

S9: FIS/TCODE Topic Session

Resilience, Transitions and Adaptation in Marine Ecosystems under a Changing Climate
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Status and trend of four commercially important coastal cephalopods in China Seas: an overview with implications for climate change

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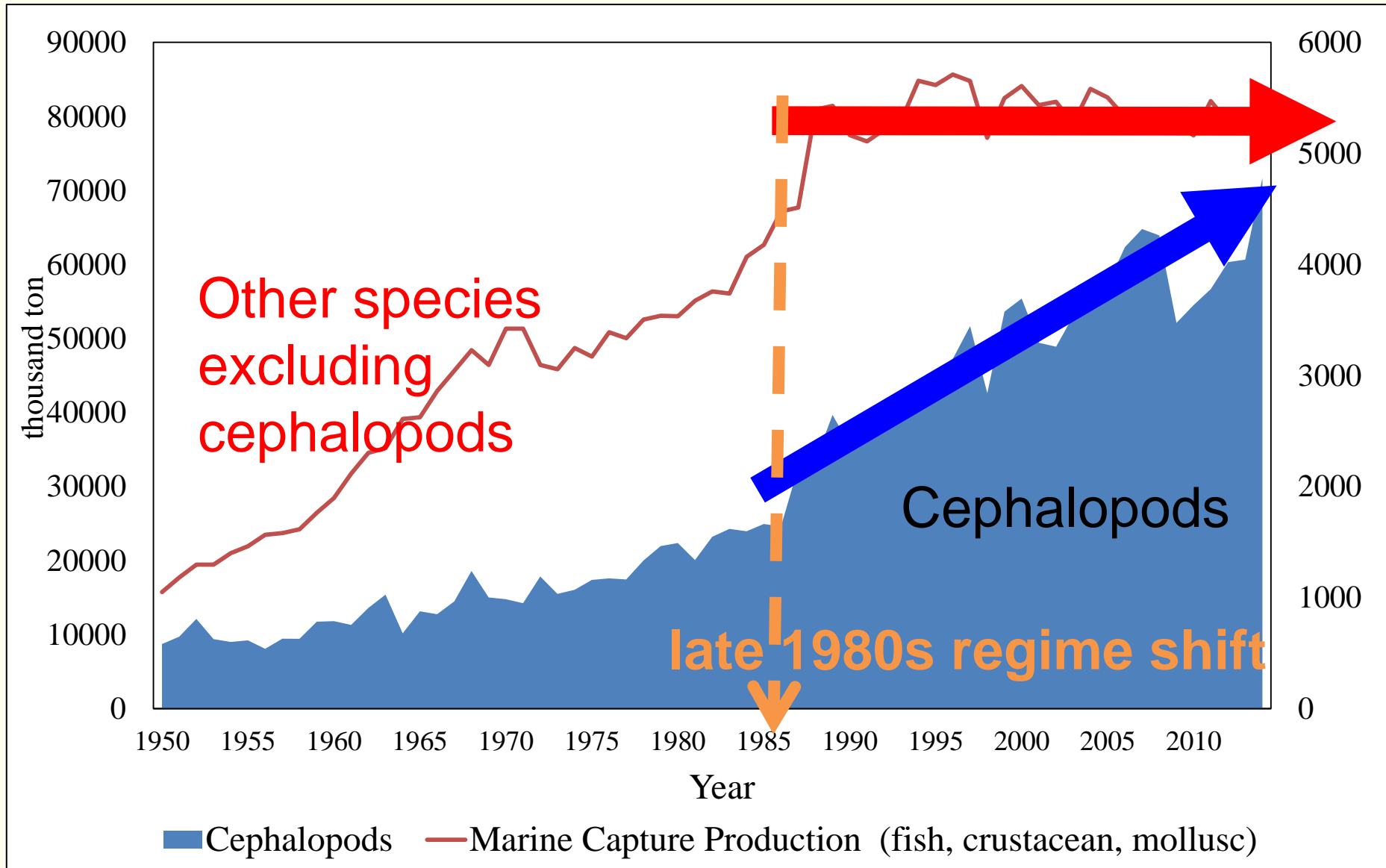
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Outline

1. Backgrounds: Why cephalopod is hot?
2. Status of Chinese coastal cephalopod
3. Trends in four typical cephalopod
4. Summary and outlook

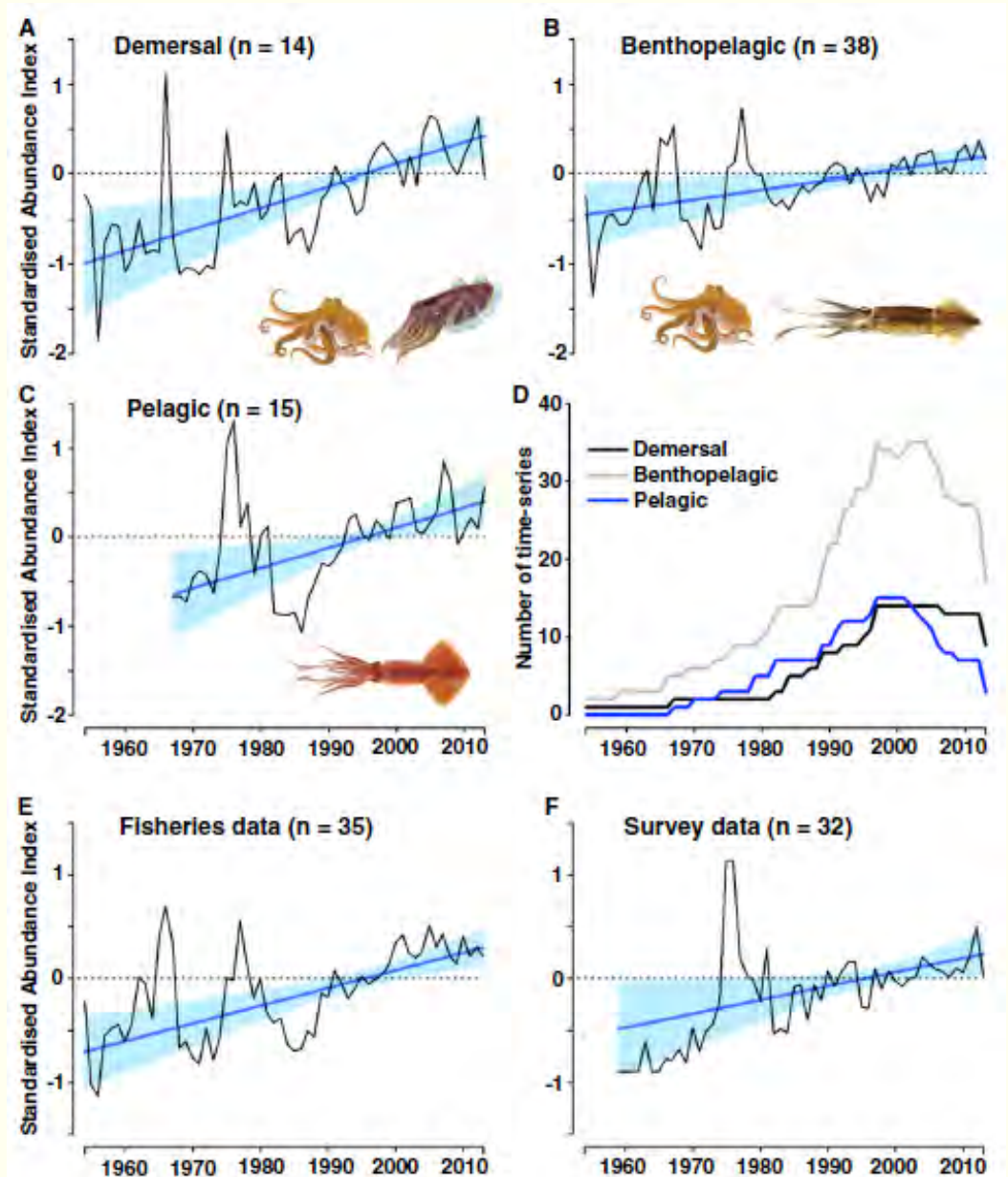
World cephalopod capture is increasing



Data source from FAO (1950 - 2014)

Global proliferation of cephalopods

- Cephalopods, including squid, cuttlefish and octopus
- From pelagic to demersal species
- Both fisheries data and survey data
- Global warming impact



(Doubleday et al. 2016, Current Biology)

Under over-exploitation, why are cephalopods increasing?

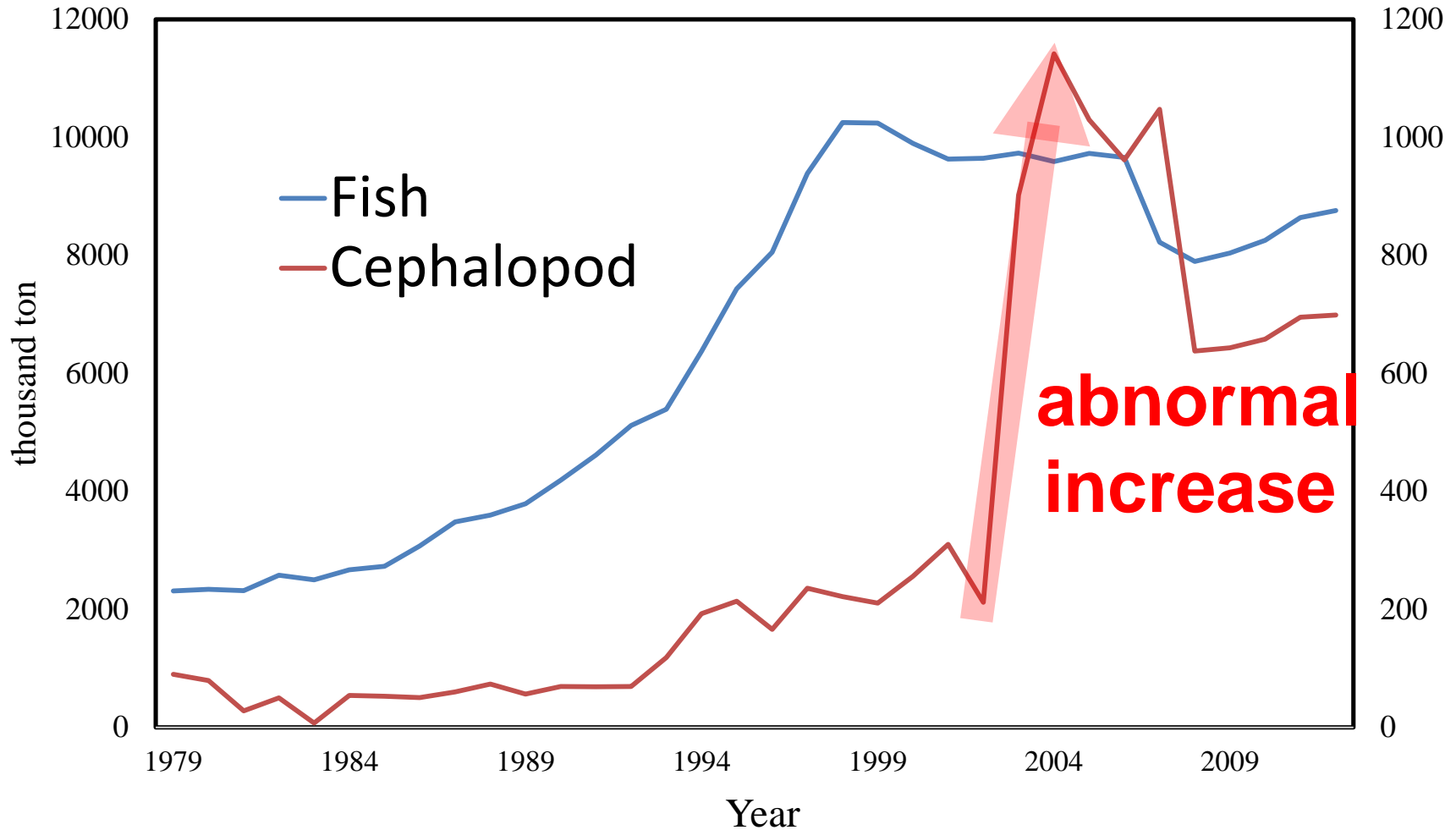
Question:

- ◆ Most studies focused on oceanic species such as flying squids.
- ◆ In China Seas, one of the most heavily over-exploited ecosystems in the world, what happened in coastal cephalopods ?

Data and method

1. Chinese fishery annual report (1979-2013)
Logbook of fisheries company in Yantai (2014)
→ annual catch of fish and cephalopod species
2. Japanese and Korean catch statistics (1950-2010)
Sea around us (1950-2013)
→ catch of Chinese oceanic cephalopod
3. Selection of four typical coastal cephalopods
4. STARS analysis
regime shift detection developed by Rodionov (2004)

Variations of fish and cephalopod in China seas



(Data source: Chinese annual fishery reports)

Cephalopod composition in China Seas

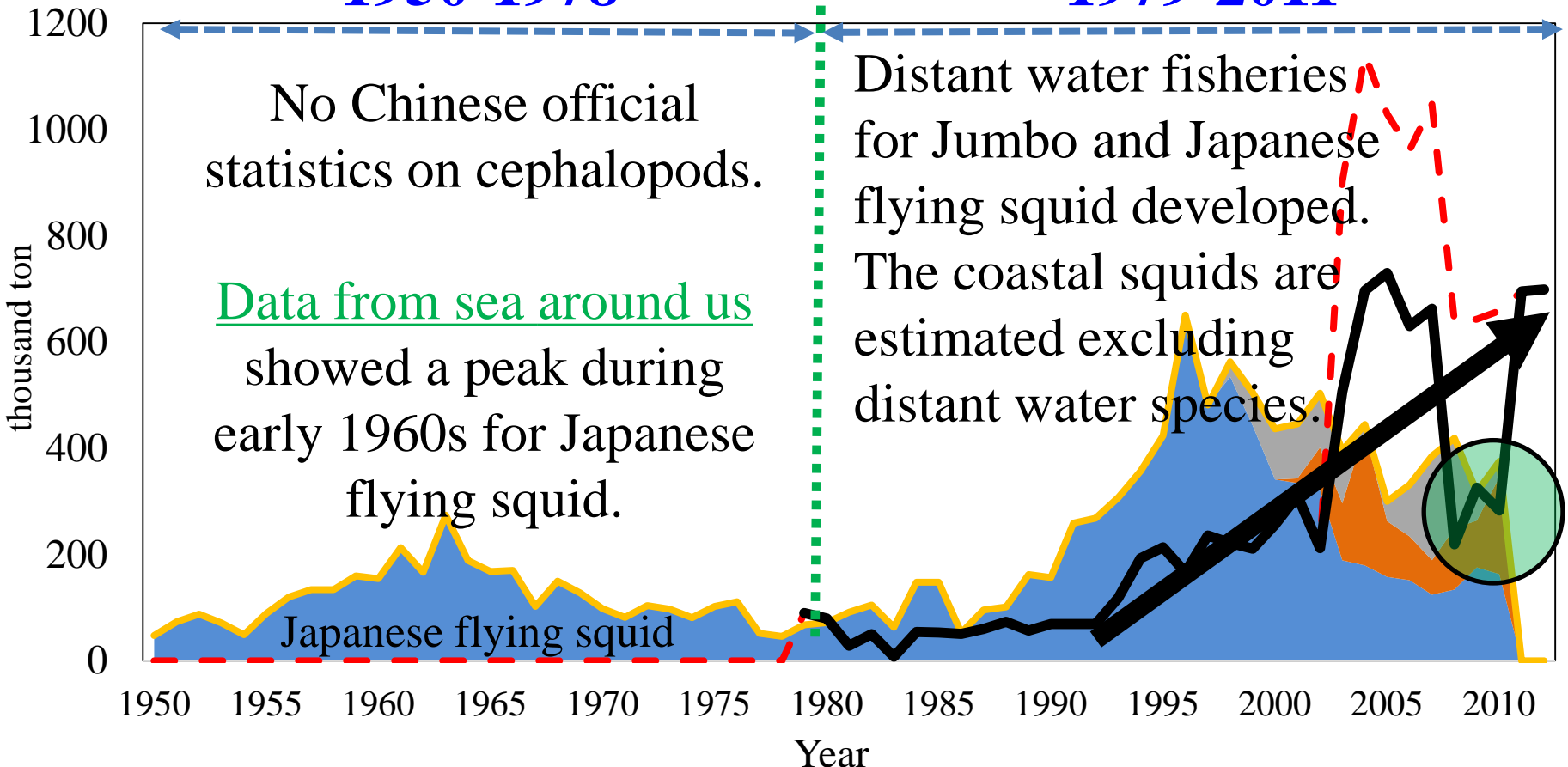
1950-1978

1979-2011

No Chinese official statistics on cephalopods.

Data from sea around us showed a peak during early 1960s for Japanese flying squid.

Distant water fisheries for Jumbo and Japanese flying squid developed. The coastal squids are estimated excluding distant water species.



Japanese flying squid

Jumbo flying squid

Argentine shortfin squid




Statistic data from sea around us

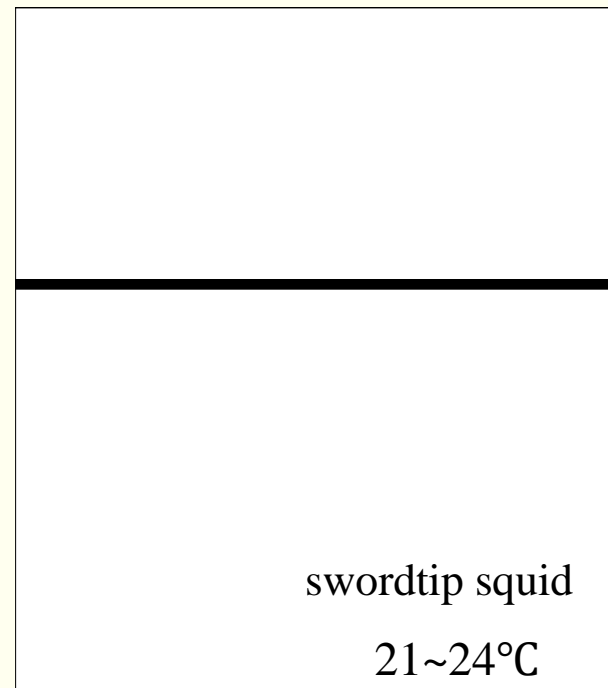
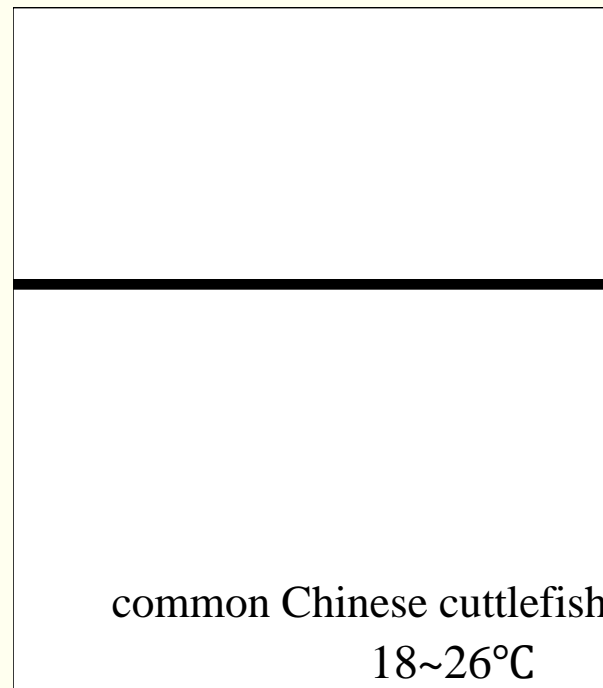
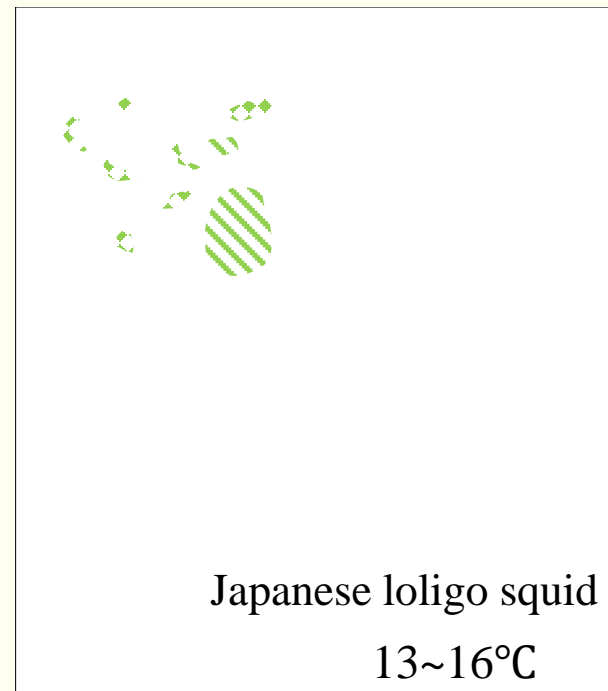
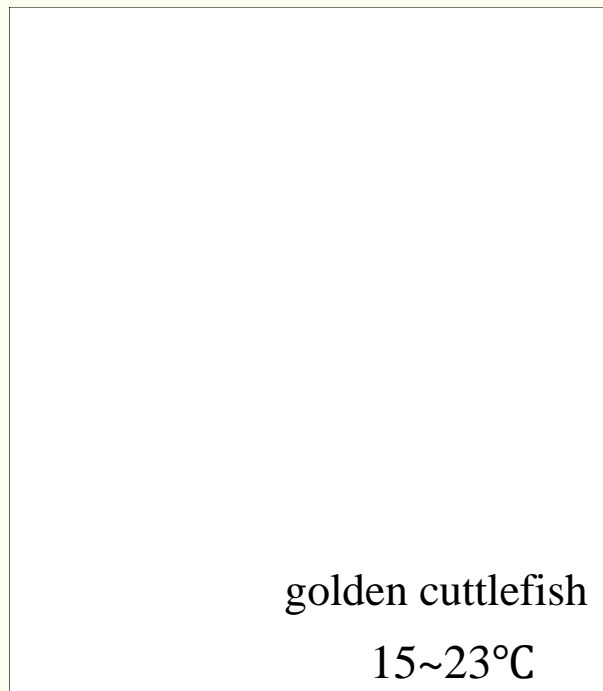
Chinese annual fishery report





Chinese coastal squid

Four typical coastal cephalopods are selected.

Partly overlapped distribution with contrastive life history.

-  Overwintering ground
-  Spawning ground
-  Distribution

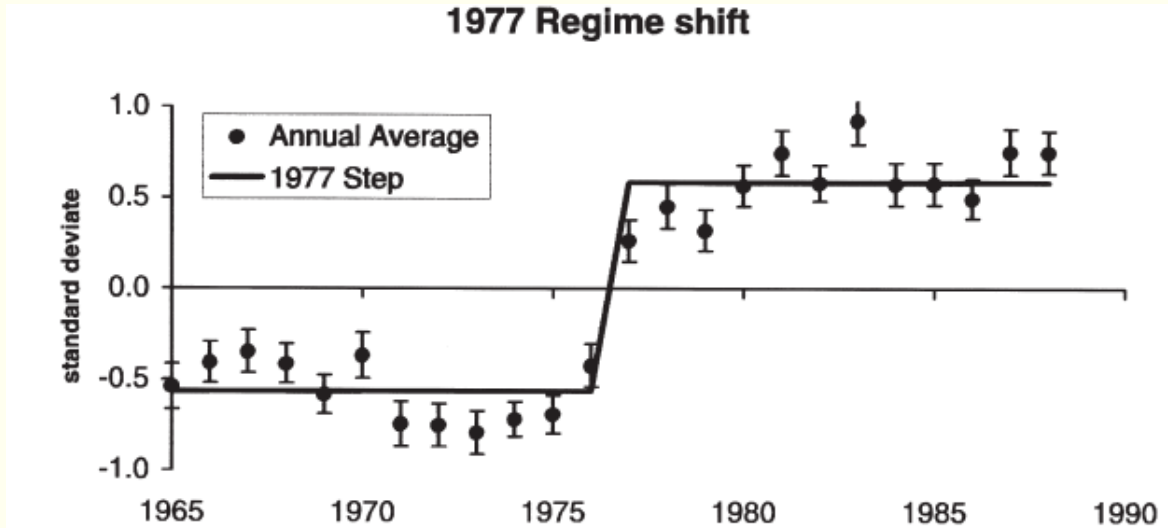


Species	Maximum size	Environmental /climate range	Ecology	Spawning season	Fishery
golden cuttlefish <i>Sepia esculenta</i> 	180mm/ 600g	Demersal, Eurythermal species	Spend winter in deep water and return to shallow water in spring to spawn. The eggs are laied onto substrates, like seaweed.	Long duration with latitudinal difference, mostly between spring and early summer	Coastal areas of <u>Shandong</u> and middle of Yellow Sea are good <u>fishing grounds in spring and winter.</u>
Japanese loligo squid <i>Loligo japonica</i> 	120mm/ 76g	Pelagic (~10m) cold water species	The fishery is concentrated in the front area of coastal currents and oceanic currents.	Spawning migration starts in March and spawning starts in May	<u>Fishing season is from December to March</u> next year. Fishing happens in <u>north and middle of Yellow Sea.</u>
common Chinese cuttlefish <i>Sepiella maindroni</i> 	200mm/ 800g	Demersal (~50m) warm water species	Be selective to spawning habitats. The eggs are laid onto egg masses or seaweed.	Seasonal spawning, lasting from April to June off Japan and East China Sea	<u>Winter, spring and summer</u> are mean seasons for fishery. <u>Zhejiang coastal areas</u> used to be fishing grounds
swordtip squid <i>Uroteuthis edulis</i> 	400mm/ 820g	Pelagic (30-170m) warm water species	Diurnal vertical migration. The longevity in temperate waters is around 1 year and in subtropical waters is 9 month.	Spawn all year round, two distinct spawning seasons (spring and autumn) in East China sea.	<u>Fishing period ends in winter.</u> Resources are exploited in <u>Taiwan</u> mainly.

Regime shifts in North Pacific

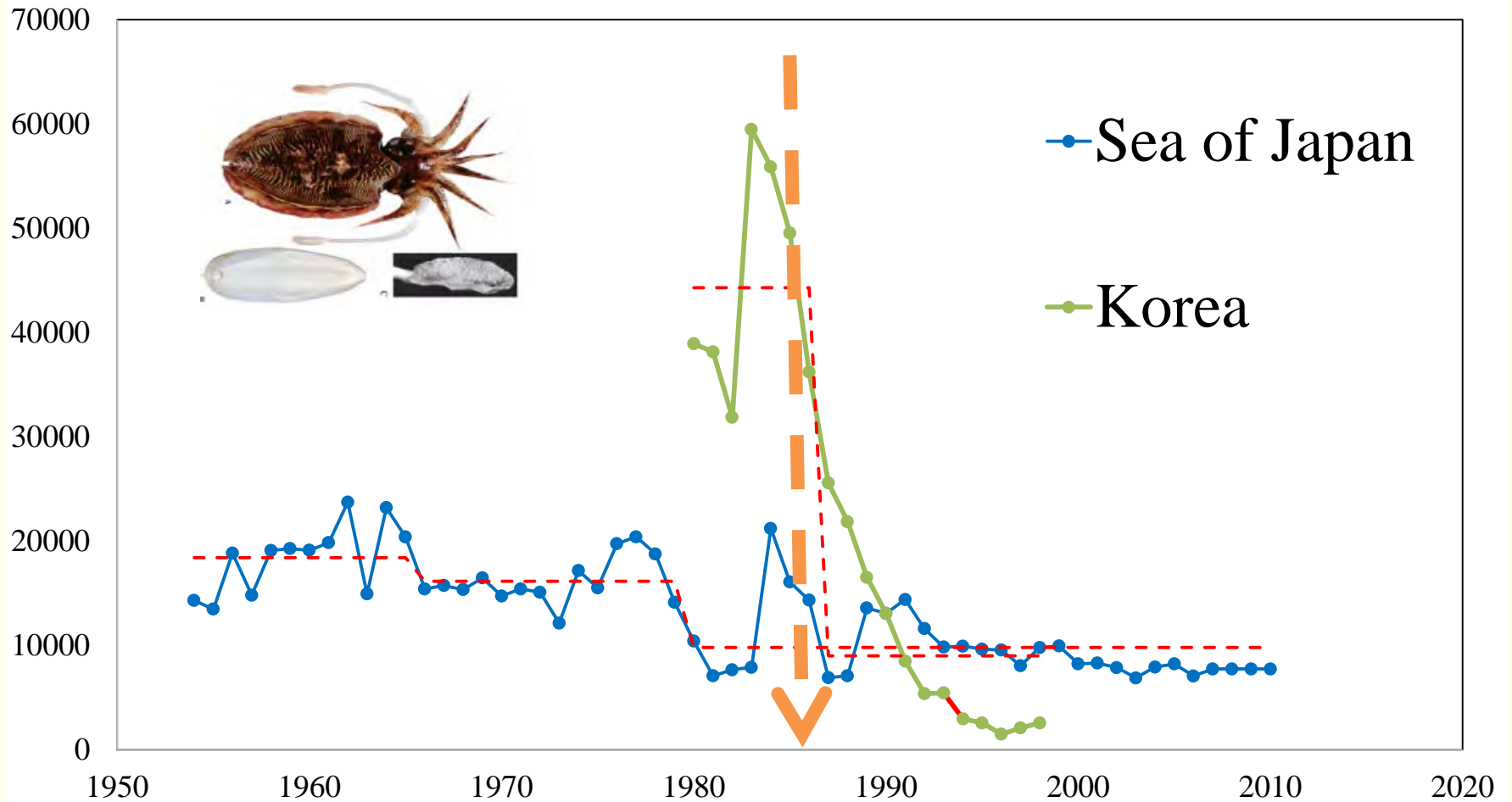
Two regime shifts
in large marine
ecosystem of
North Pacific in
1977 and 1989.

(Hare and Mantua 2000)



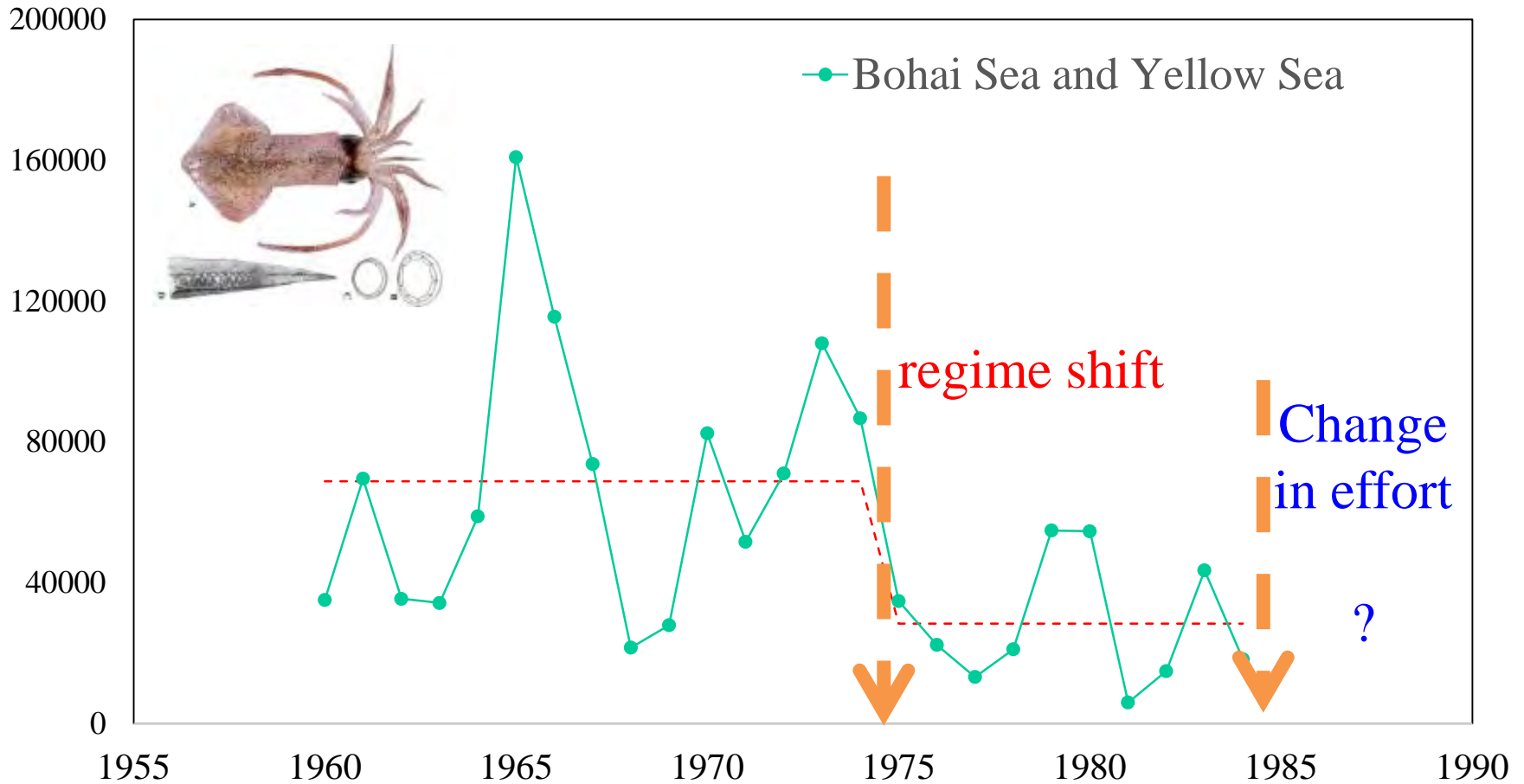
Recent studies also suggested regime shift-like change occurred in the late 1990s in the northwestern North Pacific associated with ENSO (Tian et al. 2014)

Golden cuttlefish catch trend



Late 1980s regime shift

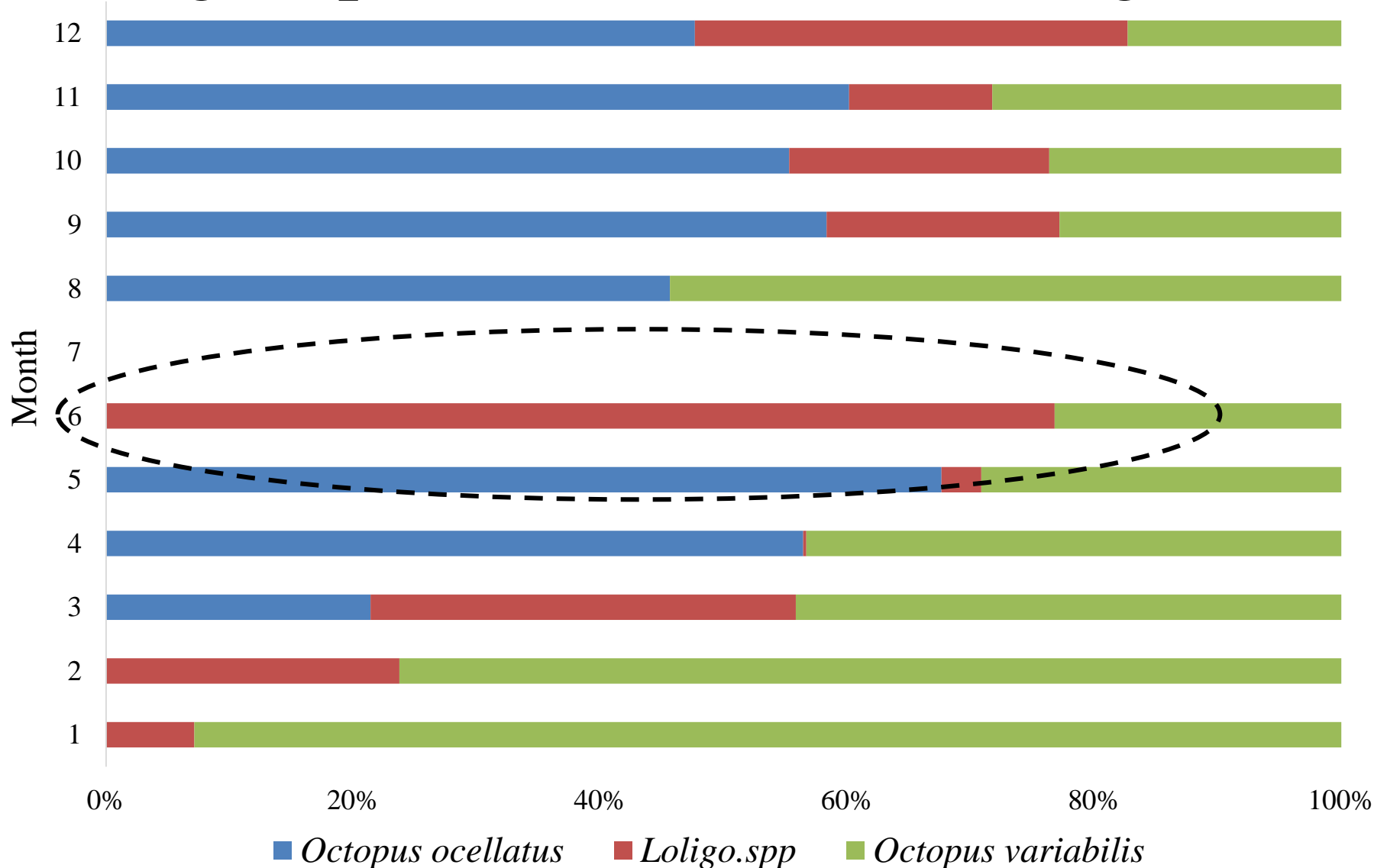
Japanese loligo squid catch trend



A regime shift occurred around mid-1970s

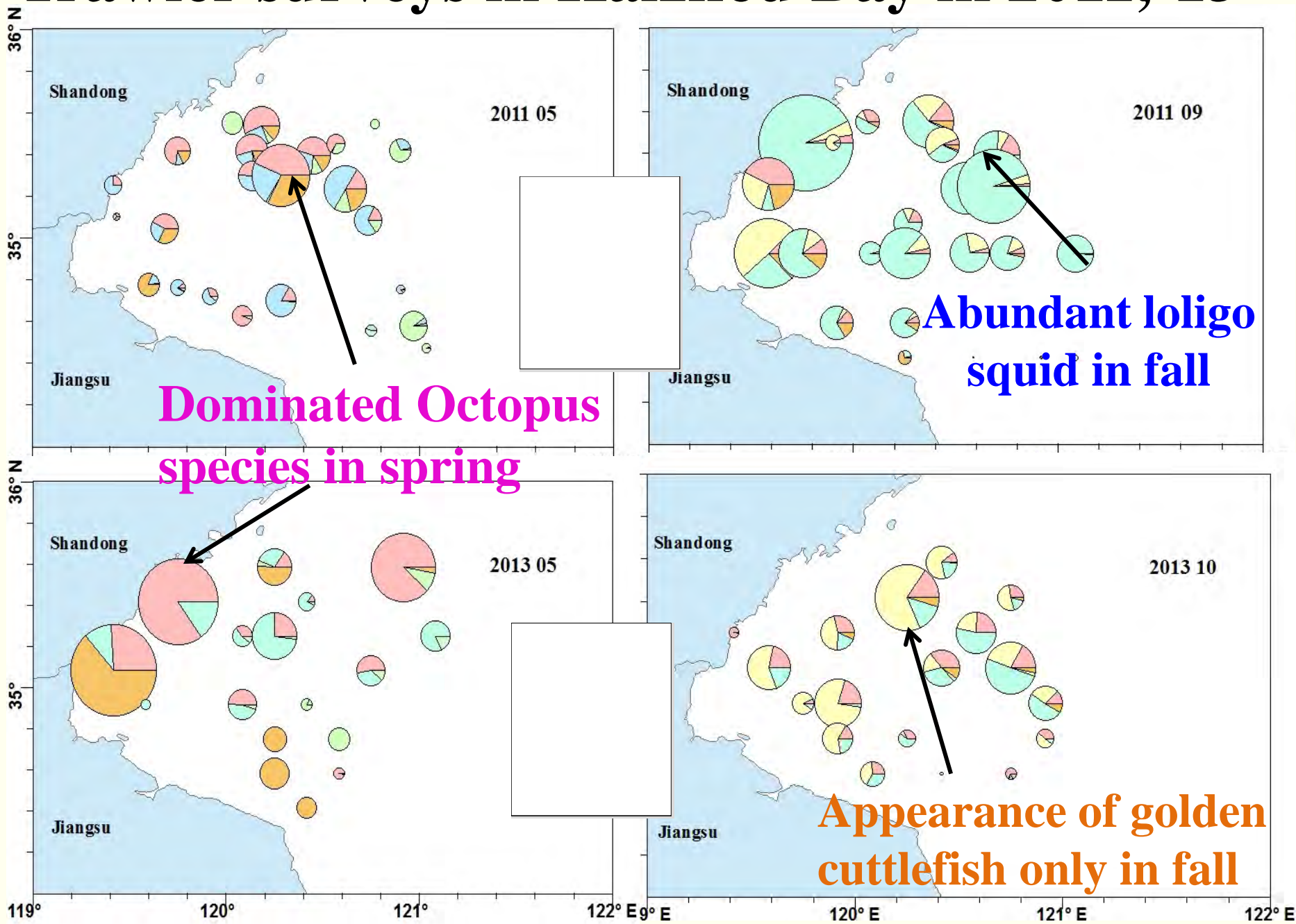
Decrease since late 1980s associated with effort changes to high value filefishes.

Loligo squid still remains in a high level

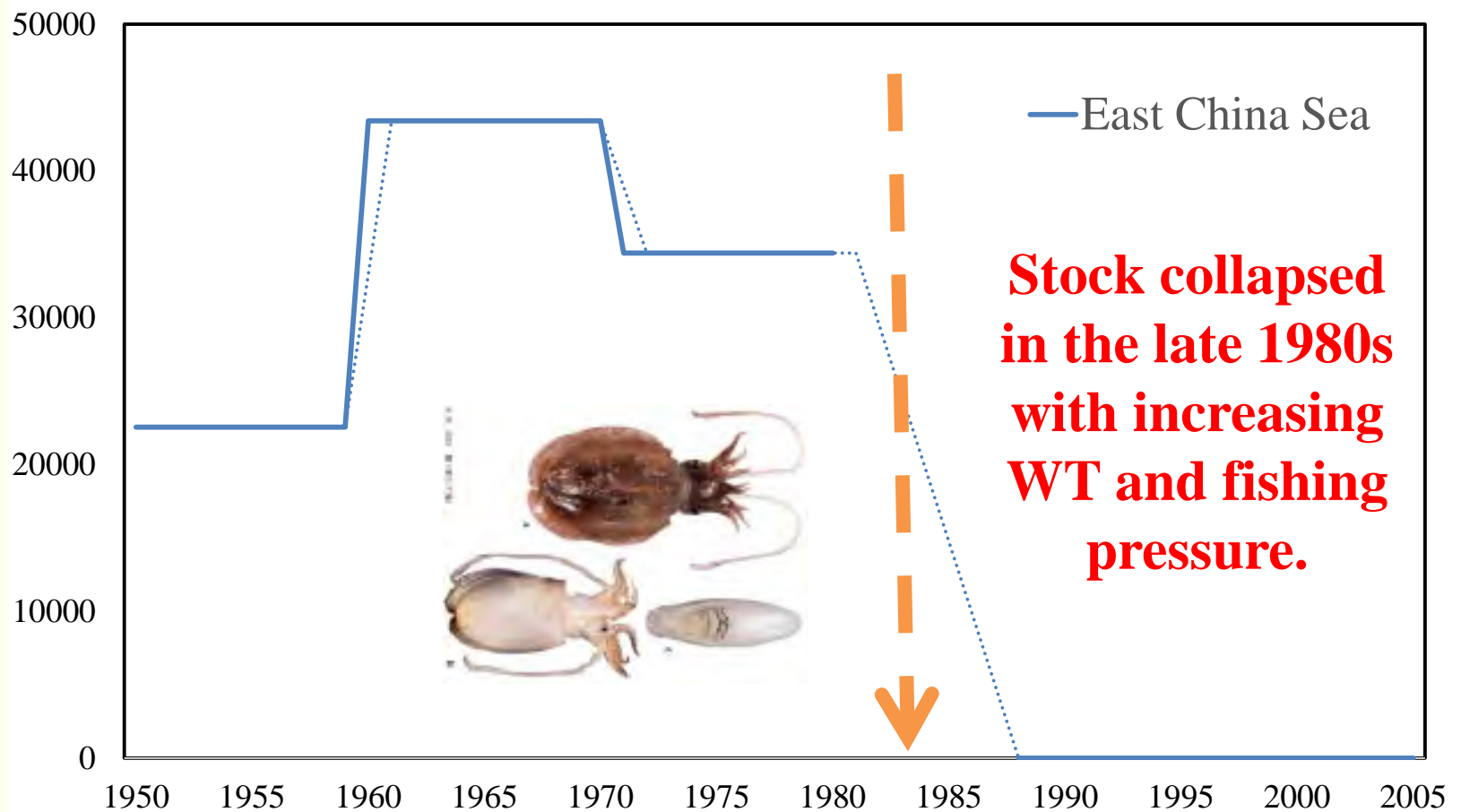


(Data source: Coastal fisheries-dependent research in Shandong in 2014)

Trawler surveys in Haizhou Bay in 2011,'13

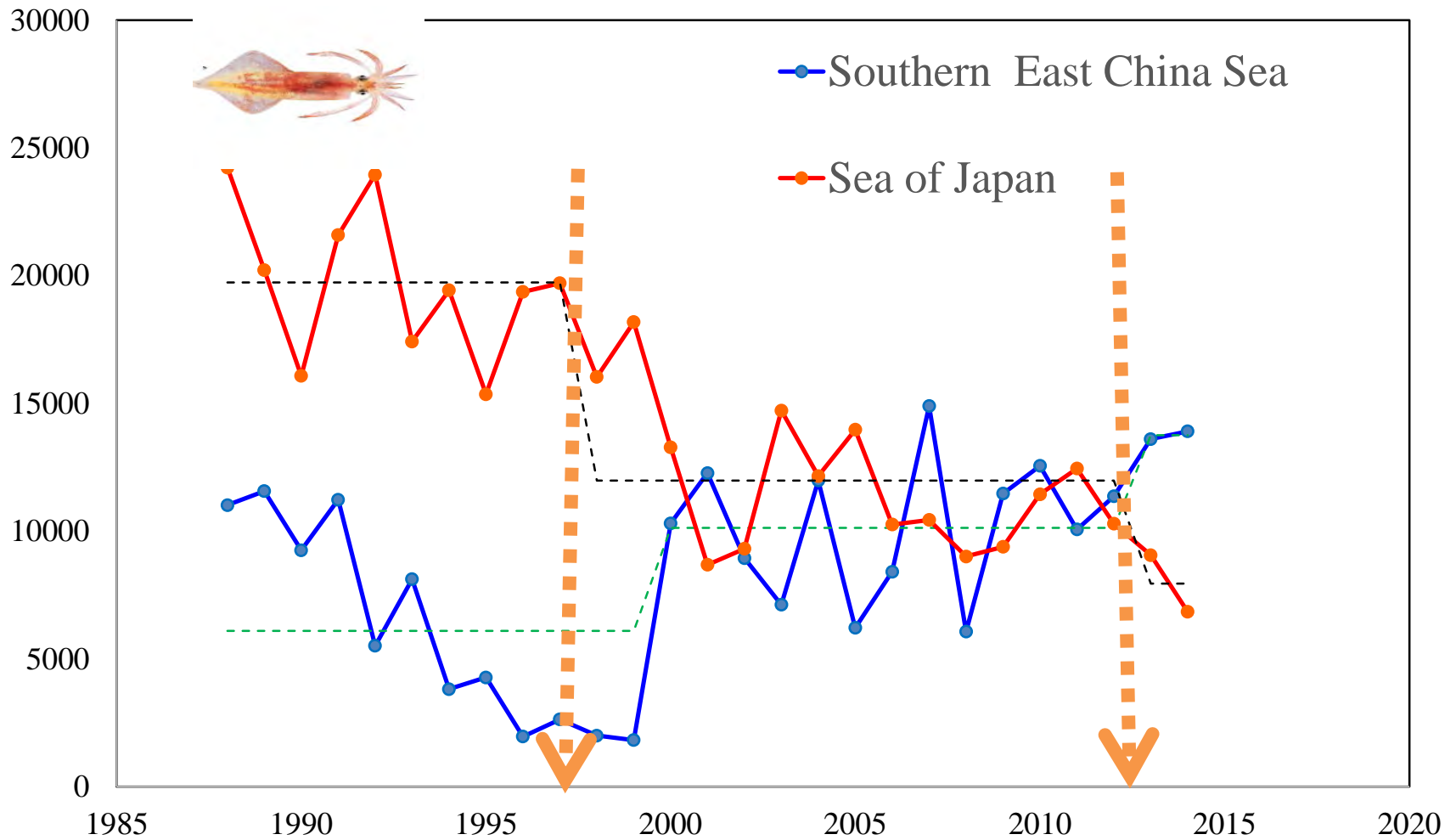


Common Chinese cuttlefish catch trend



Unfavorable environment: increasing water temperature
Intensive fishing and destruction on habitat and spawning ground

Swordtip squid catch trend



Impacts of strong ENSO events?

Summary

- Both the catch and percentage of Chinese coastal cephalopods increased largely since 1990s in spite of the over-exploitation in China Seas.
- Four typical cephalopods showed decadal variation patterns and different response suggesting impacts of environmental changes addition to the heavy fishing.
- Intrinsic biological traits is one of the most important reasons for different responses to environmental changes.
- Climate changes such as regime shift and strong ENSO events should be paid particular attention to the Chinese coastal cephalopod in the context of ecosystem-based management.

Chinese coastal cephalopod outlook

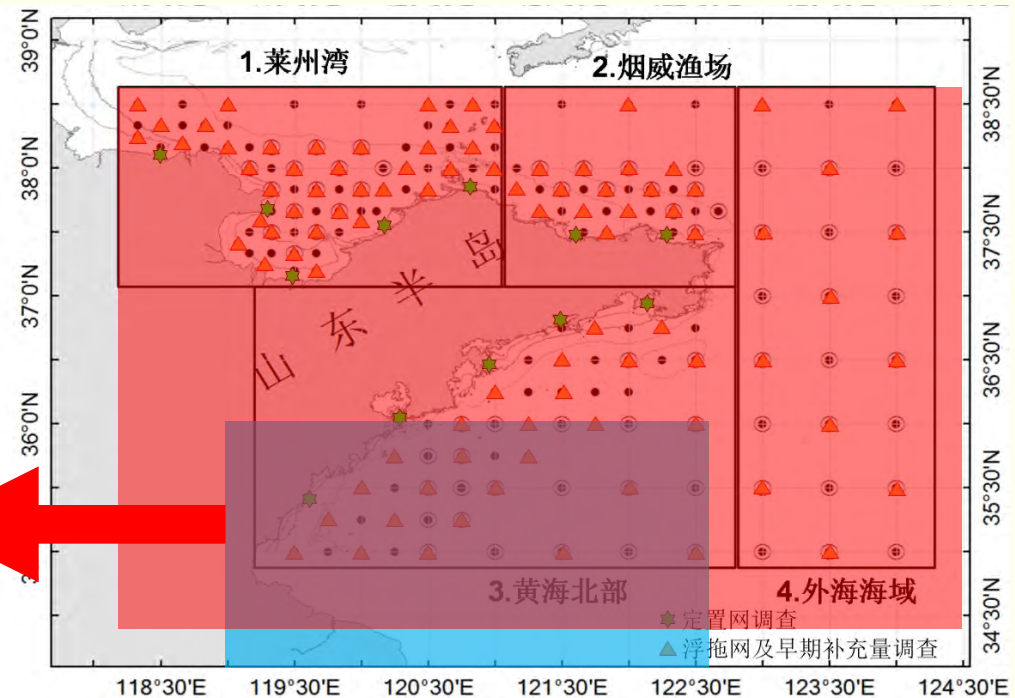
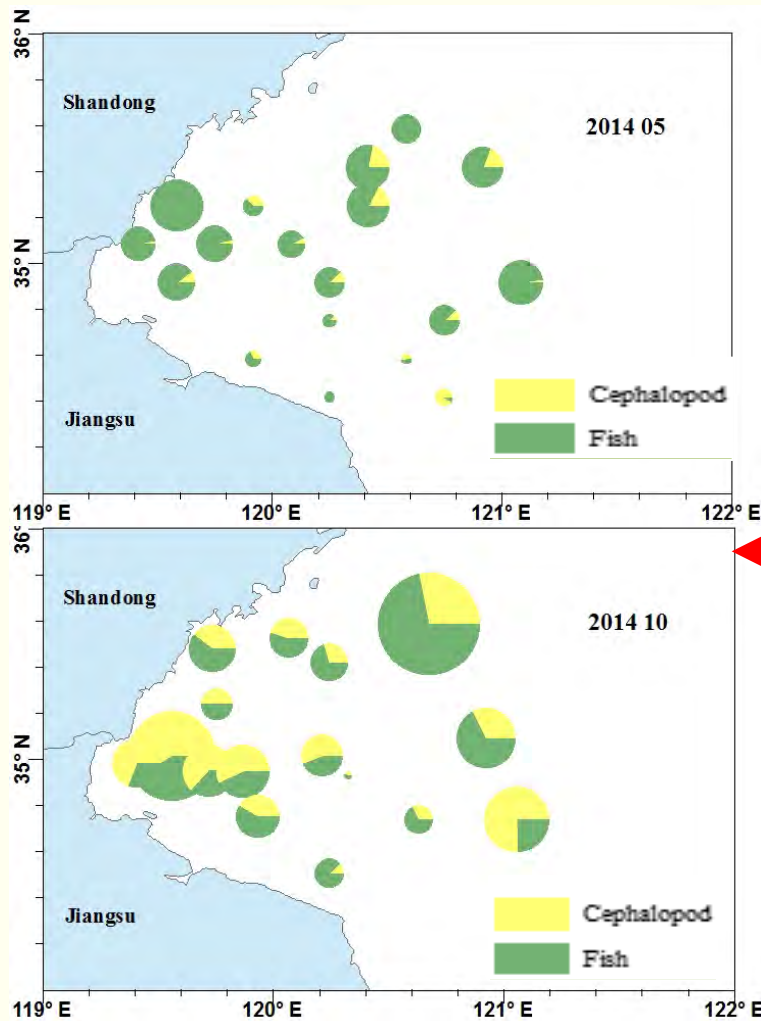
Fisheries-independent survey

- ecological roles in China Seas
- major species composition
- dominate species and related life strategies

Fisheries-dependent research

- annual yield of major fishery species
- variation of catch composition

New Survey Started in Oct. 2016



New survey covered the coastal water of Shandong Province started in October, 2016.

Previous surveys in Haizhou Bay indicate increasing cephalopods.

Thank you for your attention

