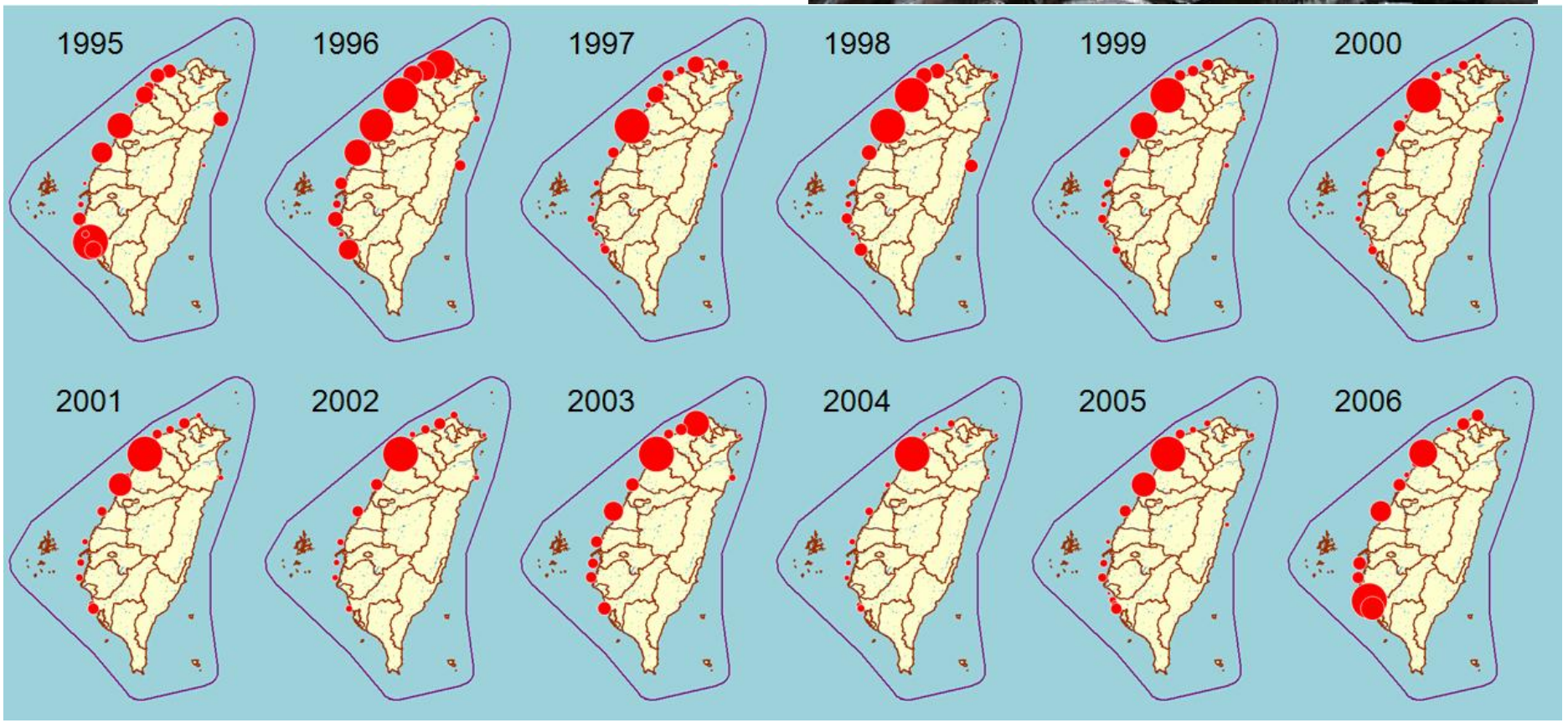
Mullet (*Mugil cephalus*)

Northward shift of species range
Observed from catch number reported by Fishers



Mullet (*Mugil cephalus)*

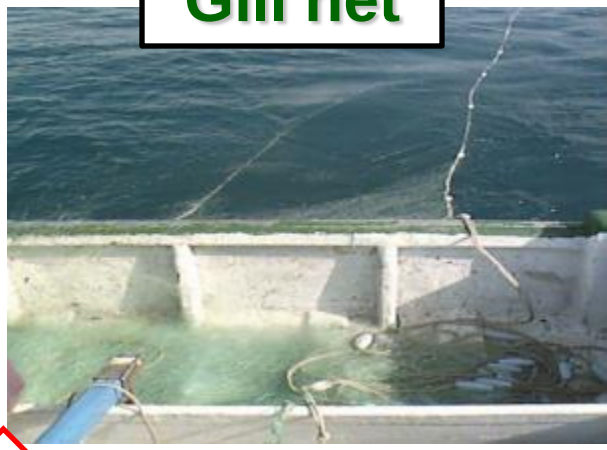
Northward shift of species range observed from landing in weight released by the government.



Pair purse seiner

aquaculture

Gill net

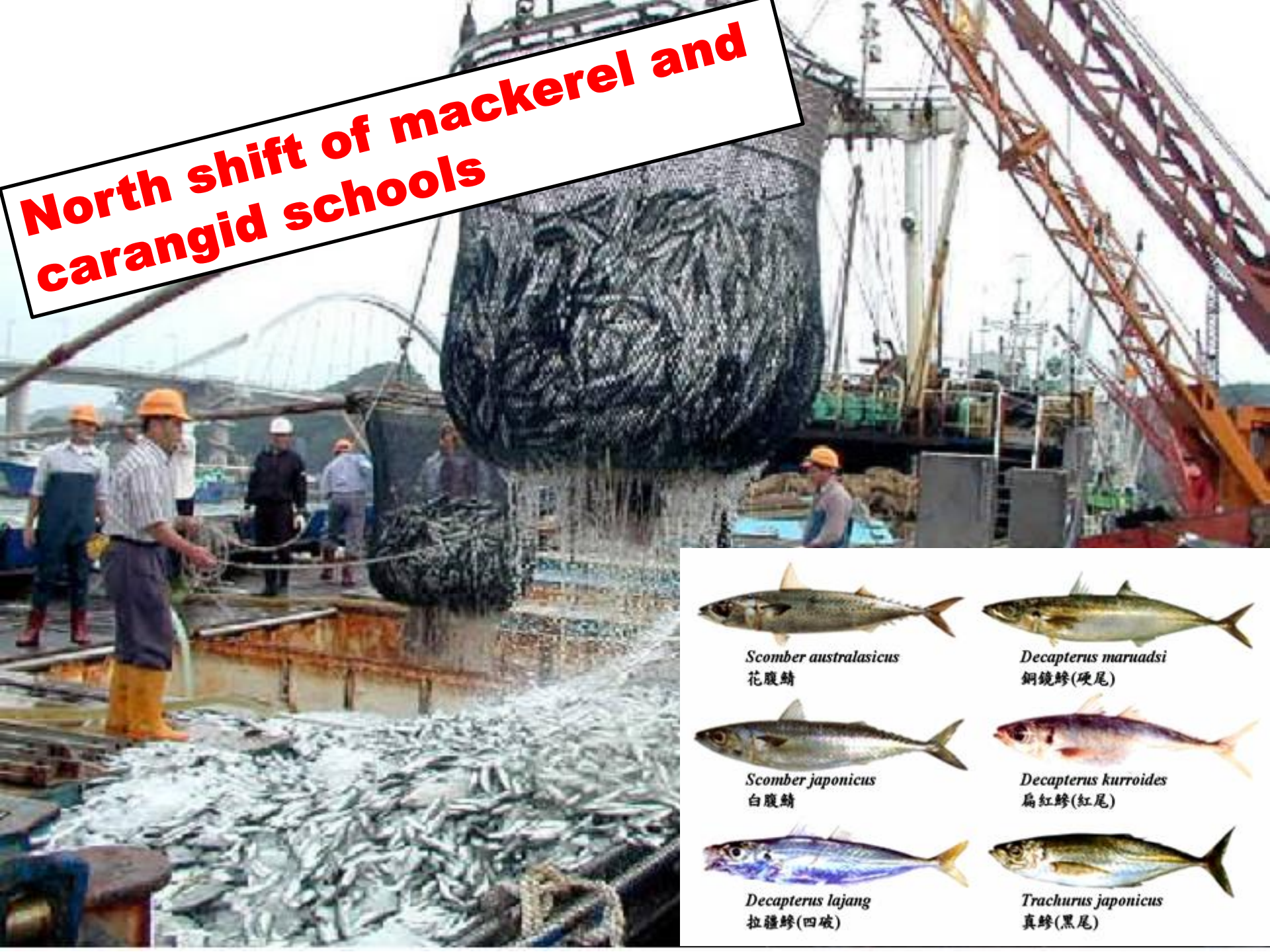


>80%

Replaced by

Fade-out fishery

North shift of mackerel and carangid schools



Scomber australasicus
花腹鯖

Decapterus maruadsi
鋼鏡鯵(硬尾)

Scomber japonicus
白腹鯖

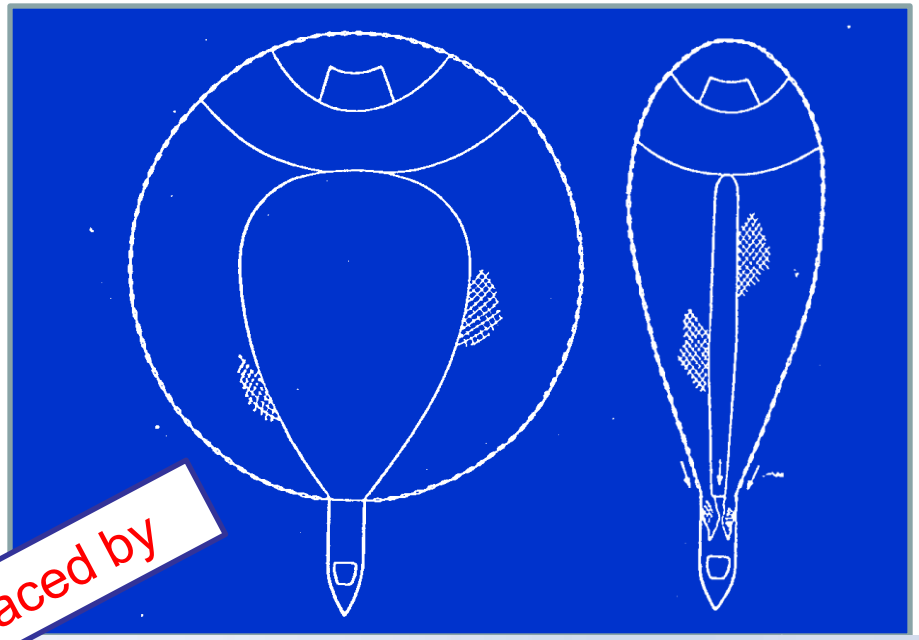
Decapterus kurroides
扁紅鯵(紅尾)

Decapterus lajang
拉疆鯵(四破)

Trachurus japonicus
真鯵(黑尾)

mackerel purse seine
(Japanese style)

mackerel purse seine
(Danish style)



Being replaced by

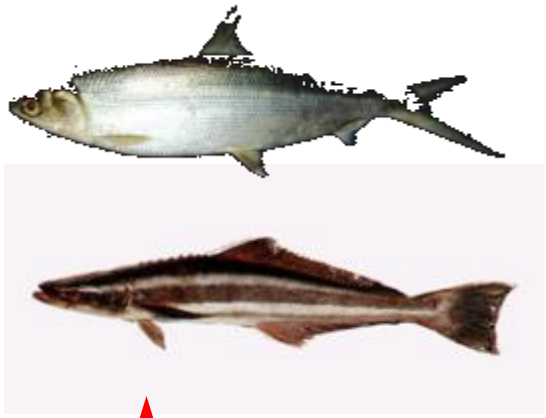
Decline of fishery production caused by impacts from SST warming in coastal of water of Taiwan

Fishery	Period	Target species	Change in catch
Paired purse seine	1958-2008	Mullet (*Mugil cephalus L.*)	decrease > 90%
	1981-2008	Pomfret (*Parastromateus niger*)	
Mackerel purse seine	1982-2008	Chub mackerel (*Scomber japonicus*)	drop from 60-75% to 25-40%
		Jack mackerl (*Trachurus japonicus*)	
		Redtail scad (*Decapterus kurroides*	
		Spotted mackerel (*Scomber australasicus*)	increase from25-40% to 60-75%
		Round scad (*Decapterus lajang*)	
Trawl	1982-2008	Anchovy (*Engraulis japonicus*)	North: >90% drop to 5-20%. South: 100% replaced by *E. punctifer and E. heteroloba*
		Anchovy (*Encrasicholina punctifer*)	
		Anchovy (*Encrasicholina heteroloba*)	
OffshoreTuna longline	1977-2008	Skipjack tuna (*Euthynnus pelamis*)	increase 10~20% (relative)
		Yellowfin tuna (*Thunnus albacares*)	
		Albacore tunas (*Thunnus alalunga*)	decrease 10~20% (relative)
		Bigeye tuna (*Thunnus obesus*)	
mariculture	1982-2008	Oyester (*Crassostrea gigas*)	decrease > 20% (productivity)
	1995-2007	Abalony (*Haliotis aqualilis*)	decrease > 90%

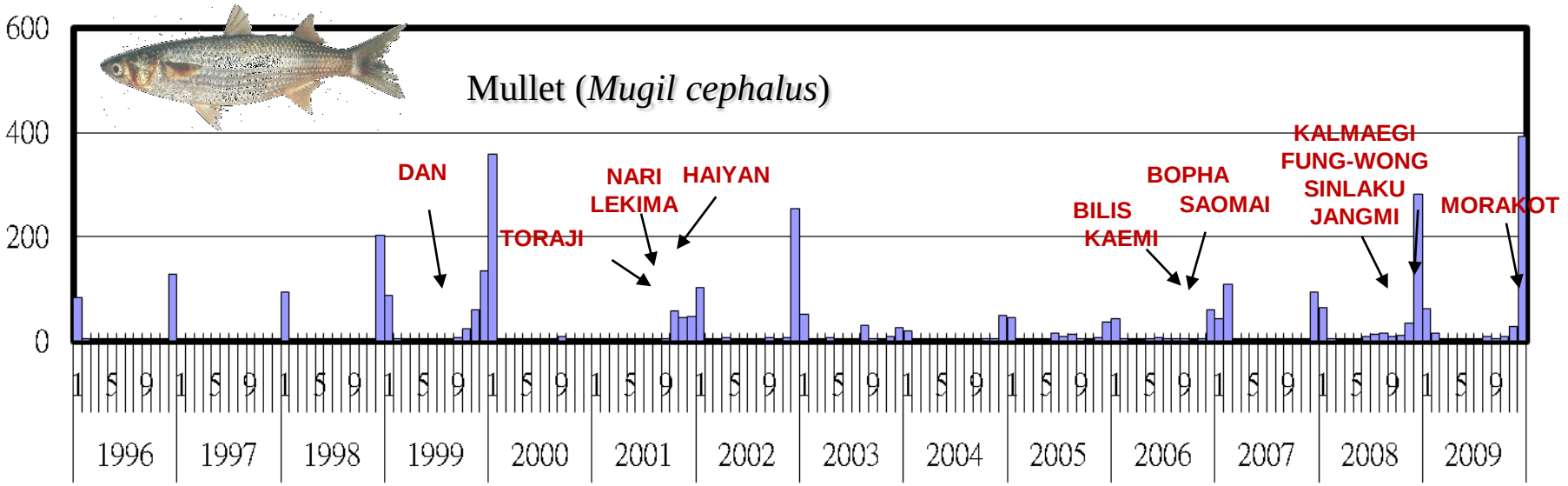
Typhoon Morakot (2009) caused 1.5 billion USD loss in aquaculture

Typhoon occurrence averaged 3-5 events annually over the last 100 years, but the 10 strongest ones occurred in the last 10 years.

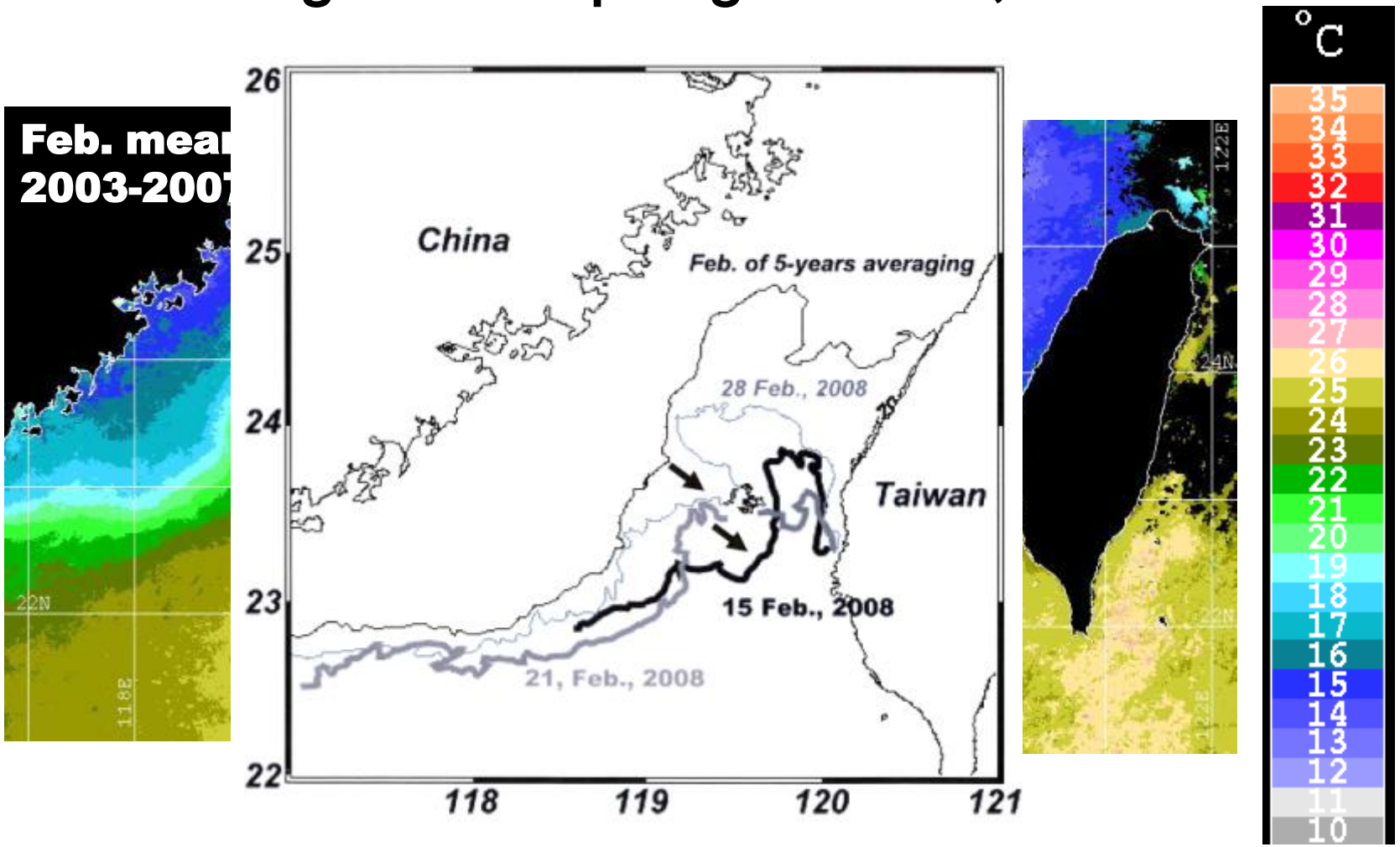
Typhoon induced flood in the southwest Taiwan caused escapement of aquaculture fish such as grouper, mullet, milkfish, cobia and sea perch recruit to wild stock.



Catch in remote fishing village Gong-Liao (NE Chinese Taipei)



Ecological disaster caused by cold extreme in Peng-Hu archipelagic waters, 2008



Strong prevailing wind (>6.7m/s) lasted for 3 weeks and average SST dropped to 12℃ in Peng-Hu archipelagic waters

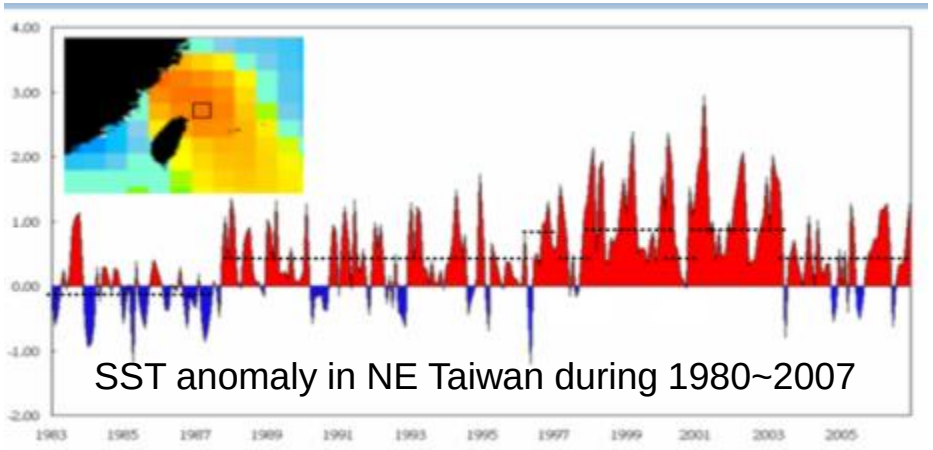
Cobia culture collapsed, mass mortality in shallow sea, economic loss more than 40 million USD

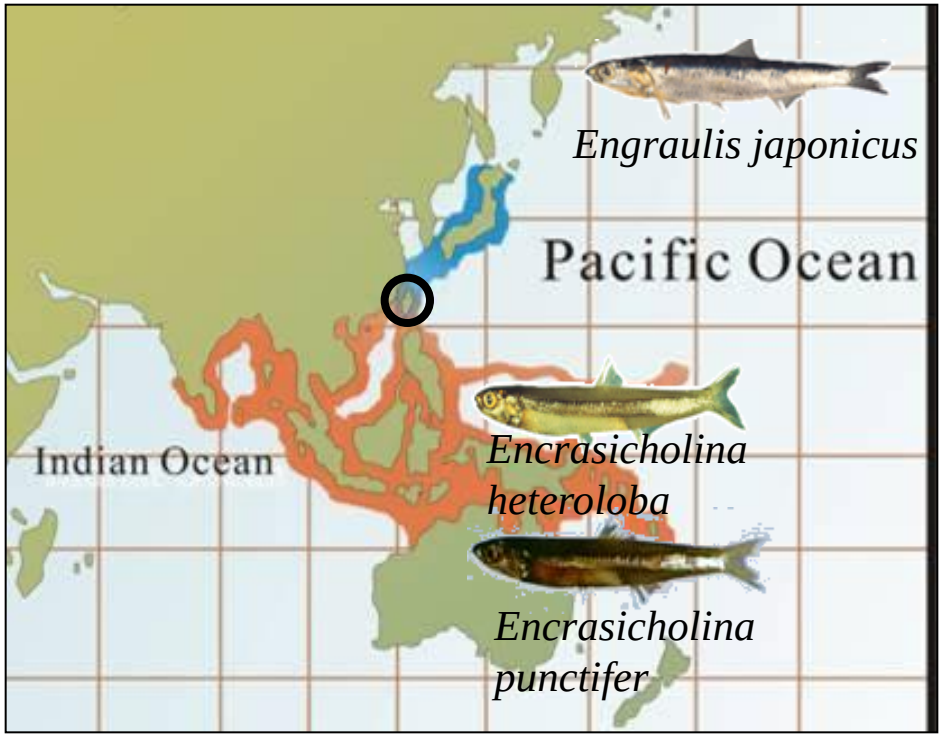
III. Impact on fishery ecosystem

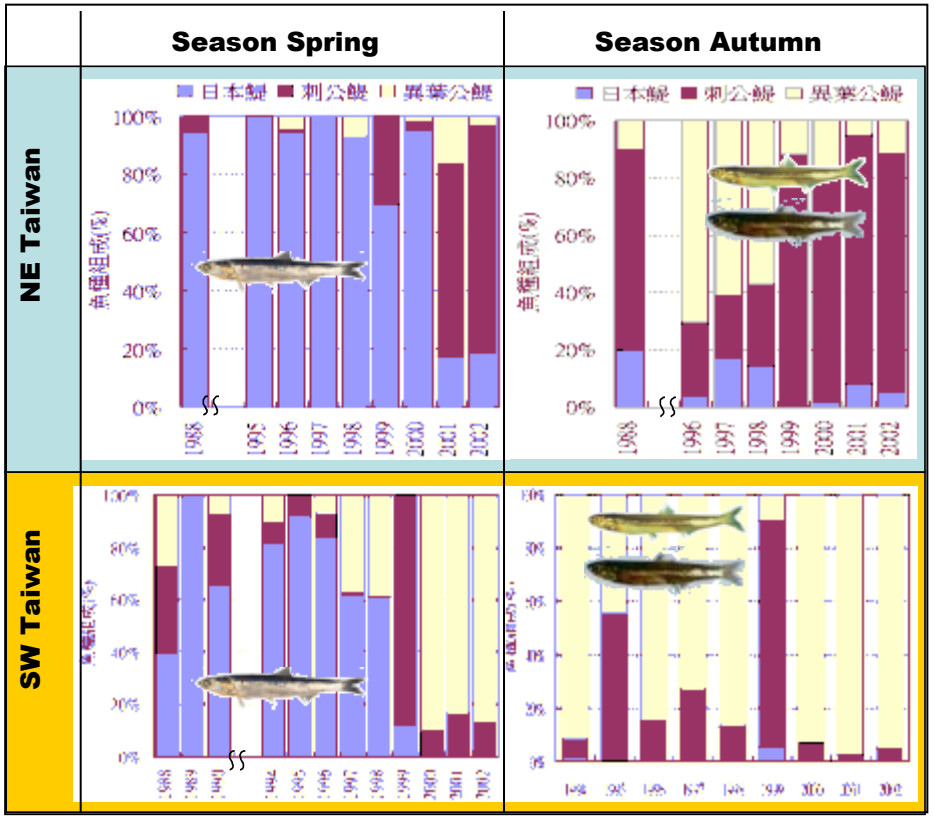
Regime shift of anchovy

Species composition of larval anchovy fisheries in two main fishing grounds in Taiwan show significant regime shift phenomena in fish society.

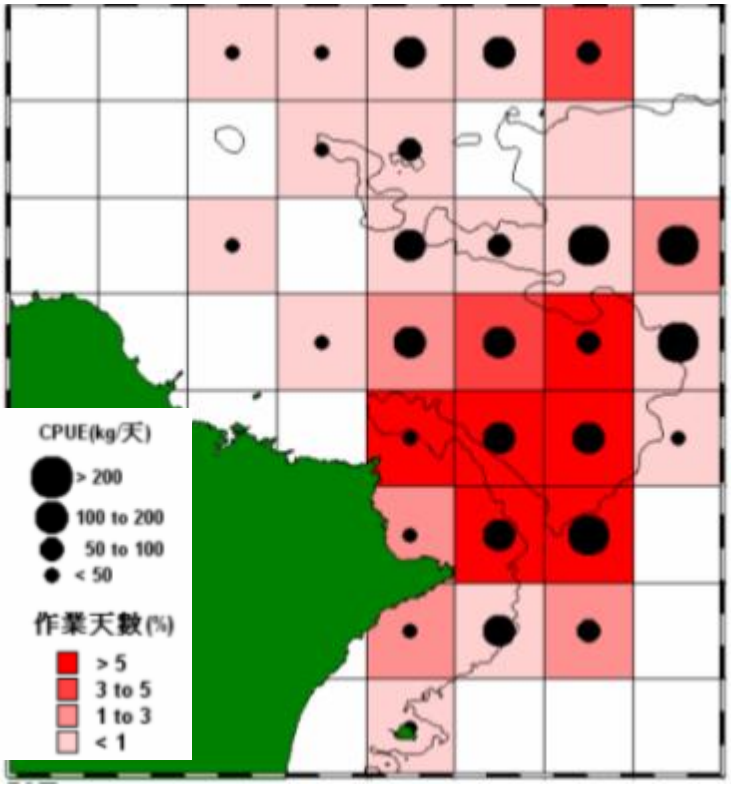
The way anchovy fish society responding to the global warming of ocean is to replace *Engraulis japonicus*, cold-water species, by *Engrasicholina*, warm-water species.

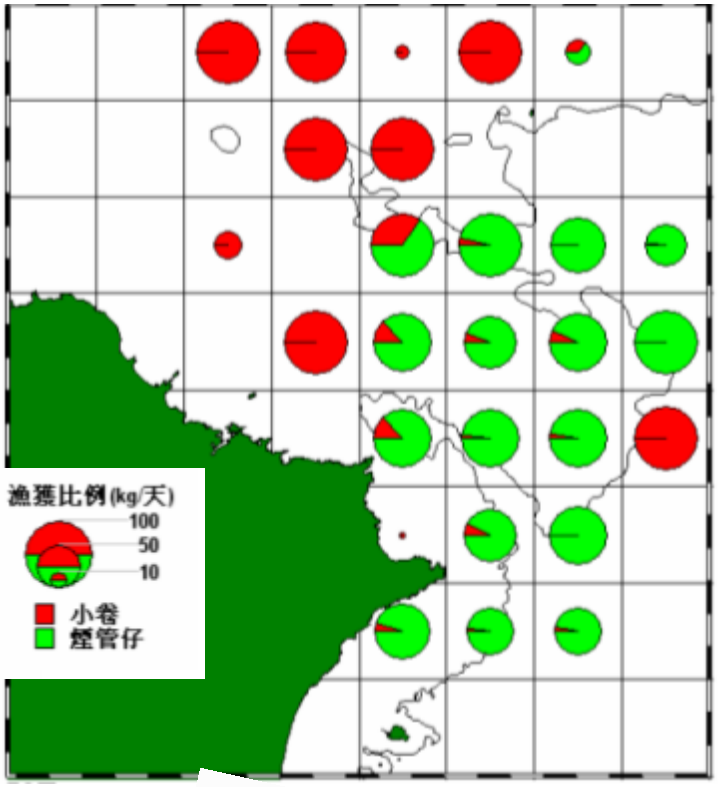


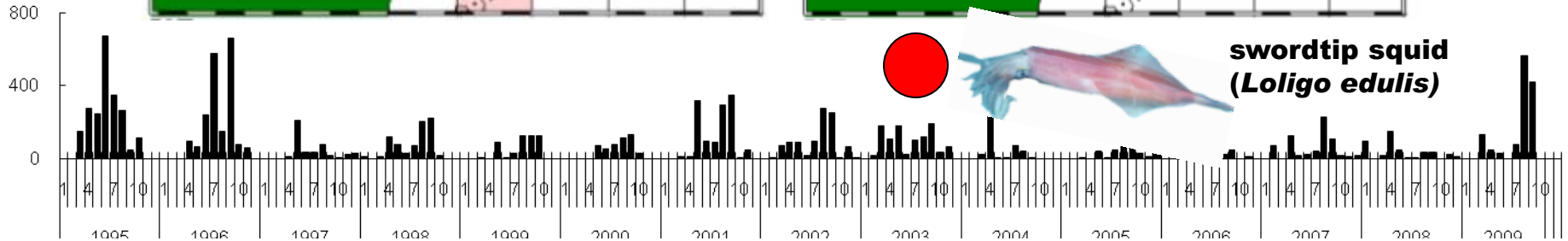




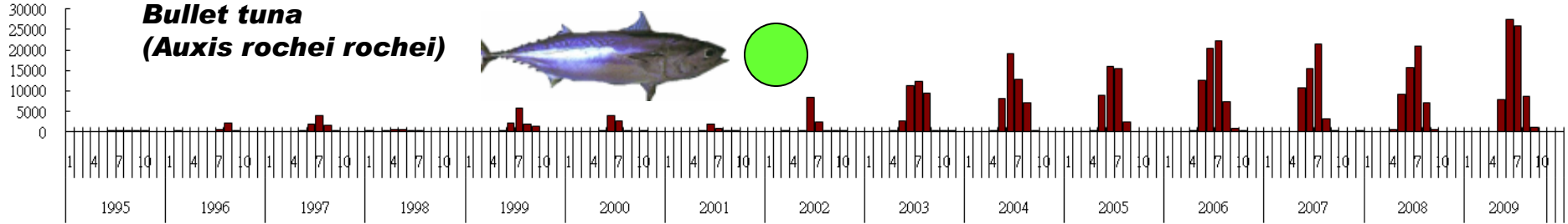
Torch-light net fishery (summer migratory species)





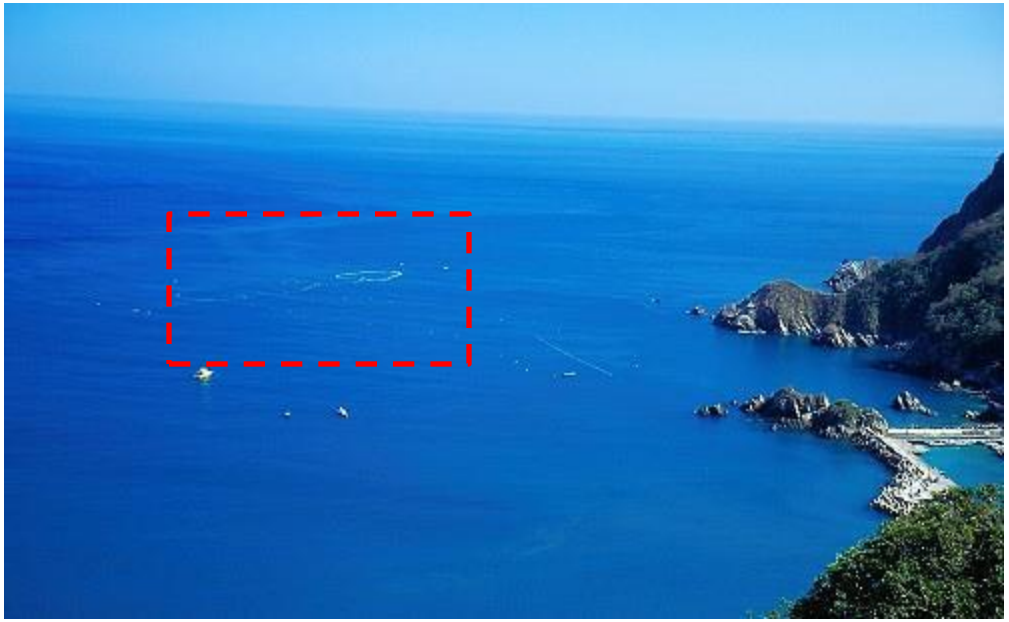


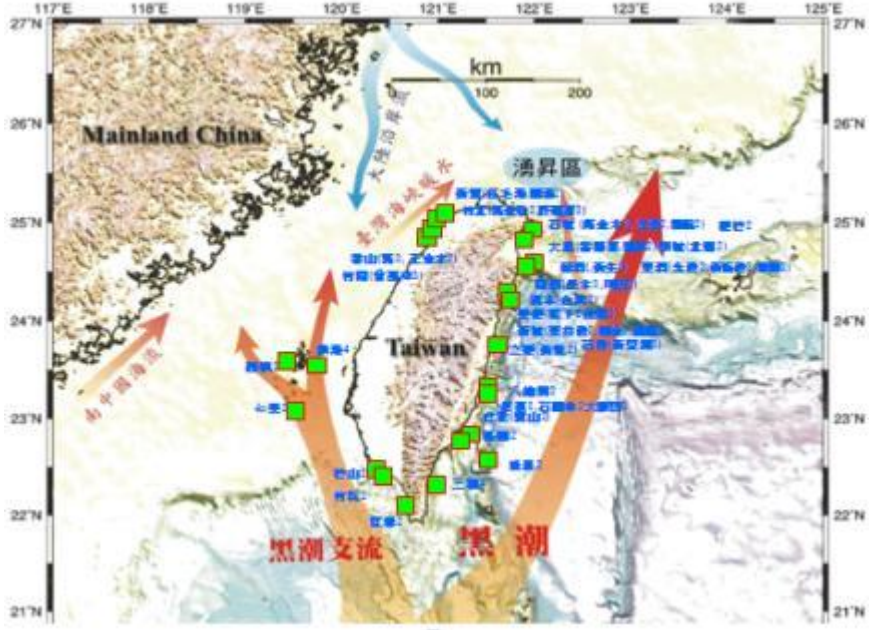
swordtip squid
(*Loligo edulis*)



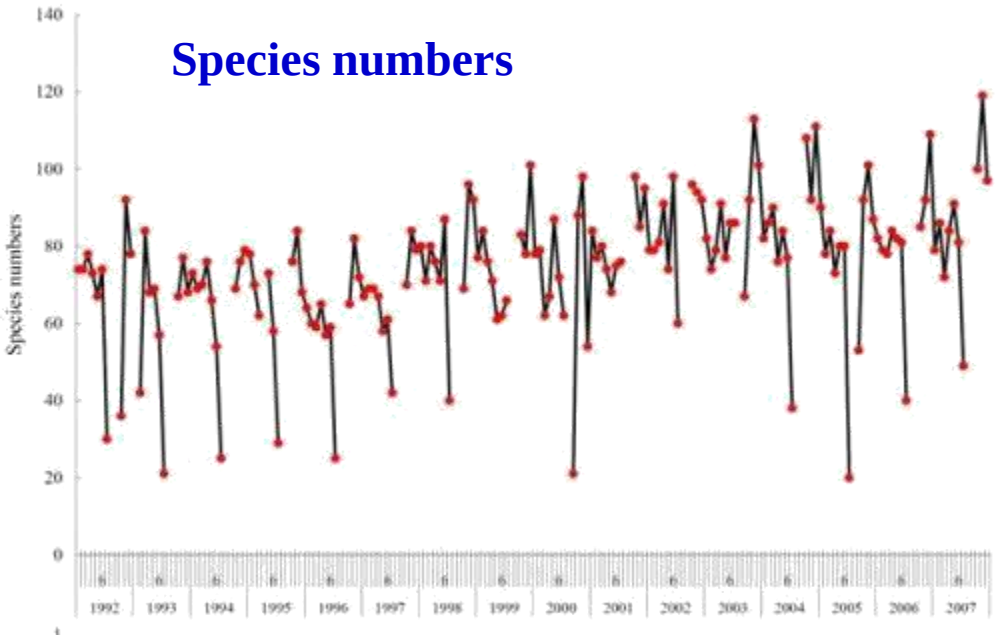
Bullet tuna
(Auxis rochei rochei)

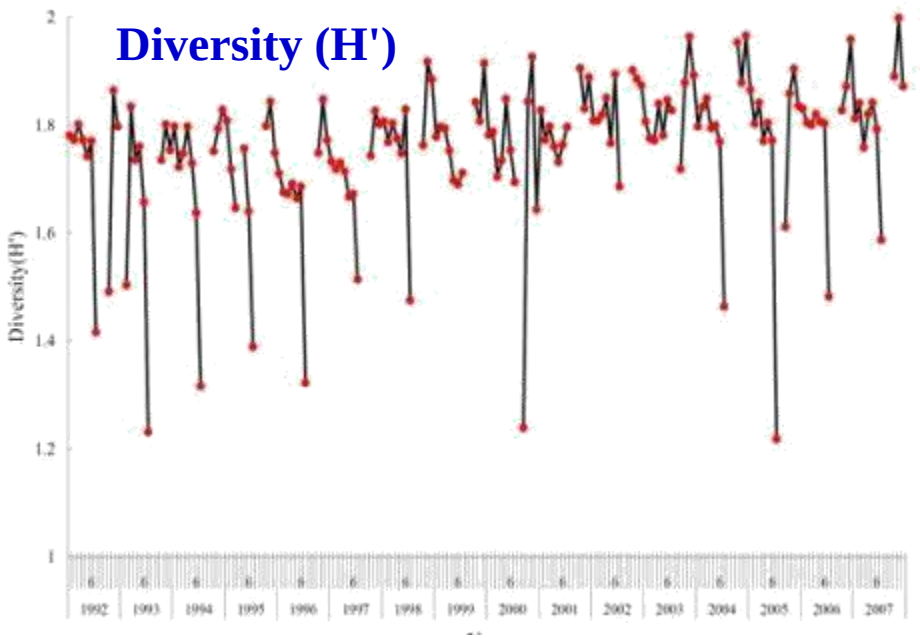
Structural change indicated by set net fishery in NE C/T

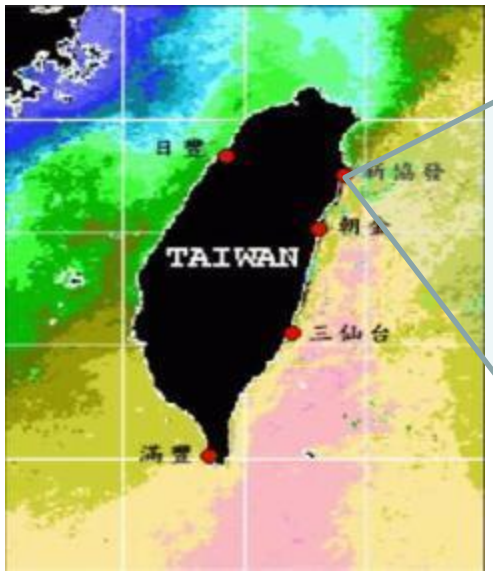


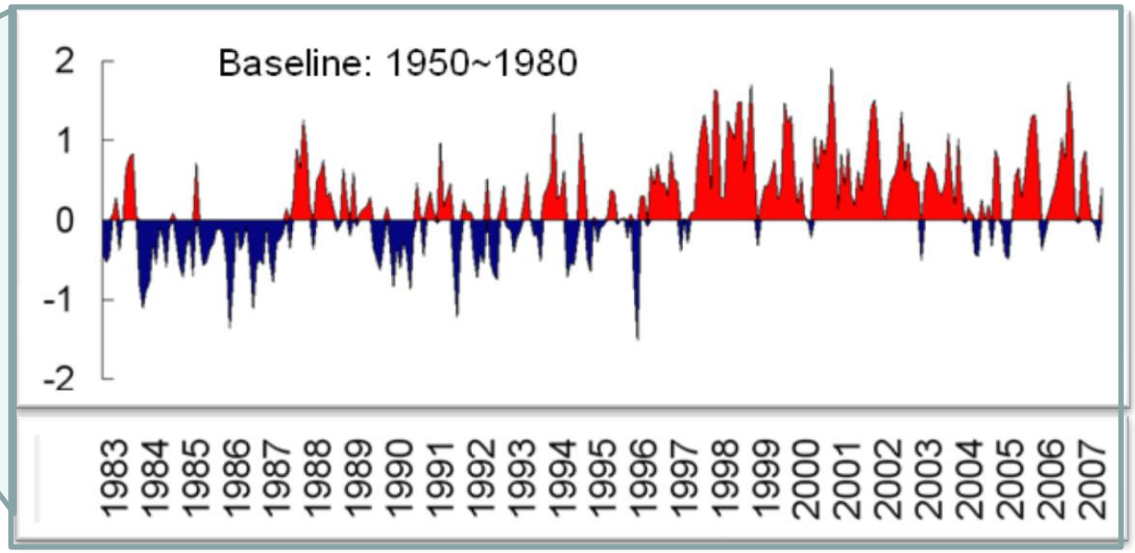


Species diversity of the catch by the set nets in NE C/T (1992~2007)





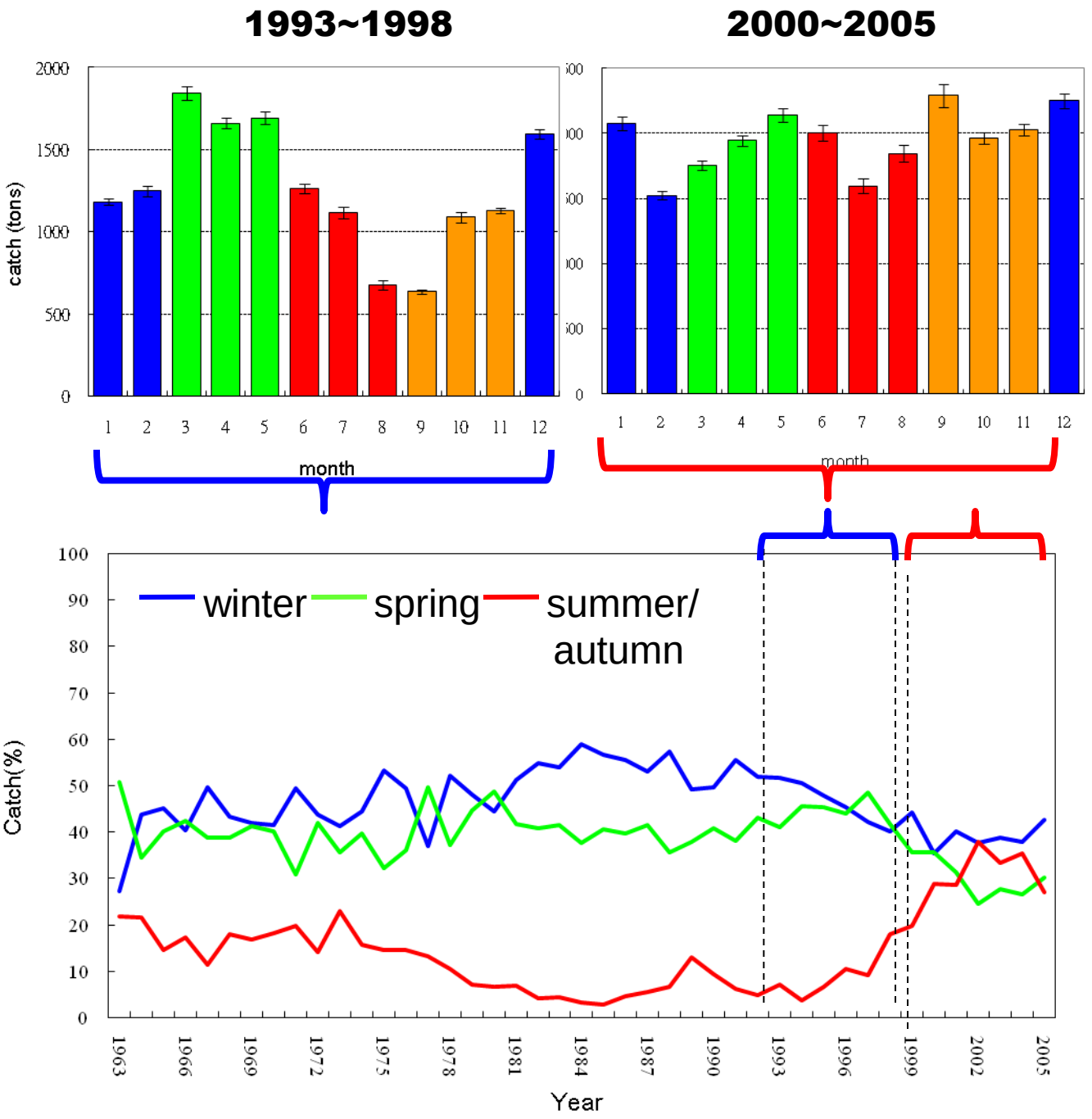




Seasonality change

•Spring and winter were two main fishing seasons for coastal fishery. Many fish migrated into fishing ground in the two season.

•According to the catch of 49 seasonal migratory fish species, the portion of catch in summer season increase substantially.



IV. Future impact and adaptation

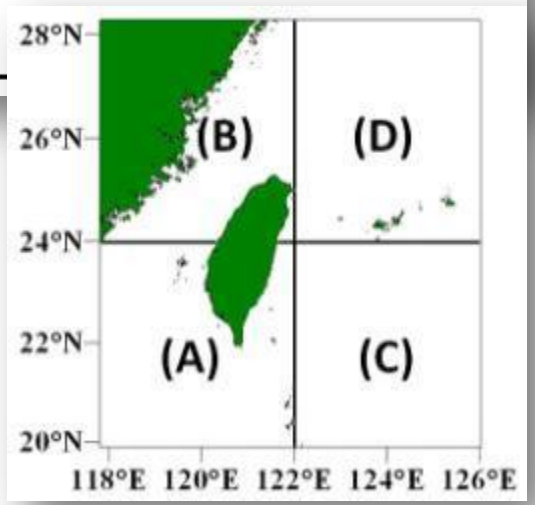
Average SST for period 2030~2059 by GCRC A2 scenarios.

Summer (August) Unit: ℃

Model	NE	E	W	SW	NW	ALL
EH4OPYC	1.13-1.15	0.8-0.89	0.56-0.6	0.64-0.82	0.85-1.74	0.99-1.07
CCSRNIES	1.54-1.57	1.33-1.48	2.08-2.68	1.14-1.66	2.01-2.07	1.57-1.75
CCCma	0.81-1.19	0.65-0.78	1.10-1.49	0.87-0.91	NA	0.79-1.62

Winter (February)

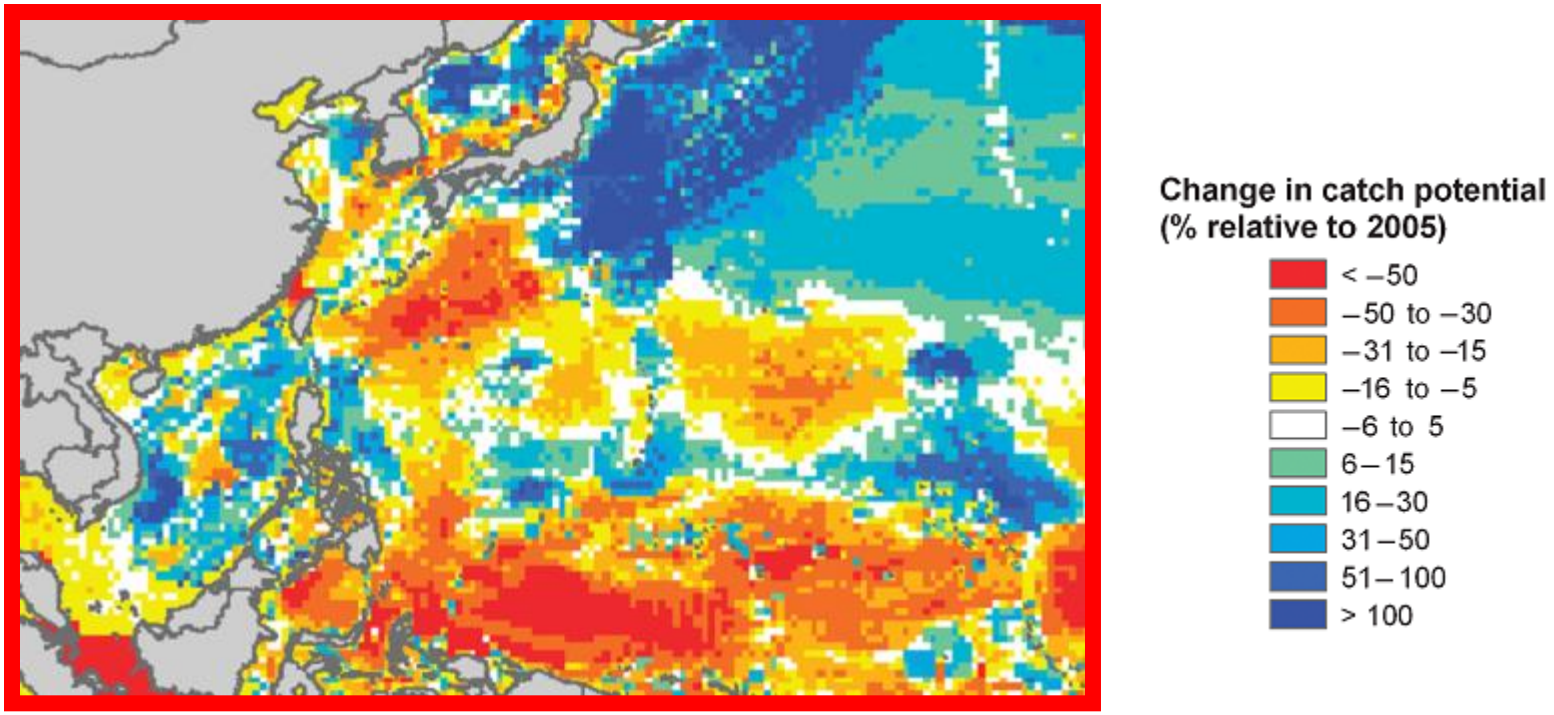
Model	NE	E	W	SW	NW	ALL
EH4OPYC	1.08-1.12	0.91-1.12	1.11-1.51	0.91-1.06	1.02-1.43	1.05-1.20
CCSRNIES	1.38-1.91	0.93-1.67	1.32-1.86	0.77-1.68	2.03-2.12	1.26-1.84
CCCma	1.08-1.27	0.86-1.10	0.93-1.52	0.92-1.14		



Most of the fish will go on decreasing; especially for those migrate with China Coastal Current, only warm-water fish species partially increase.

We estimate that in 2055 this will lead to 5-50% reduction in catch relative to the level in 2005 for those currently winter migratory species, which means considerable portion of species will disappear.

Another simulation (Chueng et al., 2009) using FAO's data under global scenario also suggests that fishery productivity in the East China Sea in 2055 will decrease more than 50% relative to level in year 2005.

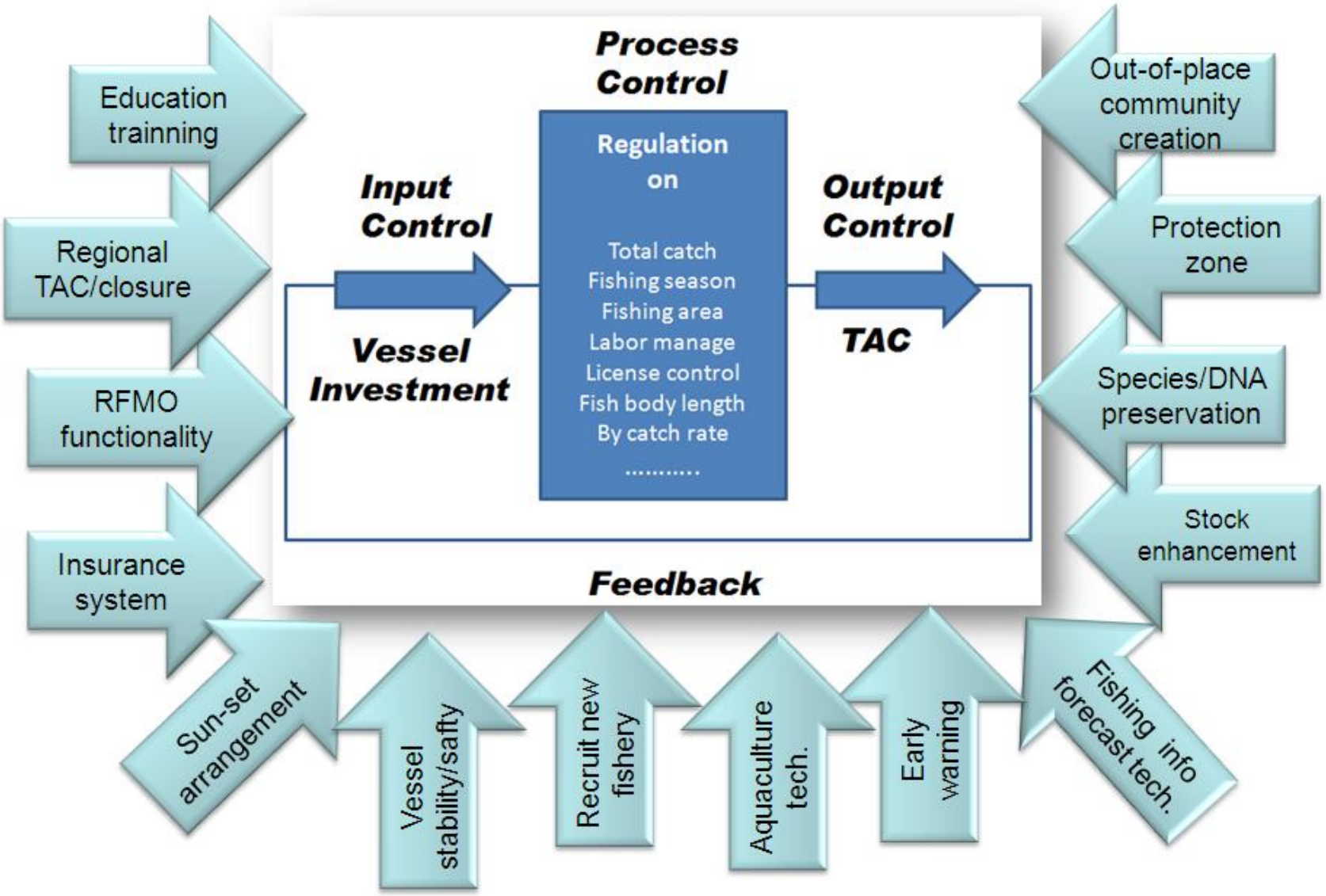


The 6th National Agriculture Meeting, the highest level meeting for policy maker, will be held on 15 June, 2010.

The theme of the meeting**:**
“Adaptation Strategy and Measures to Climate Impact”

The meeting conclusion will guide the adaptation strategy and measures of fishery to the climate impact.

Strategies for adaption to climate impact



Major issues concerned

- Climatic disaster prevention
- Structural problem of fishery and resources
- Marine biodiversity preservation
- Release aquaculture areas to wetland or floodwater reservoirs
- Water resource problem in aquaculture
- Enhancement of regional or international cooperation
- Greenhouse gas mitigation
- Green energy exploration in fishery sector

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Thank you for your attention!

감사합니다

Experience exchanges among interested countries are very important since climate impact is a new lesson.