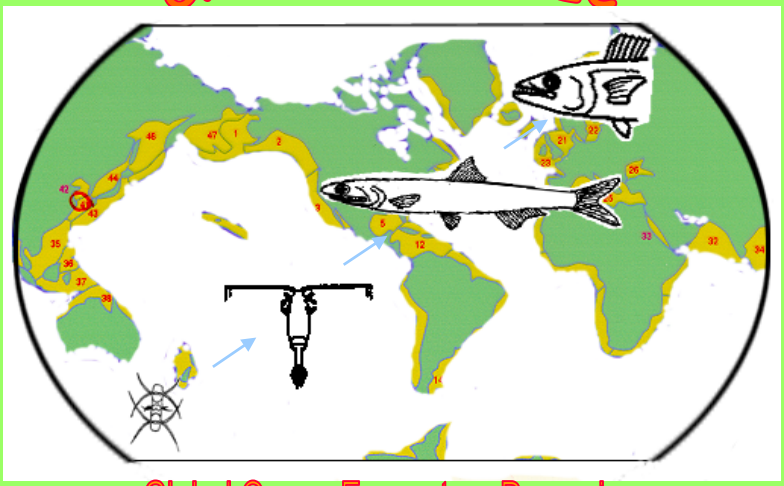
Overview of Chinese National GLOBEC Program

China - GLOBEC



Global Ocean Ecosystem Dynamics

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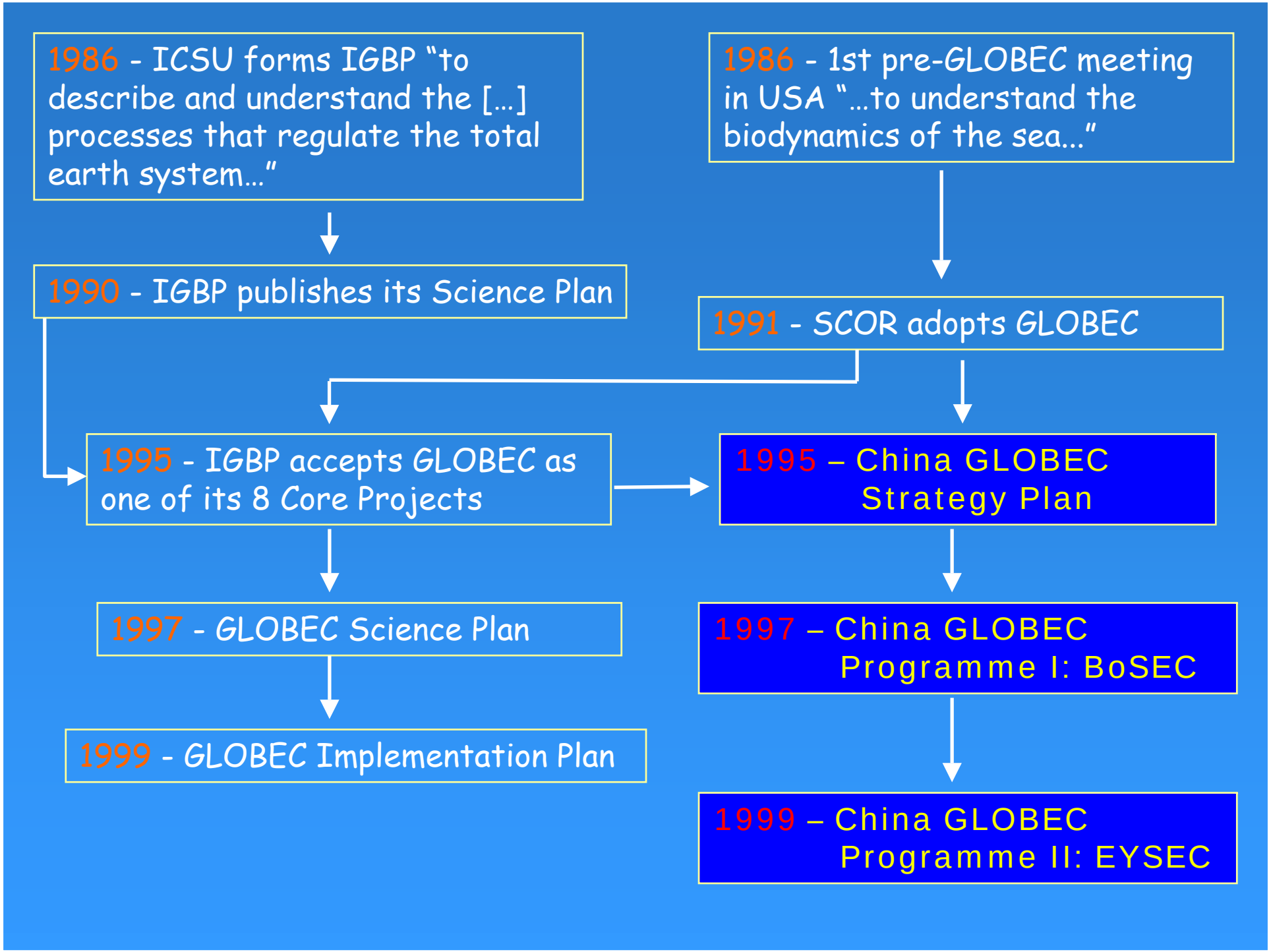
Contents:

- Programme development
- Key scientific questions
- Field surveys and *in situ* experiments
- Results and New finding
- Open problems


1. Programme Development


1986 - ICSU forms IGBP "to describe and understand the [...] processes that regulate the total earth system..."
1986 - 1st pre-GLOBEC meeting in USA "...to understand the biodynamics of the sea..."
1990 - IGBP publishes its Science Plan
1991 - SCOR adopts GLOBEC
1995 - IGBP accepts GLOBEC as one of its 8 Core Projects
1995 – China GLOBEC Strategy Plan
1997 - GLOBEC Science Plan
1997 – China GLOBEC Programme I: BoSEC
1999 - GLOBEC Implementation Plan
1999 – China GLOBEC Programme II: EYSEC

Two Projects of China-GLOBEC program :

- The Bohai Sea programme (BoSEC) include 4 projects (China-GLOBEC I, 1997-2000)
- The East China Sea and Yellow Sea programme (EYSEC) include 12 projects (China-GLOBEC II, 1999-2004)

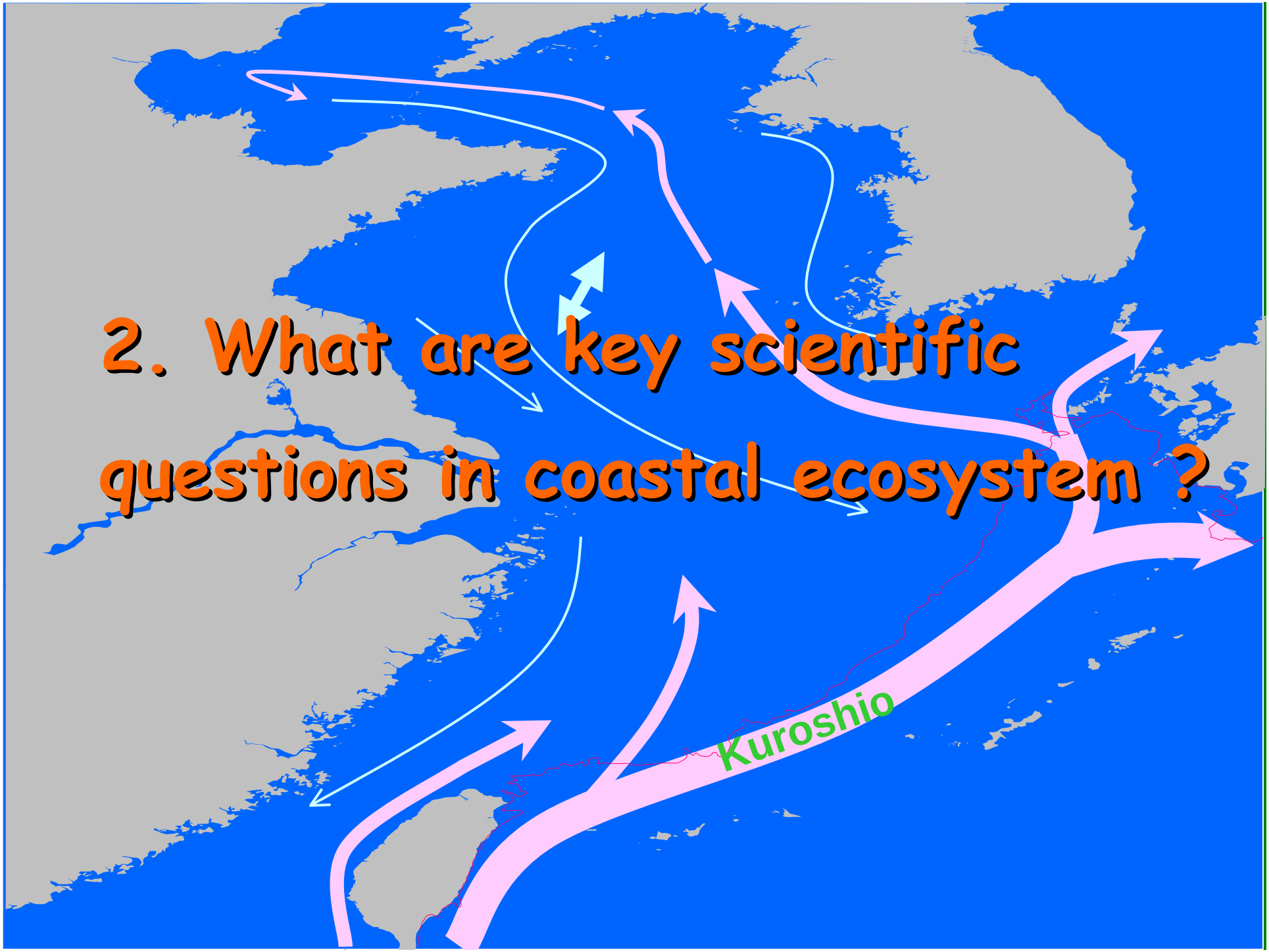
Goal of China-GLOBEC:

- Identify how climate changes and the anthropogenic influences to affect the dynamics of coastal ecosystems.
- Provide scientific underpinning for the sustainable utilization of ecosystem and the rational management system of fisheries and other marine species.

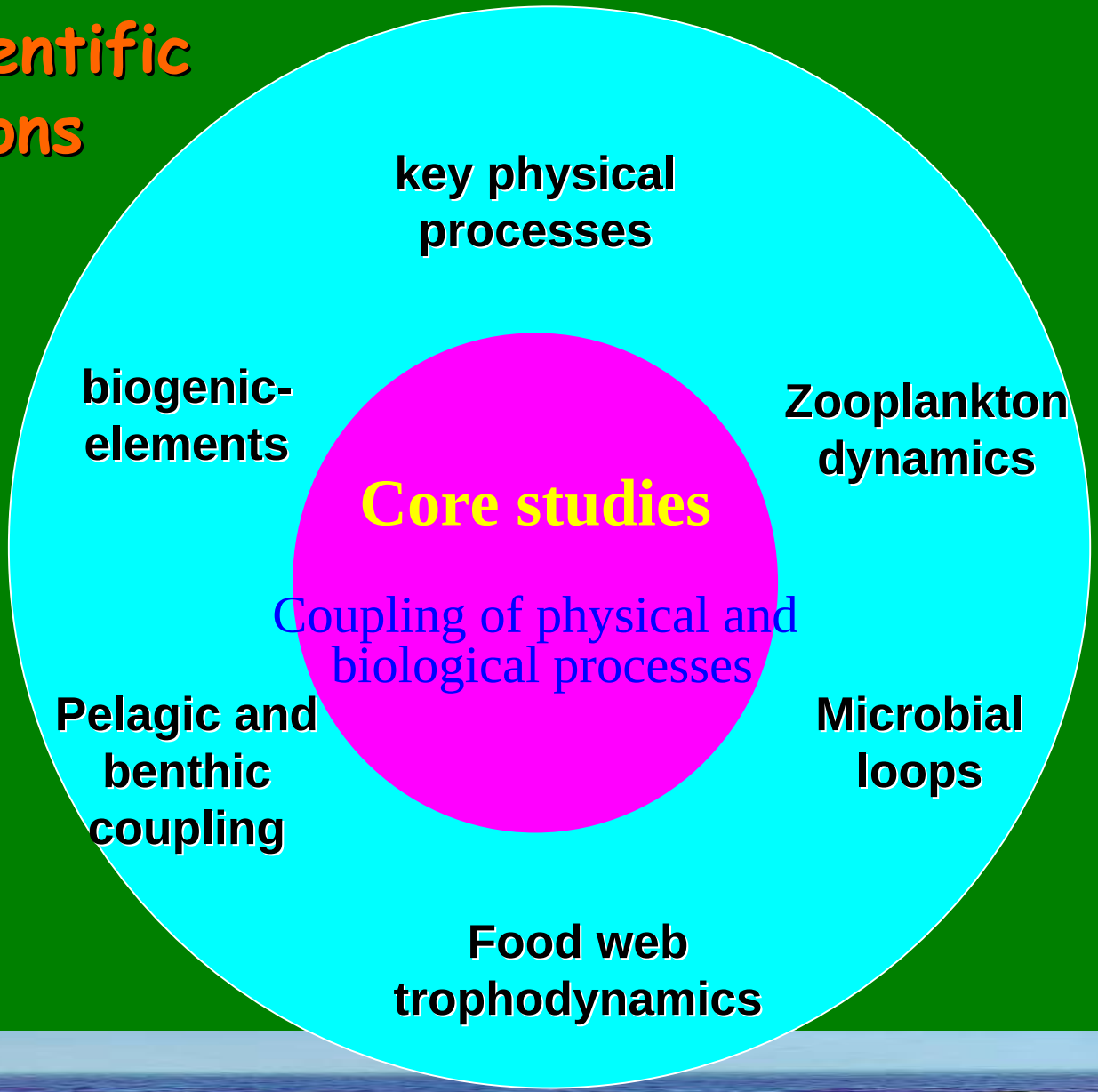
Two books published by China Science Press

One Atlas of Res. & Envi. of ECS and YS published in 2004

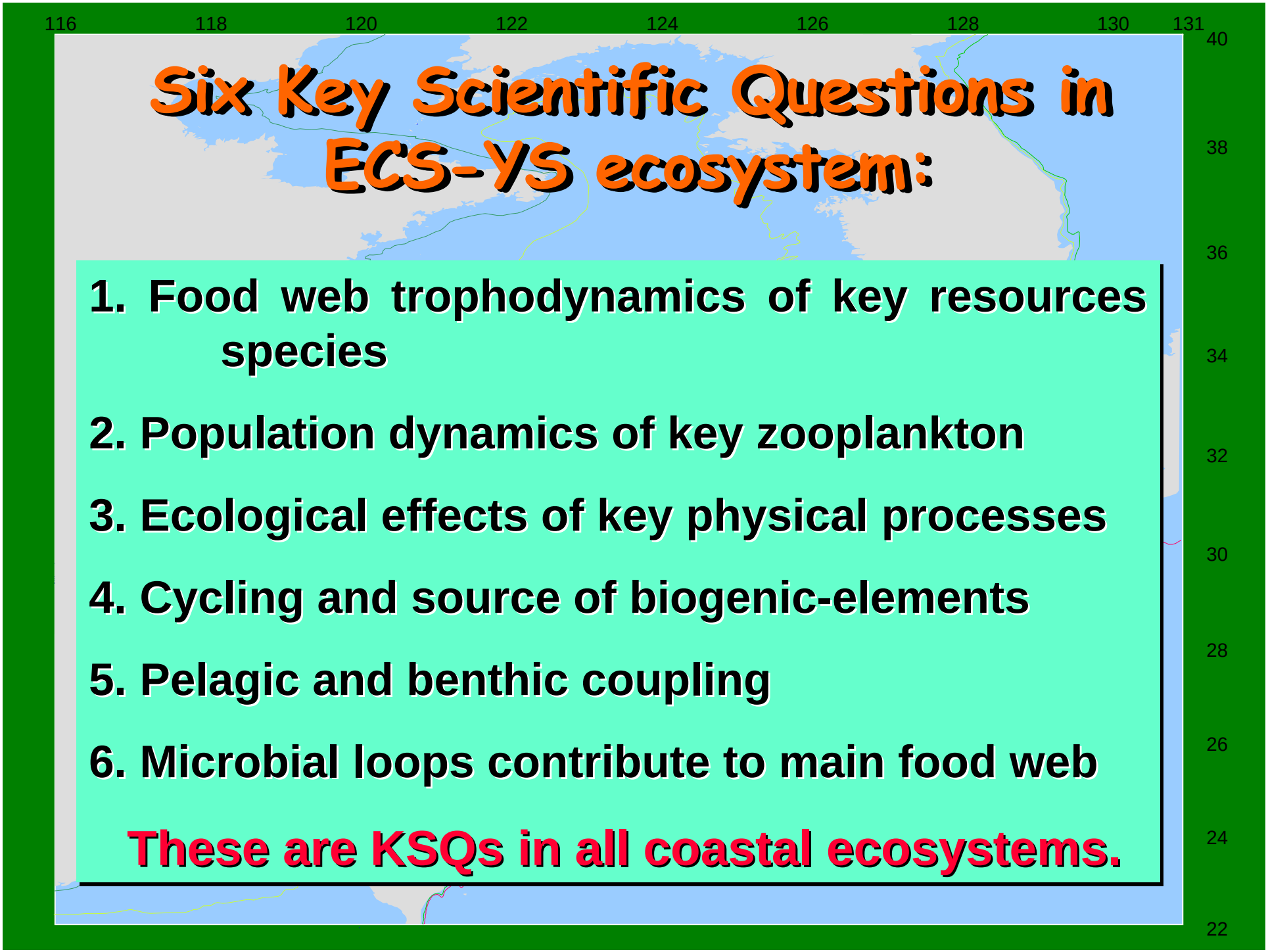
The total of 428 scientific papers have been published in scientific journals


2. What are key scientific questions in coastal ecosystem ?
Kuroshio

Key Scientific Questions



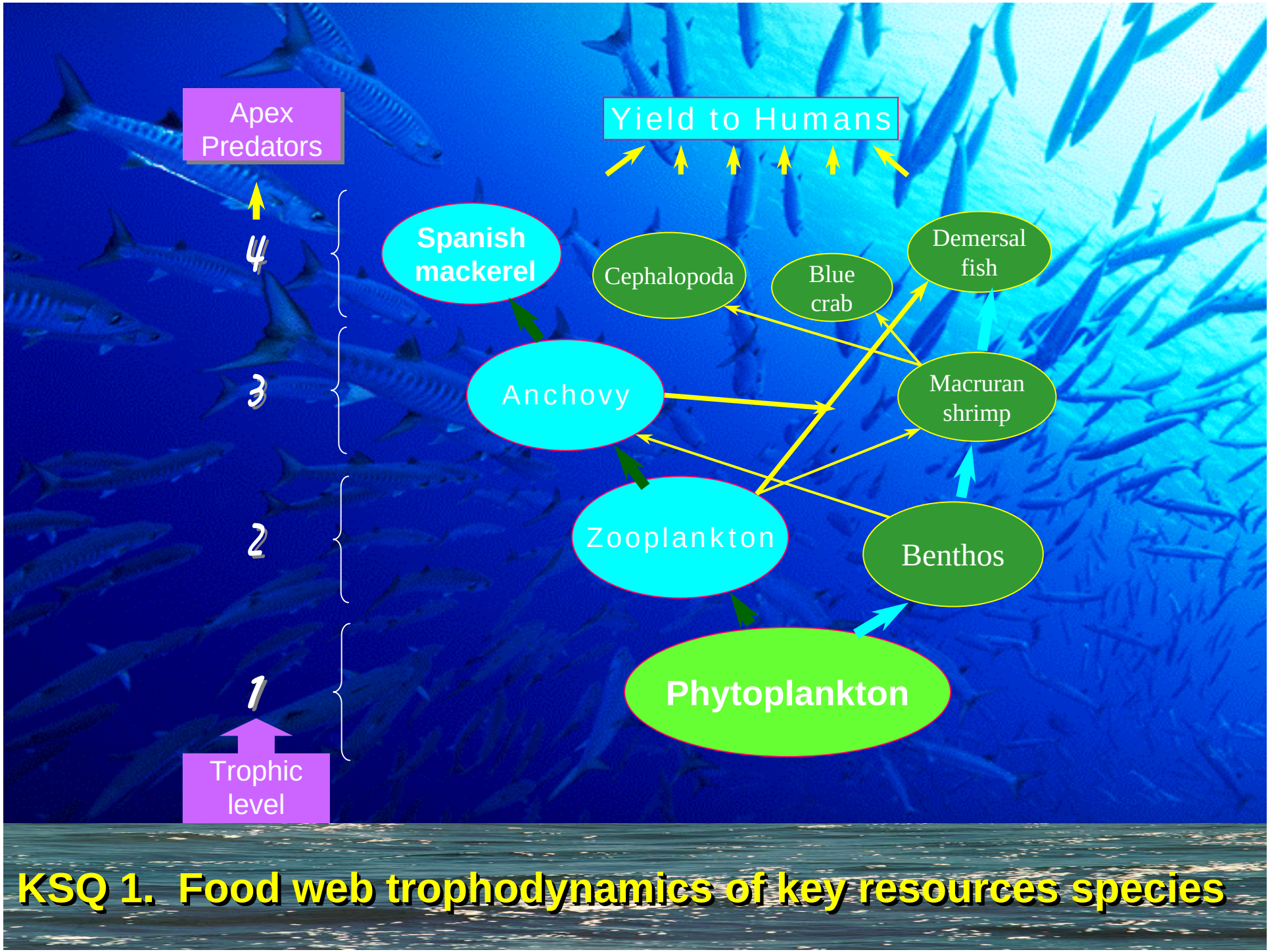
key scientific studies in coastal ecosystem



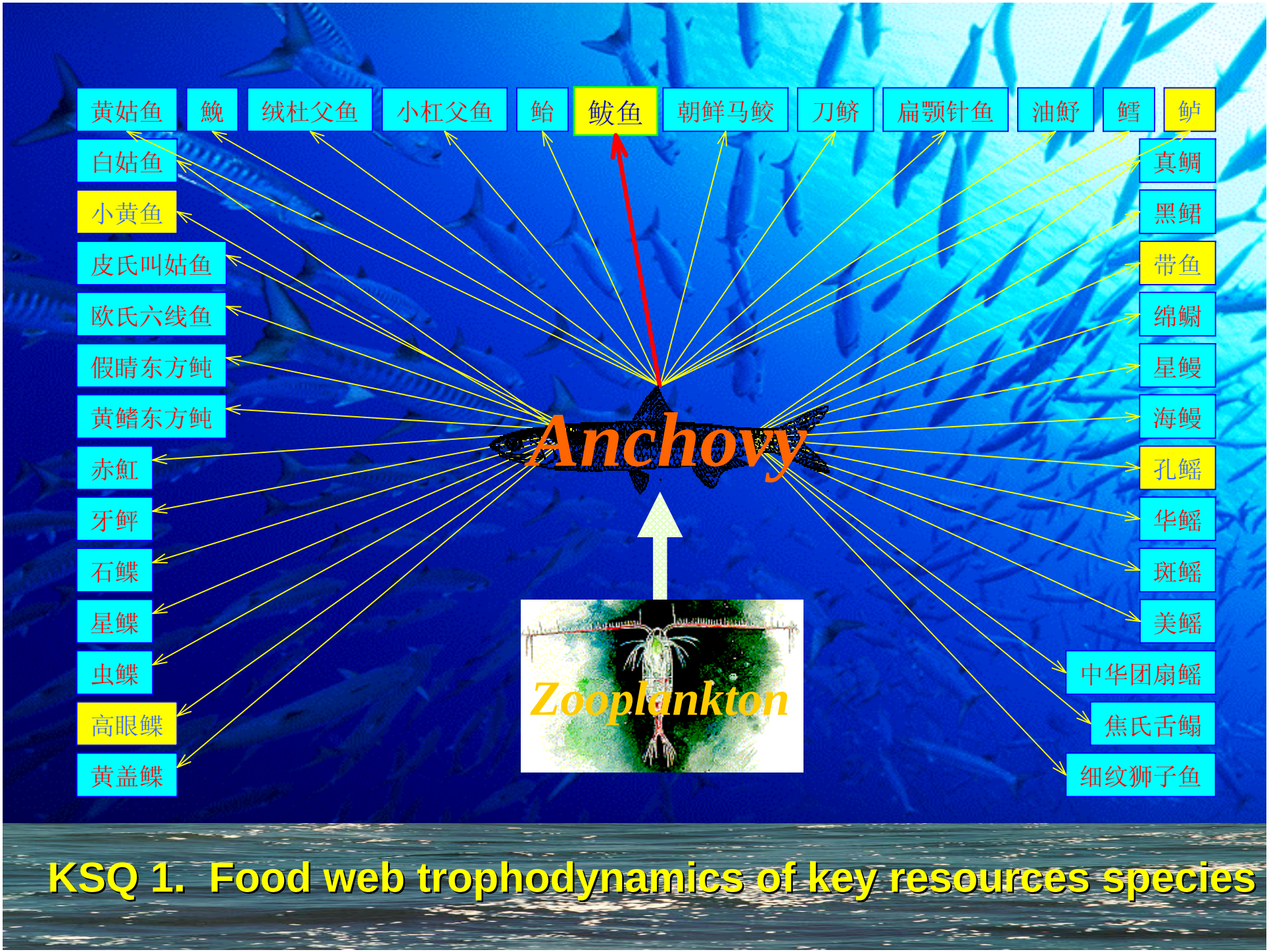
Six Key Scientific Questions in ECS-YS ecosystem:

1. Food web trophodynamics of key resources species
2. Population dynamics of key zooplankton
3. Ecological effects of key physical processes
4. Cycling and source of biogenic-elements
5. Pelagic and benthic coupling
6. Microbial loops contribute to main food web

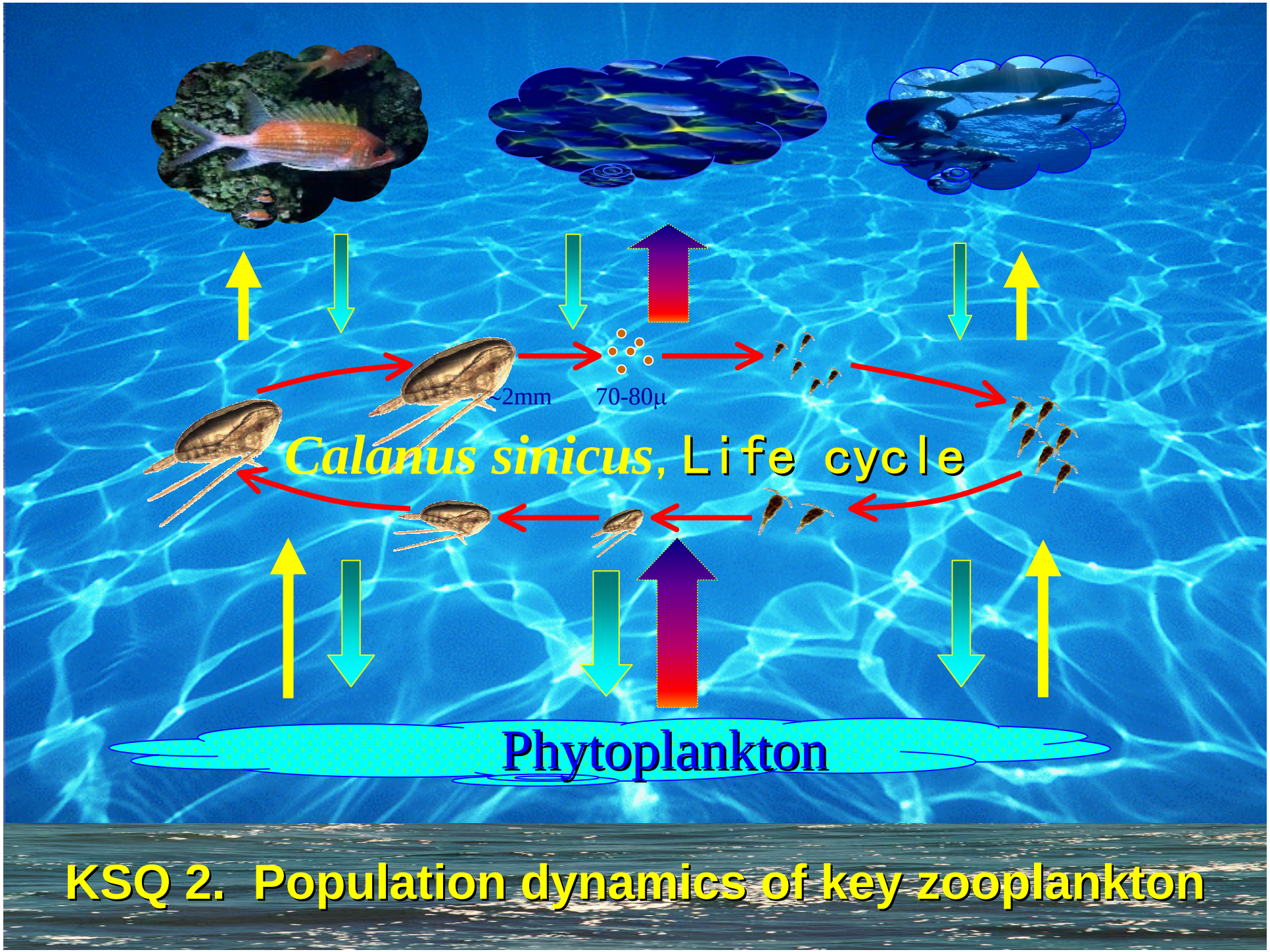
These are KSQs in all coastal ecosystems.



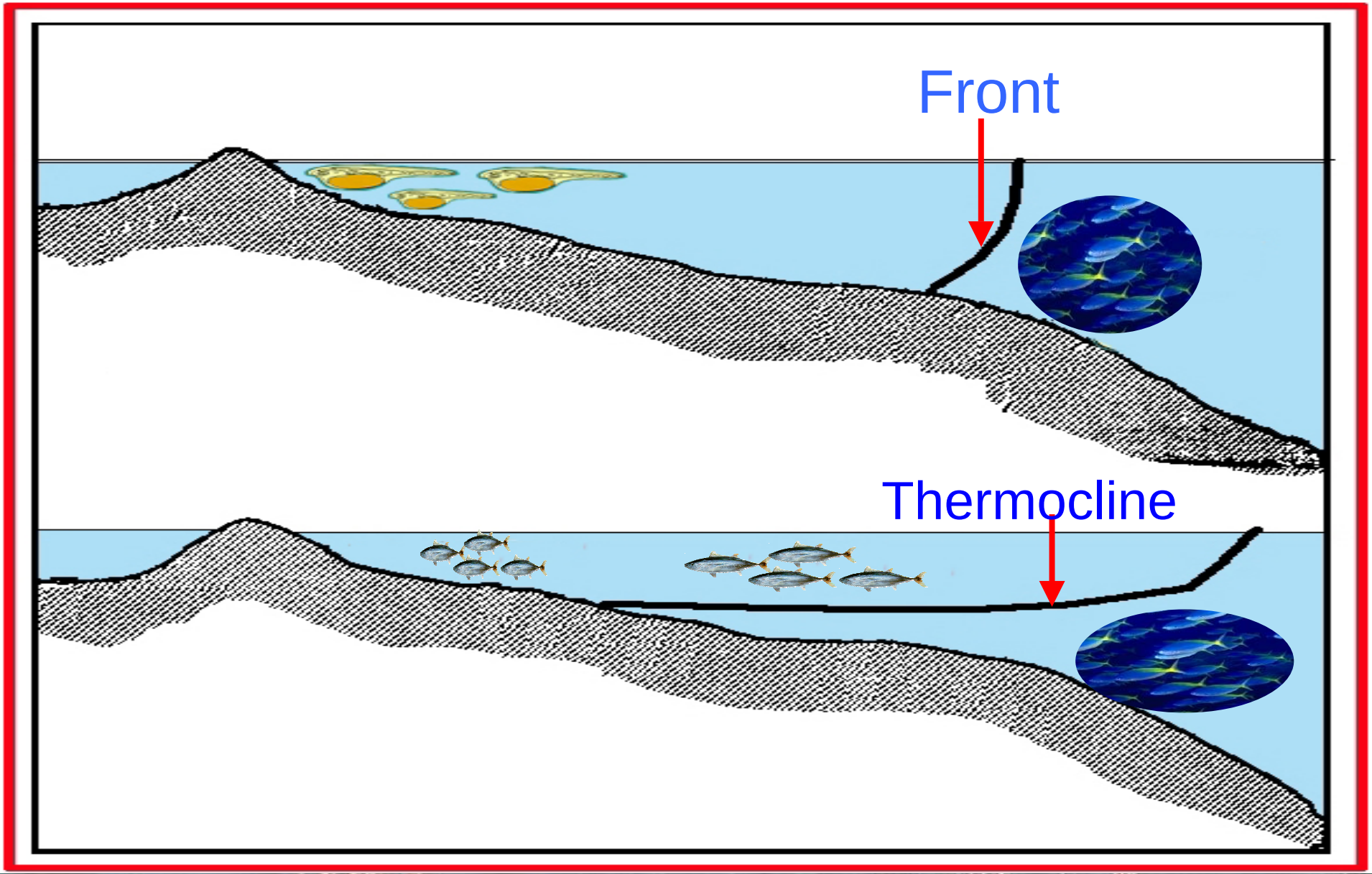
KSQ 1. Food web trophodynamics of key resources species



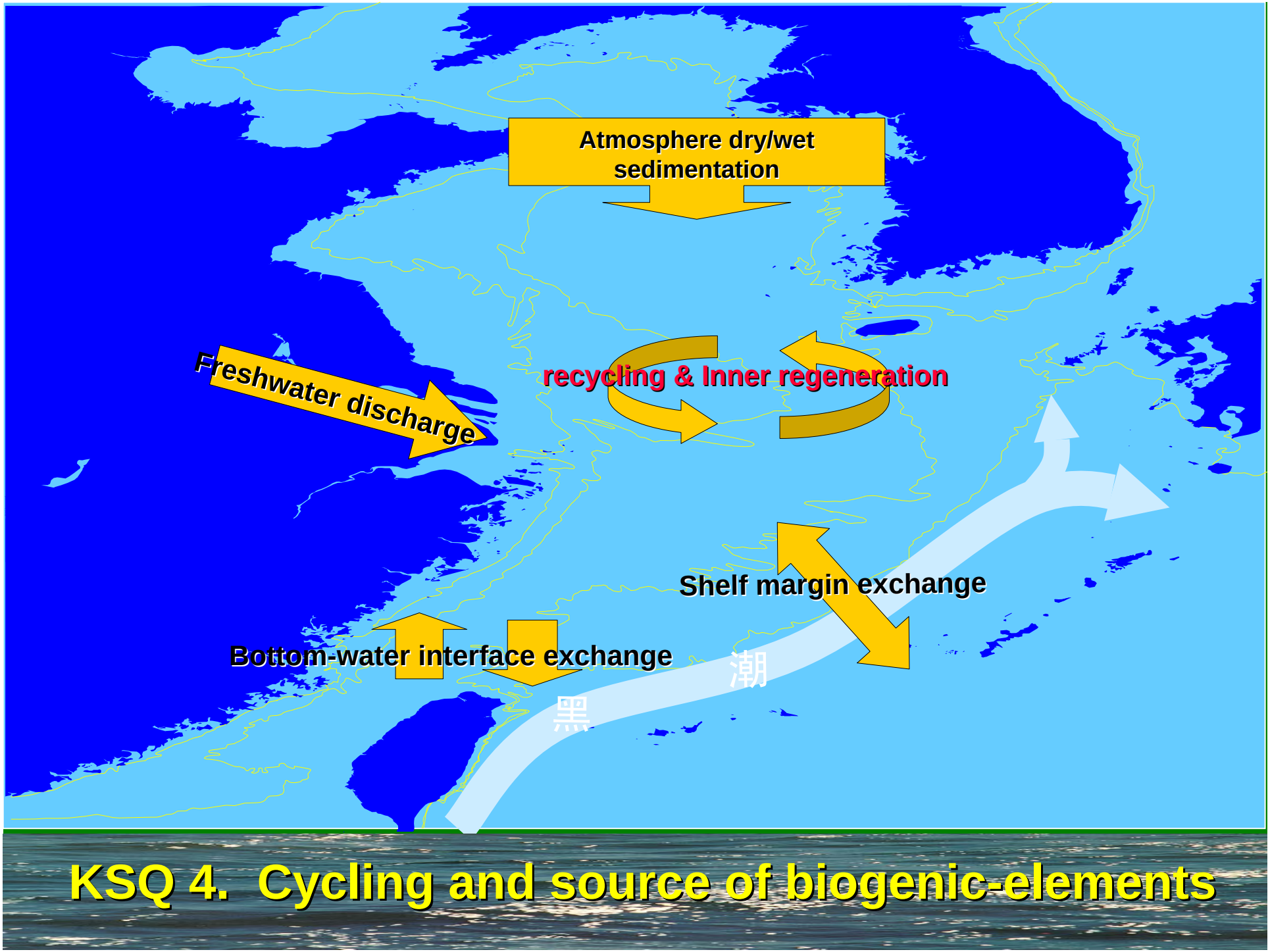
KSQ 1. Food web trophodynamics of key resources species



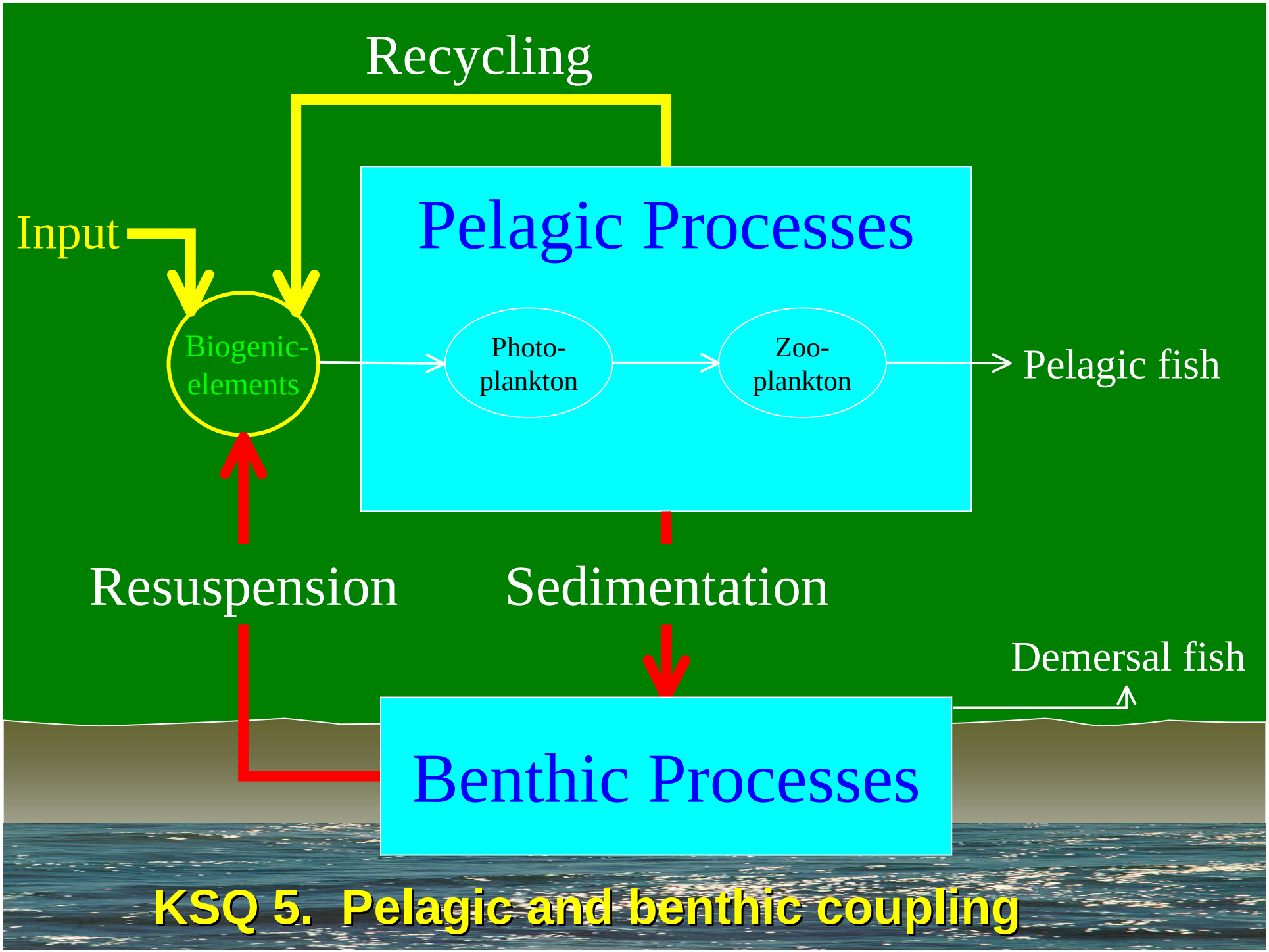
KSQ 2. Population dynamics of key zooplankton



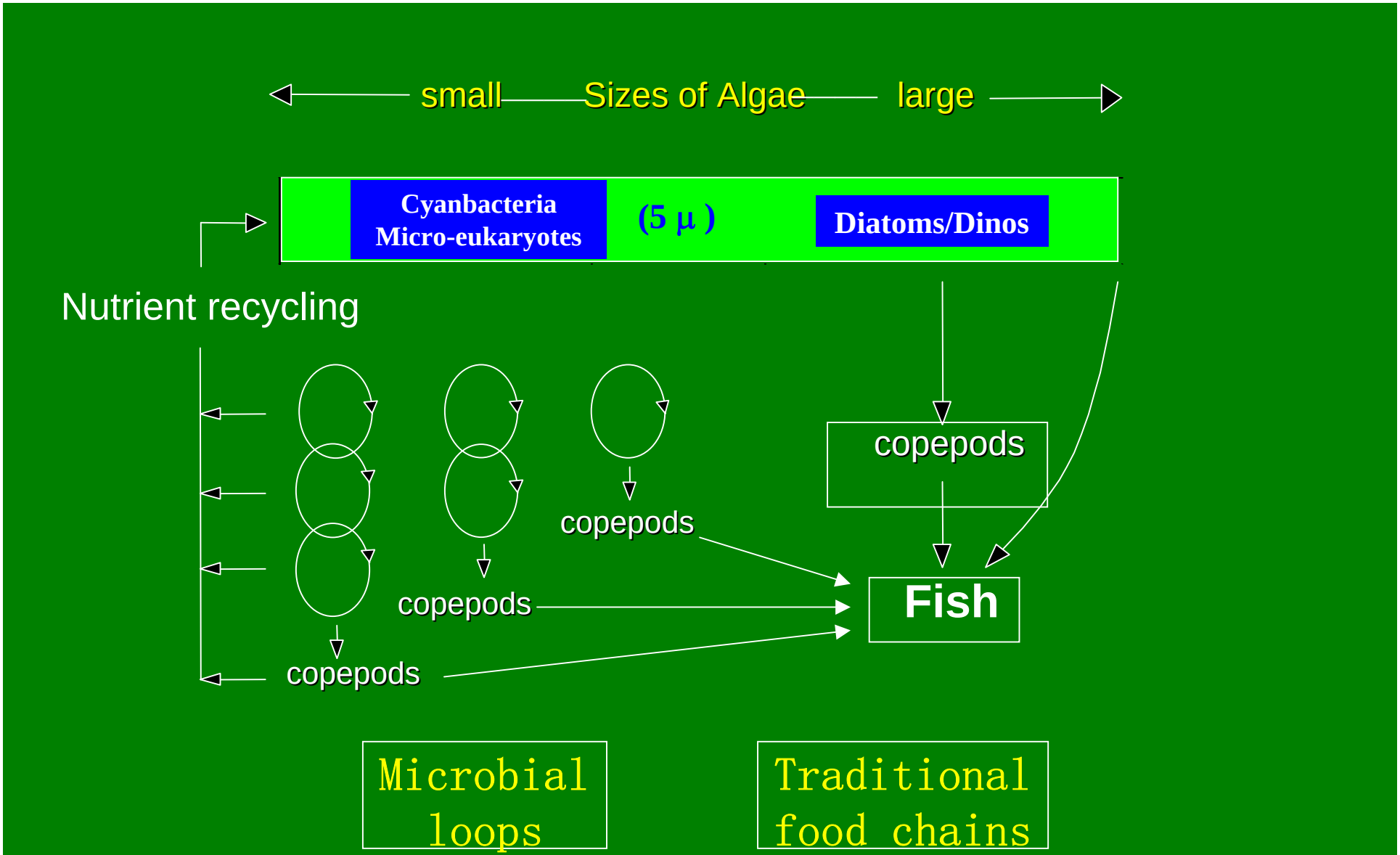
KSQ 3. Ecological effects of key physical processes



KSQ 4. Cycling and source of biogenic-elements

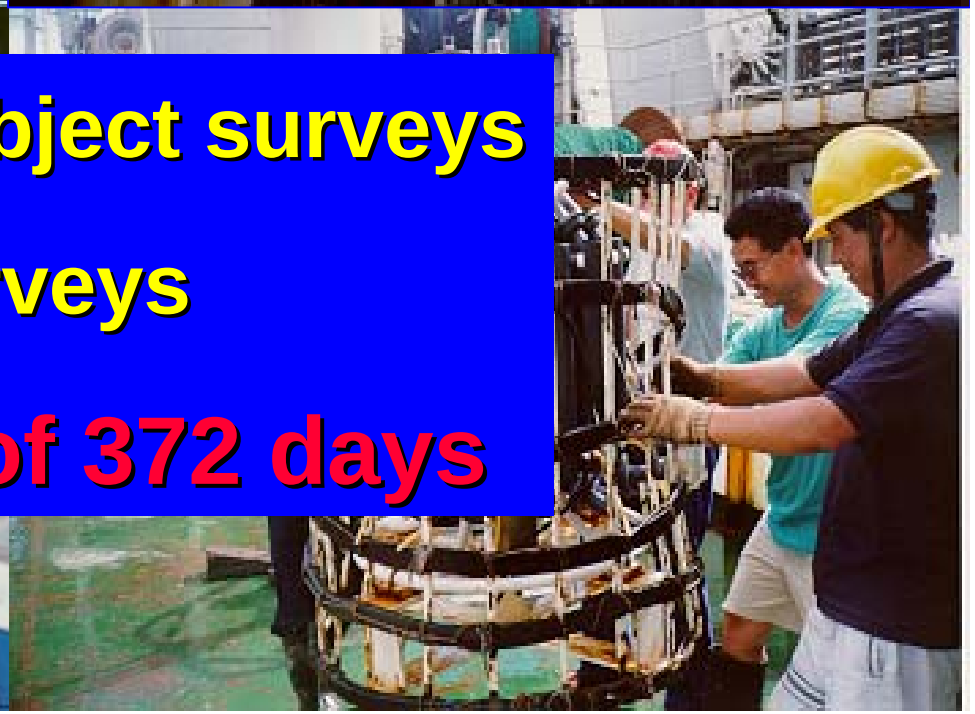


KSQ 5. Pelagic and benthic coupling



KSQ 6. Microbial loops contribute to main food web

3. Field surveys and *in situ* experiments



- 4 special-subject surveys
- 2 holistic surveys

Total survey of 372 days

➢ Special-subject surveys

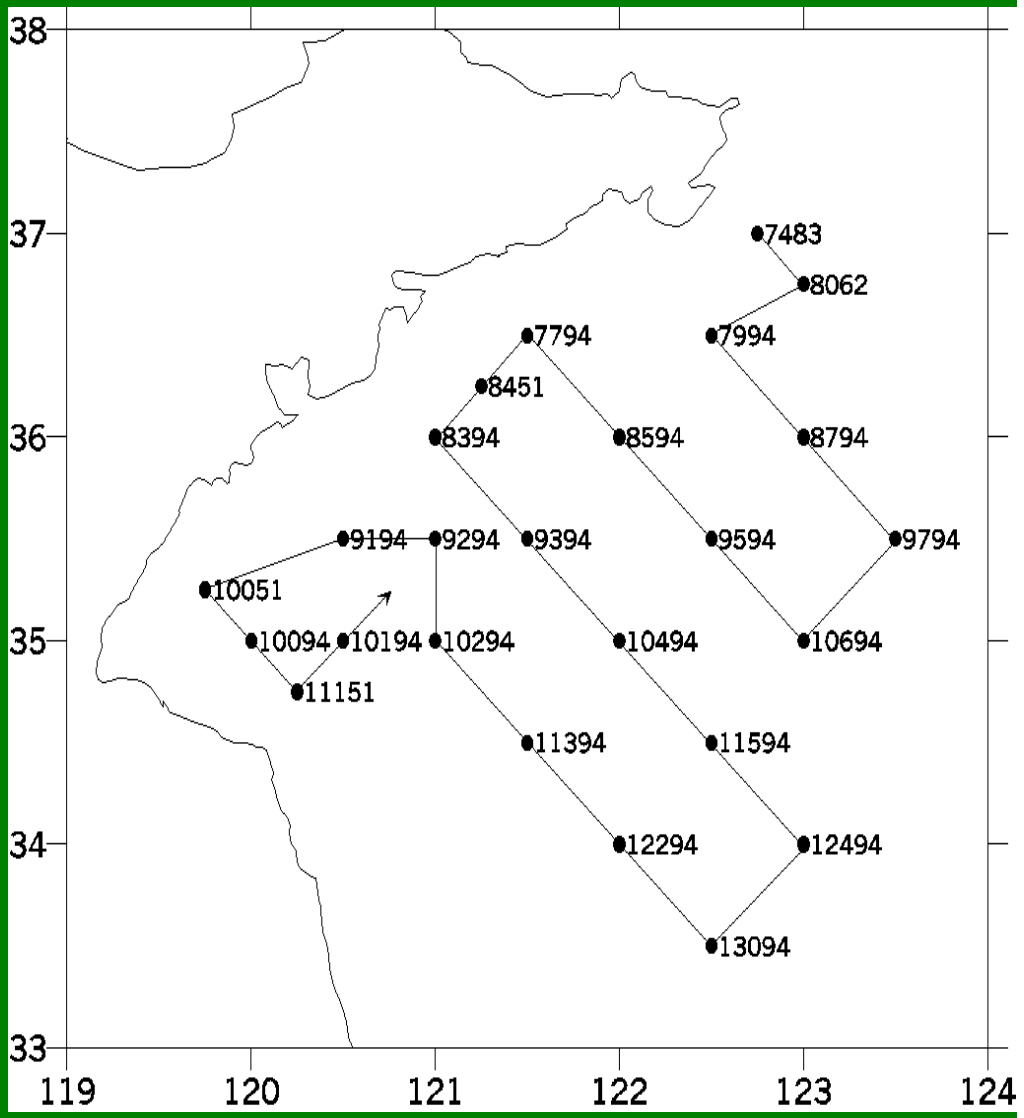
1. Spawning ground surveys and recruitment mechanism of anchovy
2. Population dynamics & oversummering strategy of *Calanus sinacus*
3. The physical mechanism in the forming of anchovy overwintering ground
4. Biogenic-element flow between different water masses

北斗号

1. Spawning ground surveys and recruitment mechanism of anchovy

Survey schedules and progress:

- June 2000, 15 days √
- May 2001, 11 days √
- June 2001, 14 days √
- July 2001, 6 days √
- June 2002, 20 days √
- June 2003, 18 days √
- June 2004, 20 days √

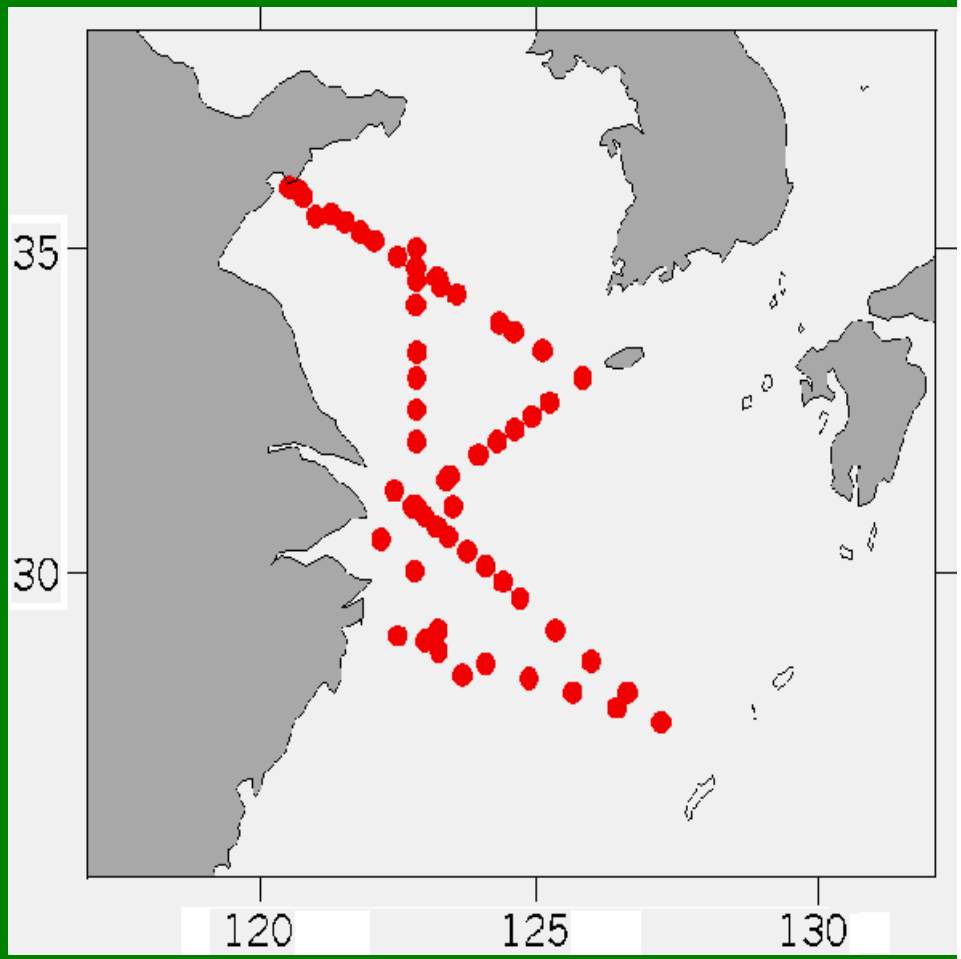


2. Population dynamics and oversummering strategy of *Calanus sinicus*

Survey schedules and progress:

- **Aug. 1999, 12 days** √
- **Aug. 2001, 14 days** √
- **July 2002, 13 days** √
- **Aug. 2002, 8 days** √
- **Sept. 2002, 5 days** √

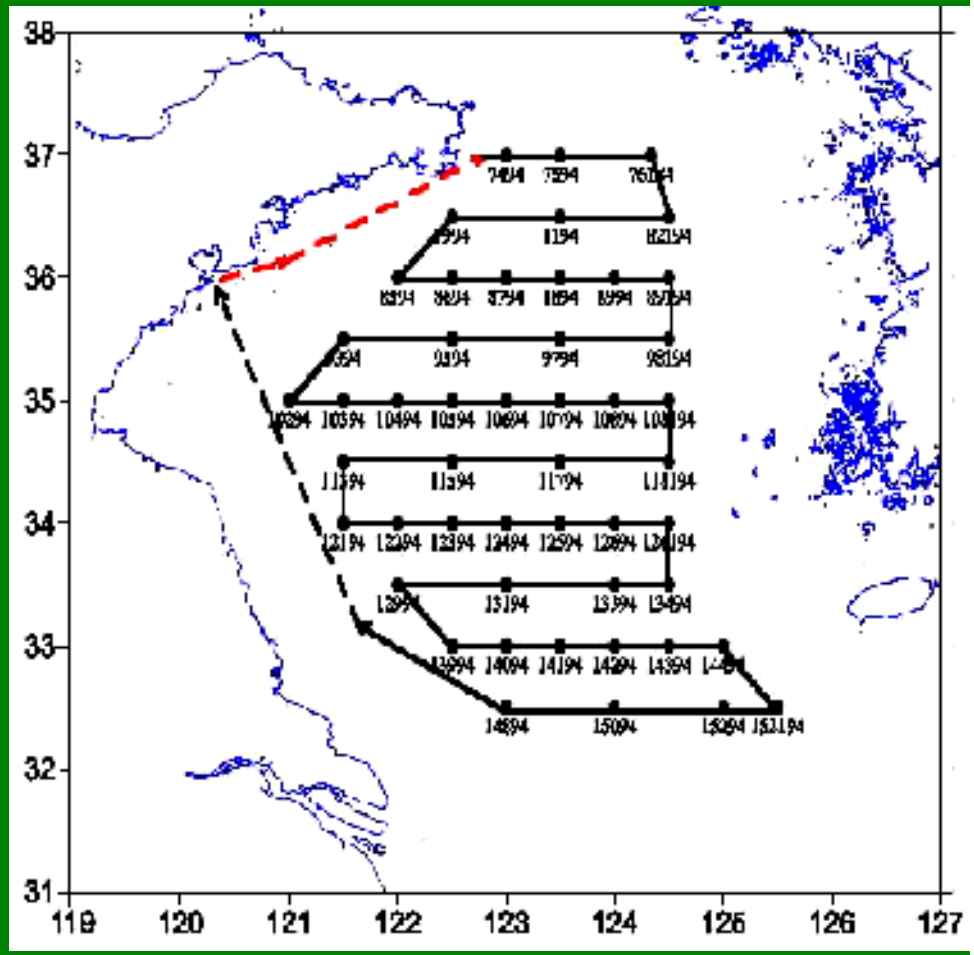
(Continuous Undulating Plankton Sampler to be used in 2002)



3. The physical mechanism in the forming of anchovy overwintering ground

Survey schedules and progress:

- Jan. 2001, 12 days √
- Nov. 2001, 19 days √*
- Jan. 2002, 16 days √*
- Nov. 2003, 8 days √*
- Jan. 2003, 12 days √*
- Jan. 2004, 16 days √



*** The surveys were divided into two legs, one prior to a strong winter wind and one immediately after it.**

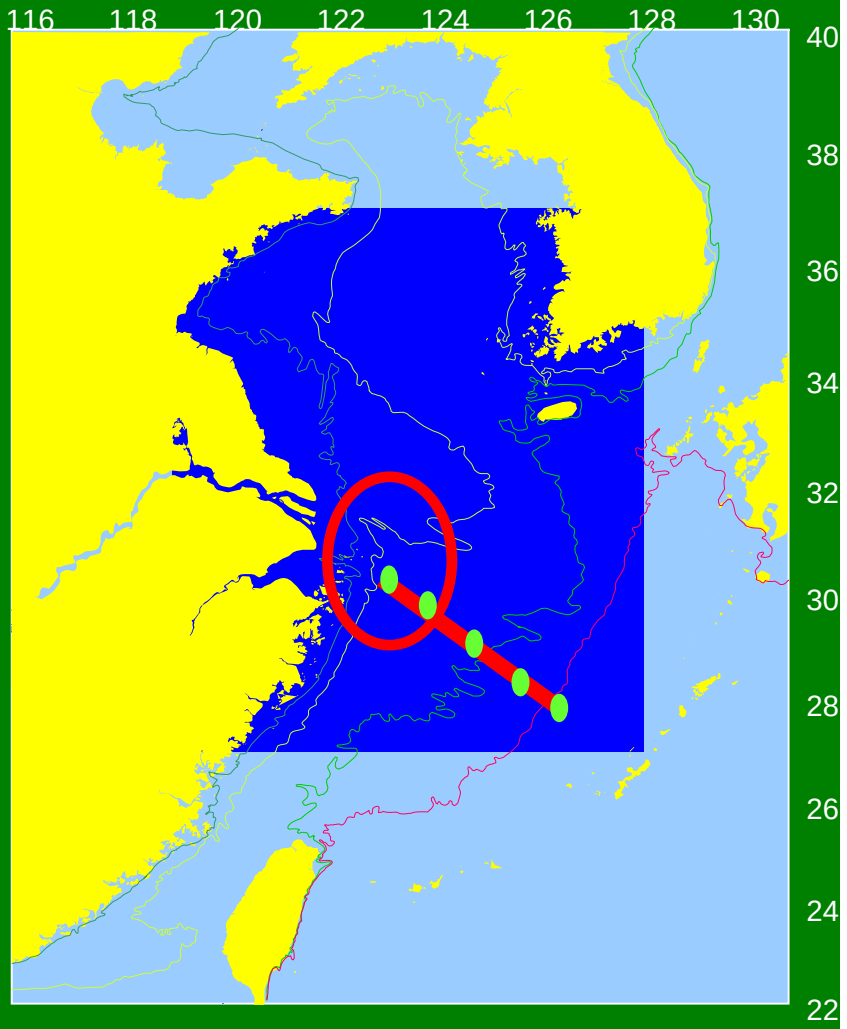
4. Biogenic-element flow between different water masses

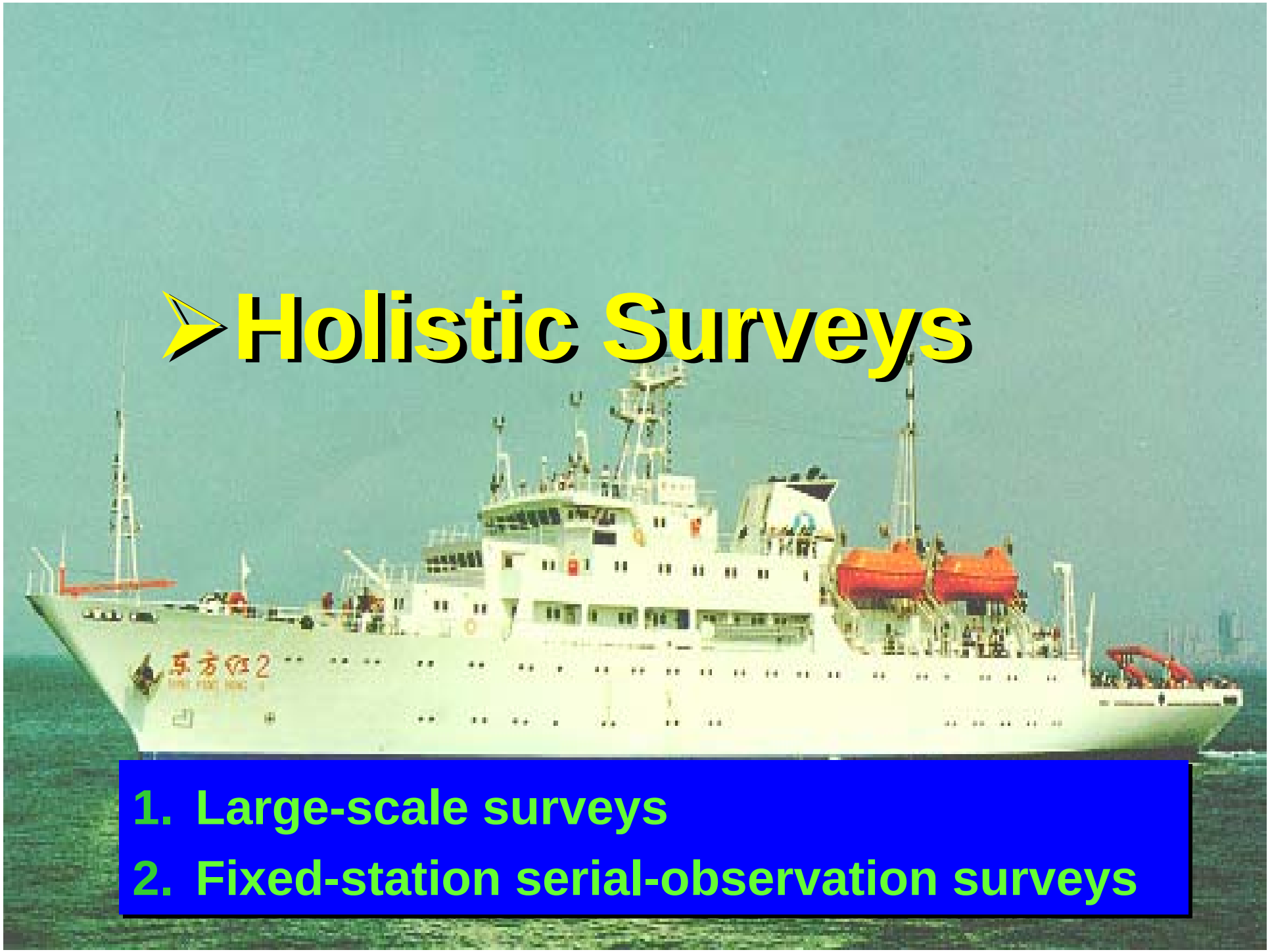
Survey schedules and progress :

- **July 2001, 16 days √ ***
- **Sept. 2002, 20 days √**

*** With four chartered vessels:**

1 stationary for continuous observation, 1 run small-scale at estuary and 2 run the transect





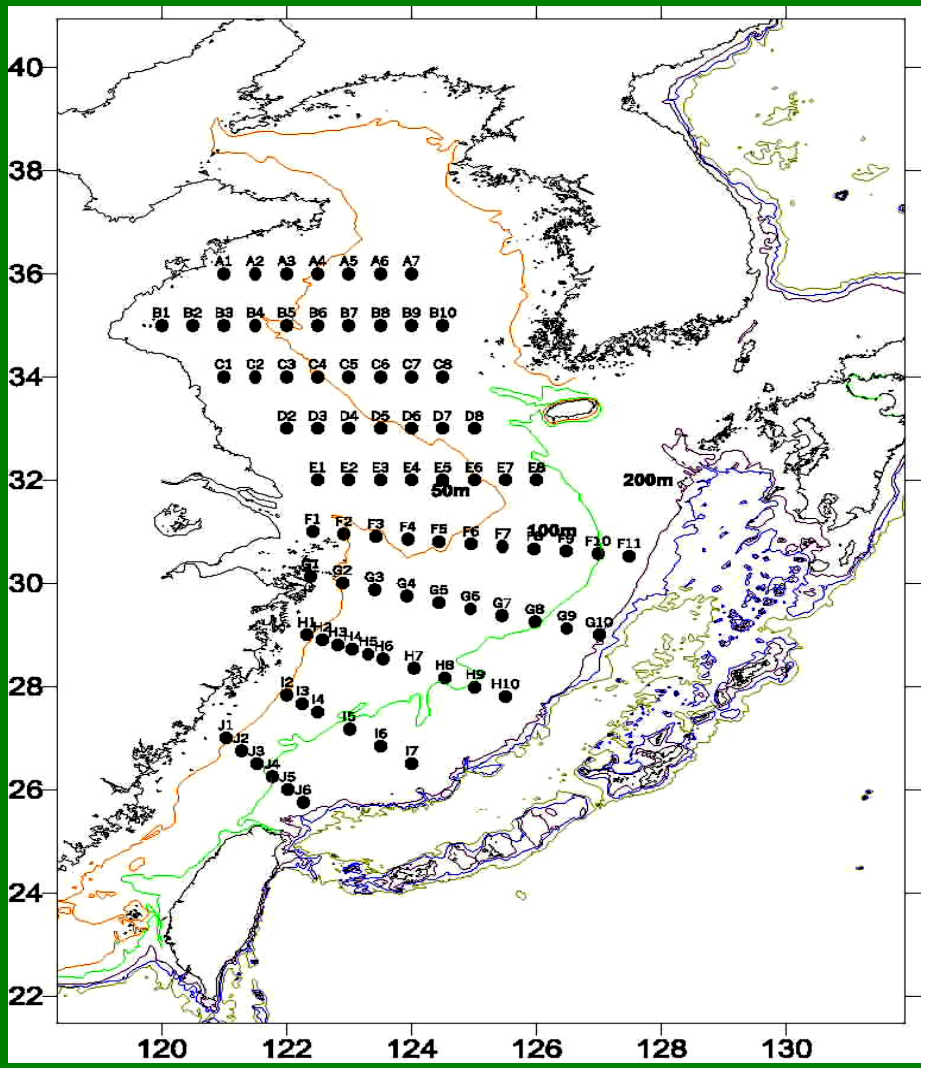
➢Holistic Surveys

1. Large-scale surveys
2. Fixed-station serial-observation surveys

1. Large-scale surveys

Survey schedules and progress:

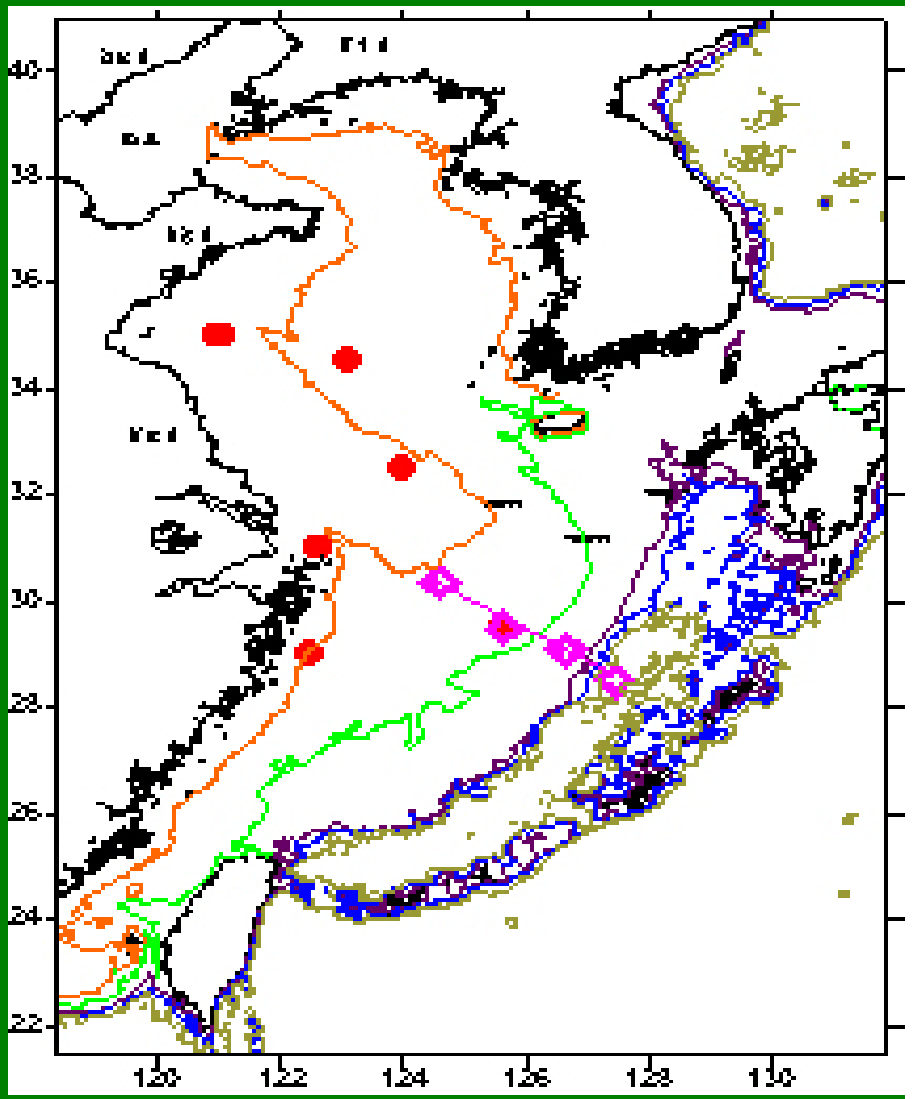
- **Fall 2000, 49 days √**
- **Spring 2001, 35 days √**

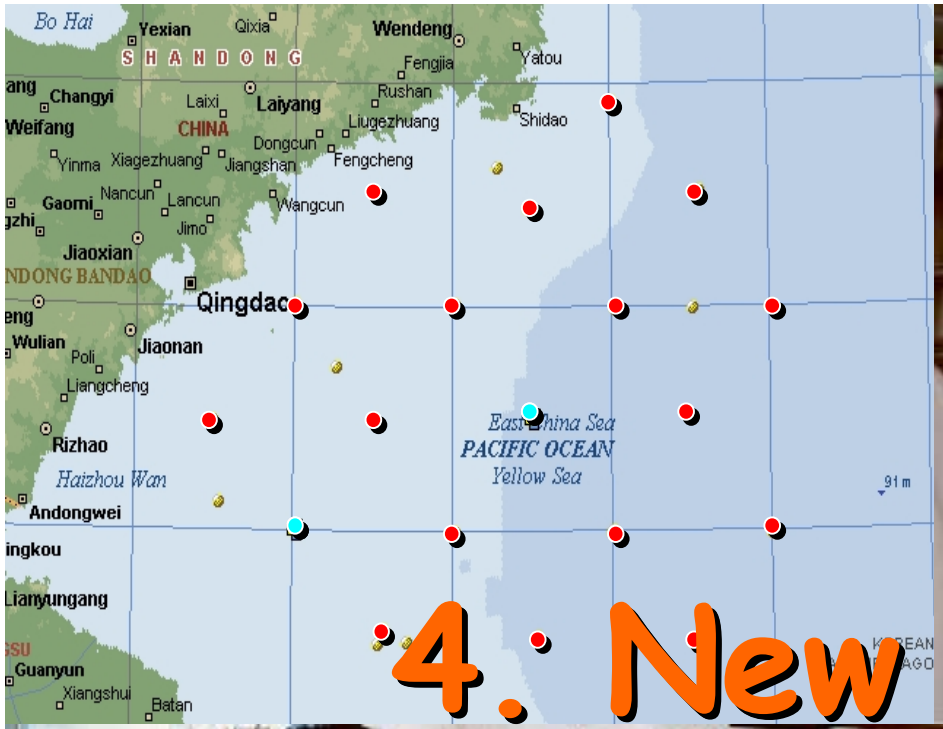


2. Fixed-station serial-observation surveys

Survey schedules and progress:

- **Fall 2000, 17 days √**
- **Spring 2001, 12 days √**
- **Fall 2002, 20 days √**





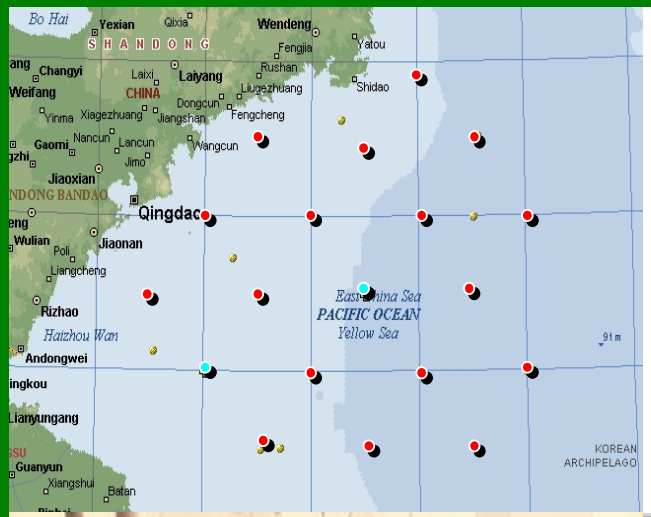
4. New finding

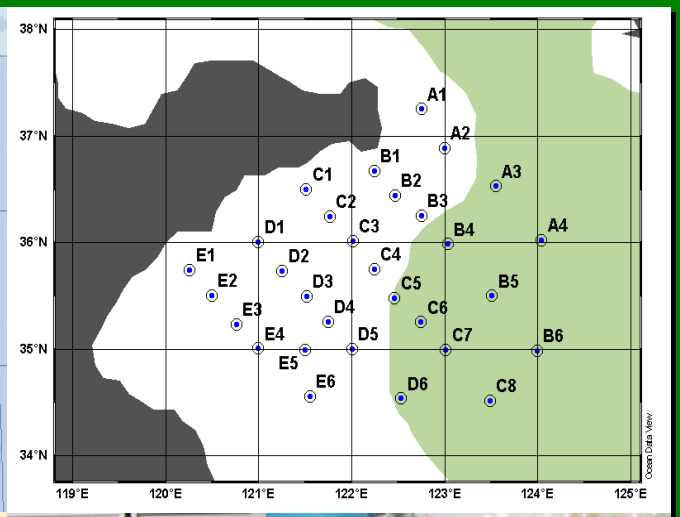
▪ Major progress and result – 1.

Results from anchovy spawning ground surveys

- Anchovy larvae mainly distributed in inshore tidal front zones, in the upper 10m layer; no distinct vertical megration was found.
- No clear distributional relationship were found between anchovy larvae and its prey (eg *Calanus sinicus*) and predators (eg *Sagitta crasa*)
- The percentage of dead eggs was very high, with a mean of 83% and up to 97%
- New insights obtained on prey & predator relationship
- It is understood that dense anchovy larvae distribution area is more related to physical effects than trophic supports

Major progress and result – 1. Recruitment mechanism of anchovy

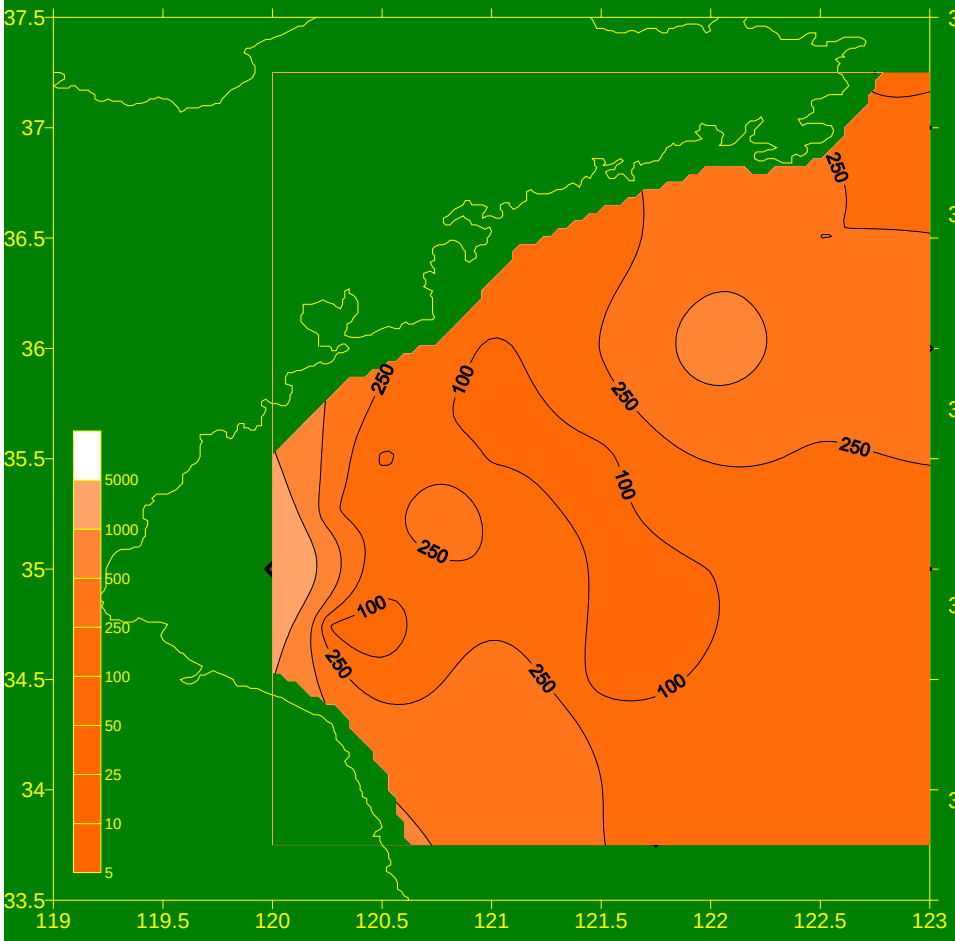




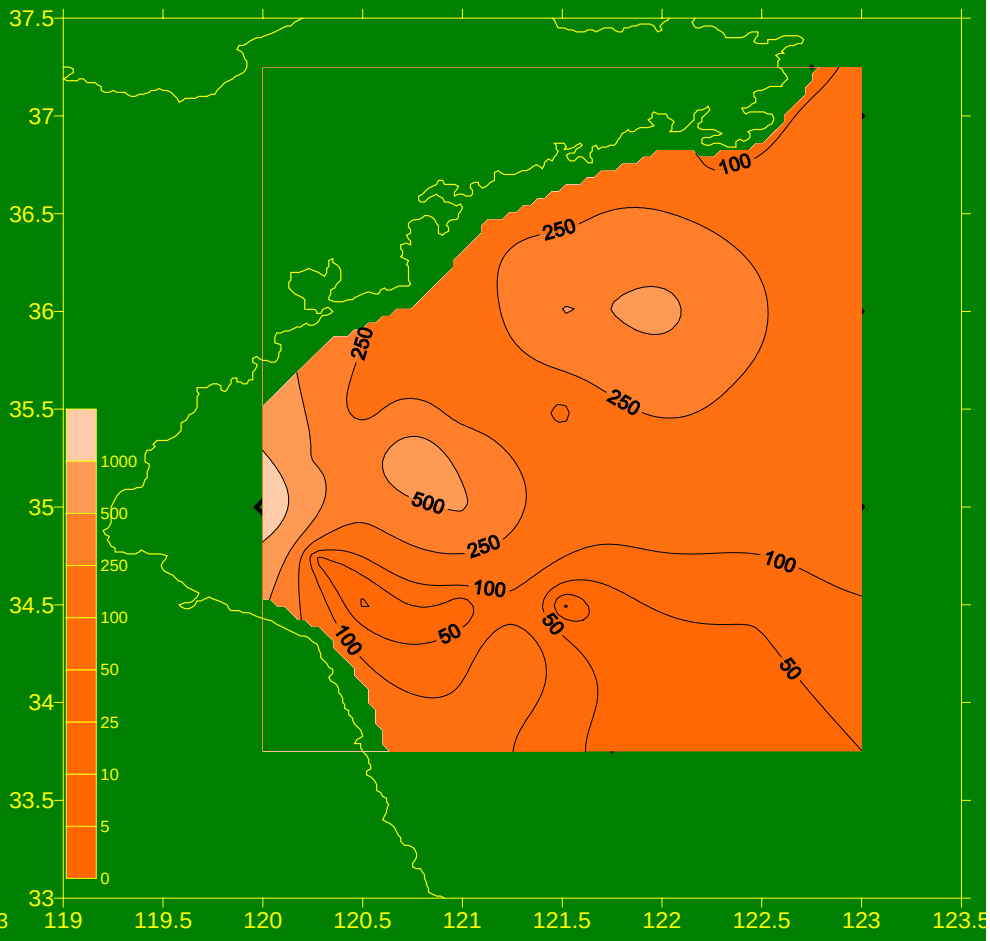
Field & Lab work

The recruitment mechanism of key species was studied at ecosystem level

Spawning ground of anchovy, June, 2001

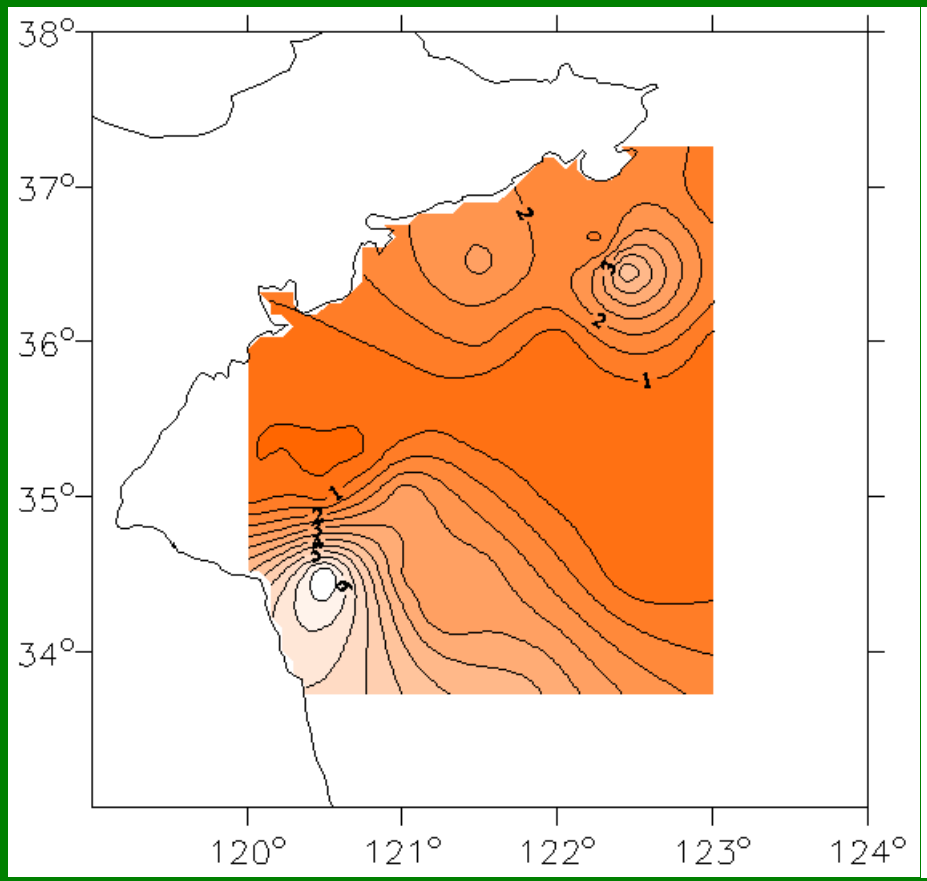


Biomass distribution of zooplankton

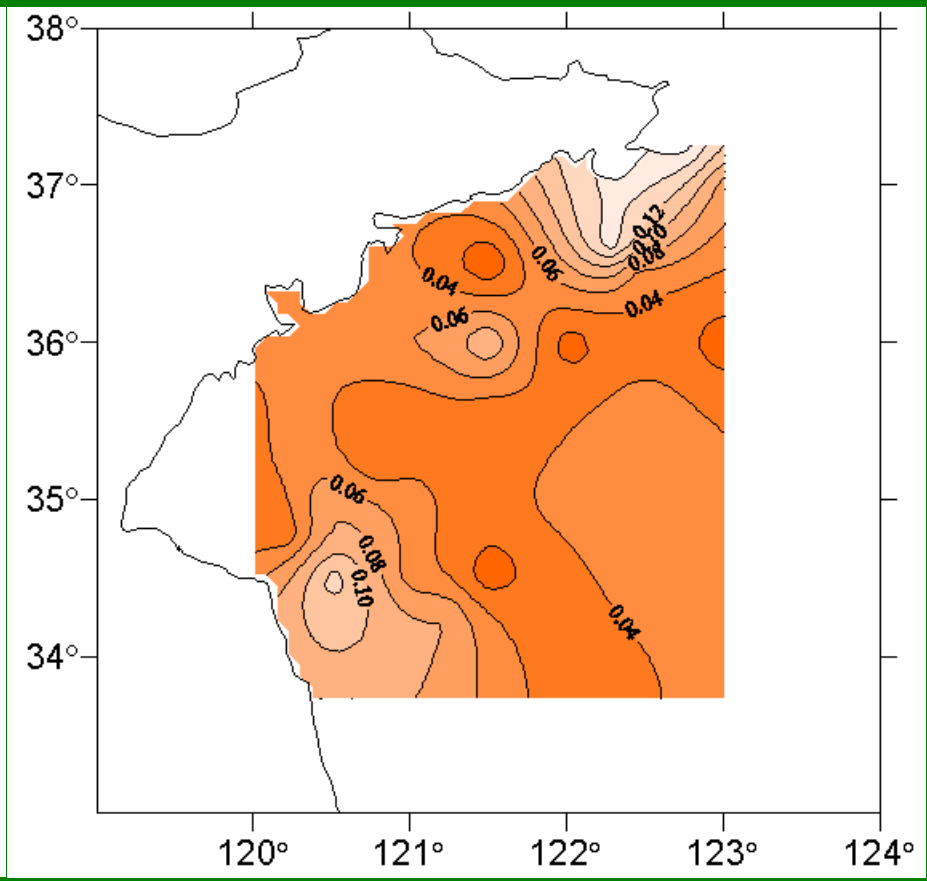


Biomass distribution of *Calanus sinicus*

Concentration distribution of NO_3^- & PO_4^{3-} in anchovy spawning ground, June, 2001

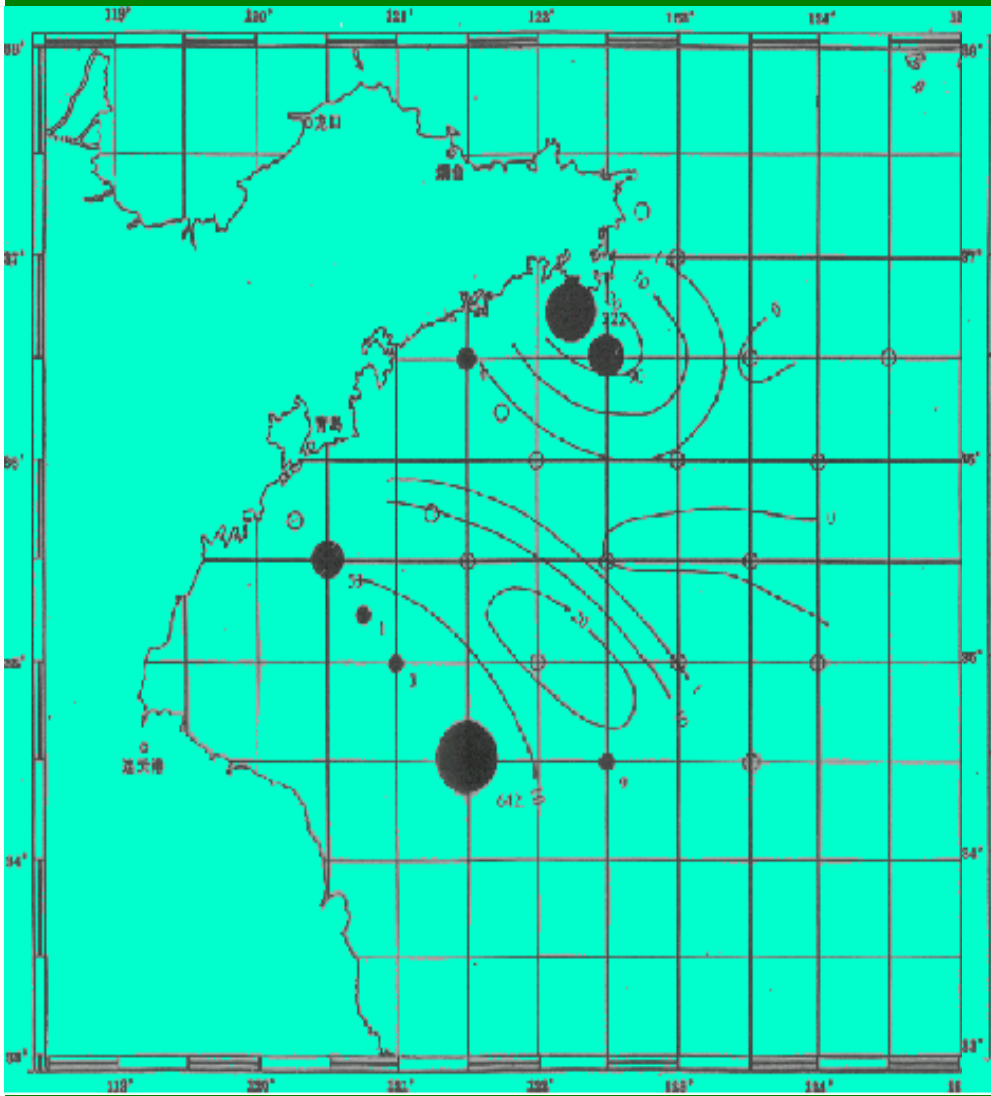


NO_3^-

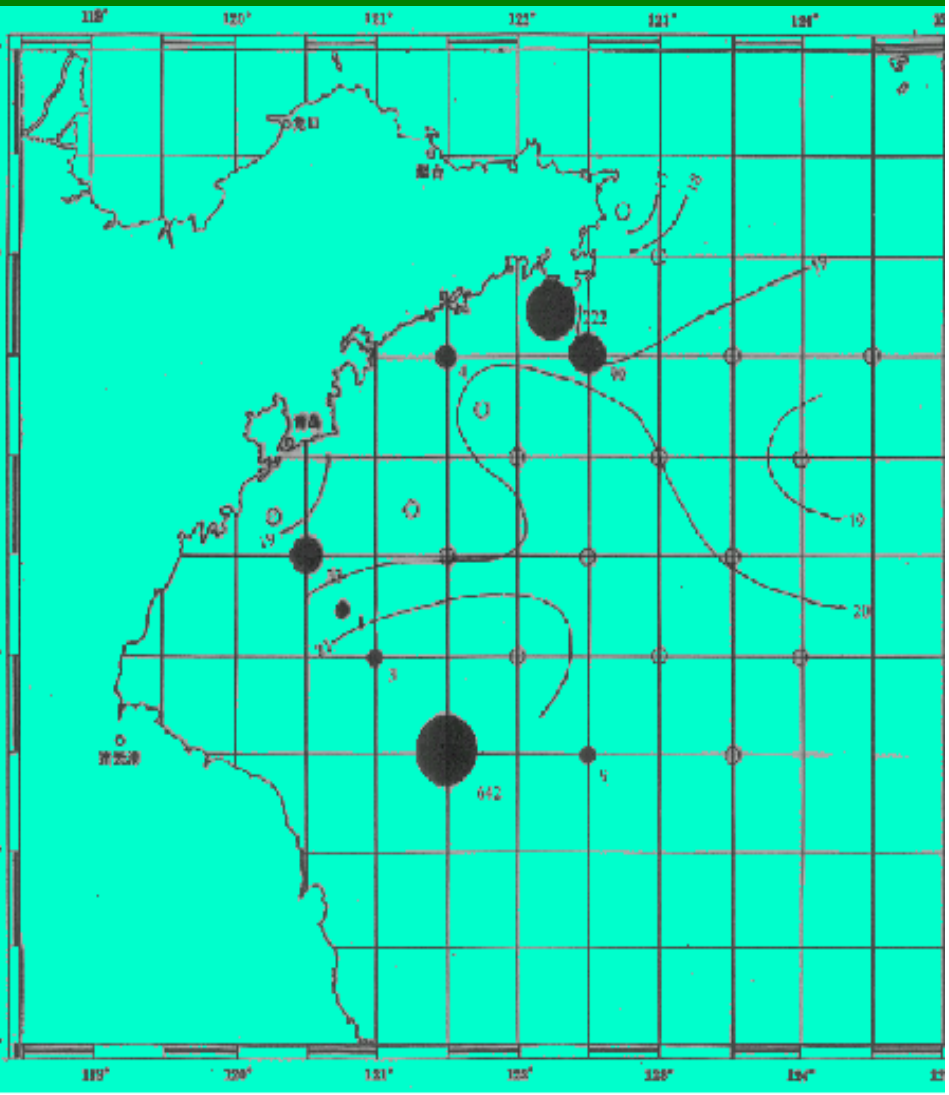


PO_4^{3-}

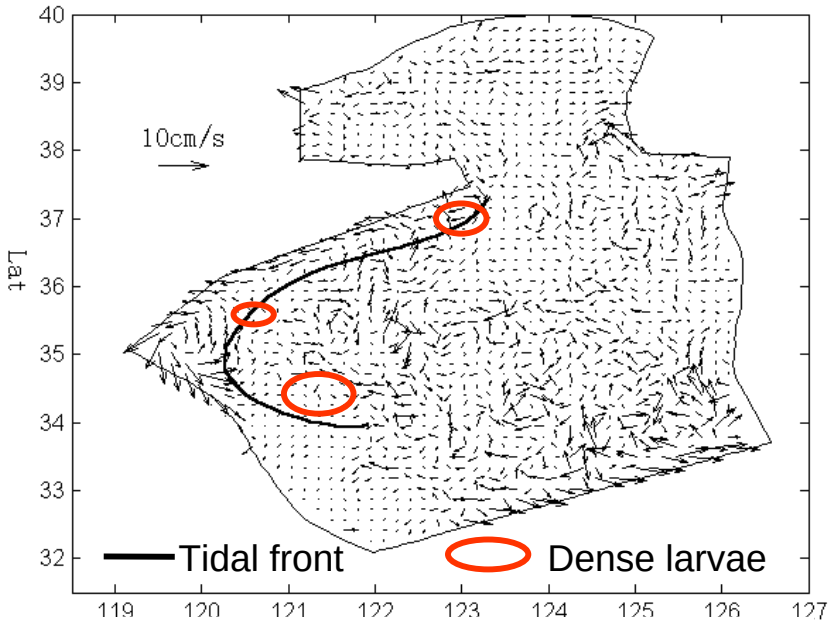
Prey and predator relationship



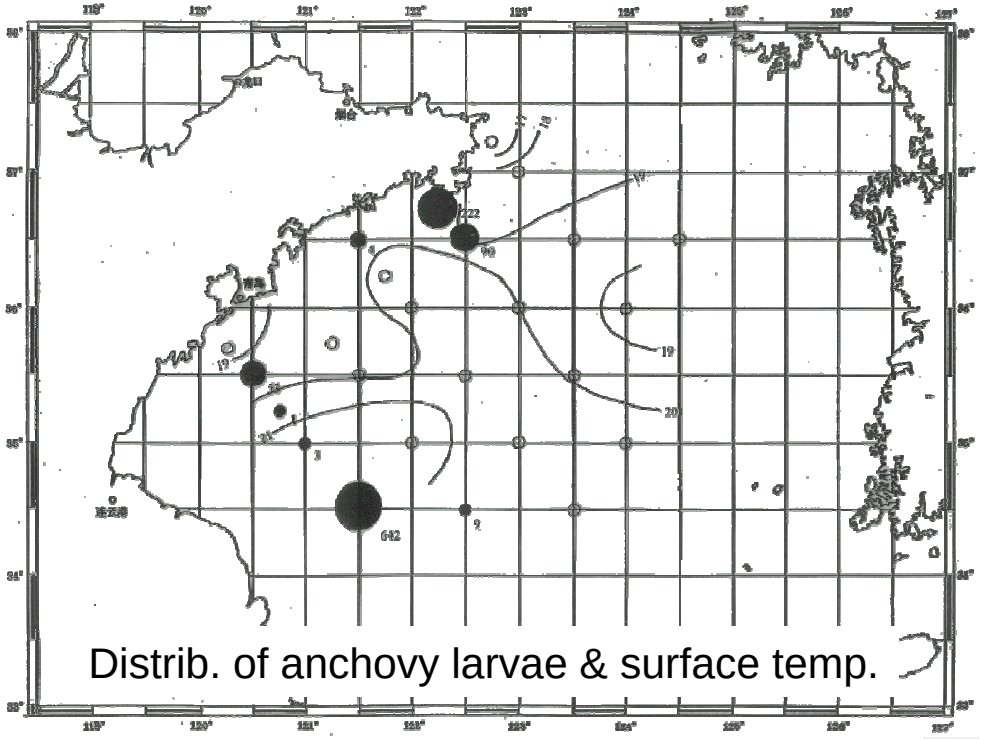
Distributions of anchovy larvae
& *Paracalanus parvus*



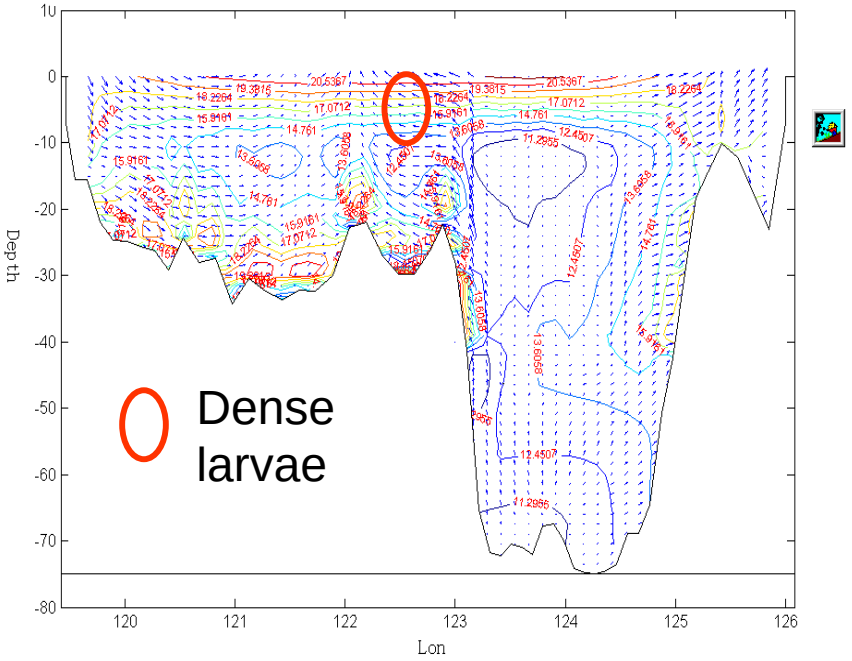
Distributions of anchovy larvae
& surface water temperature

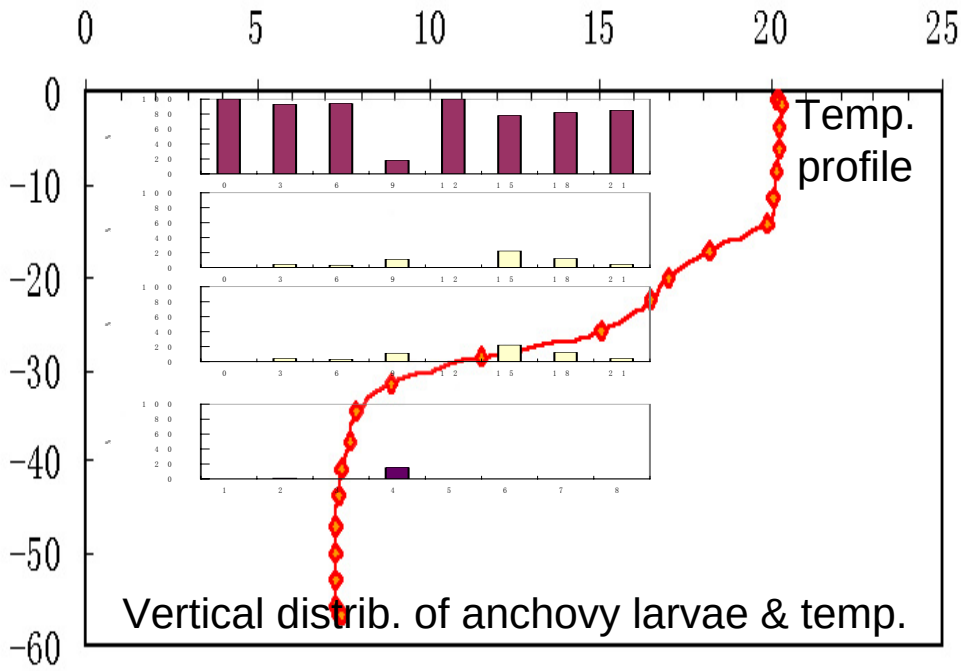


Distributions of dense anchovy larvae & tidal front



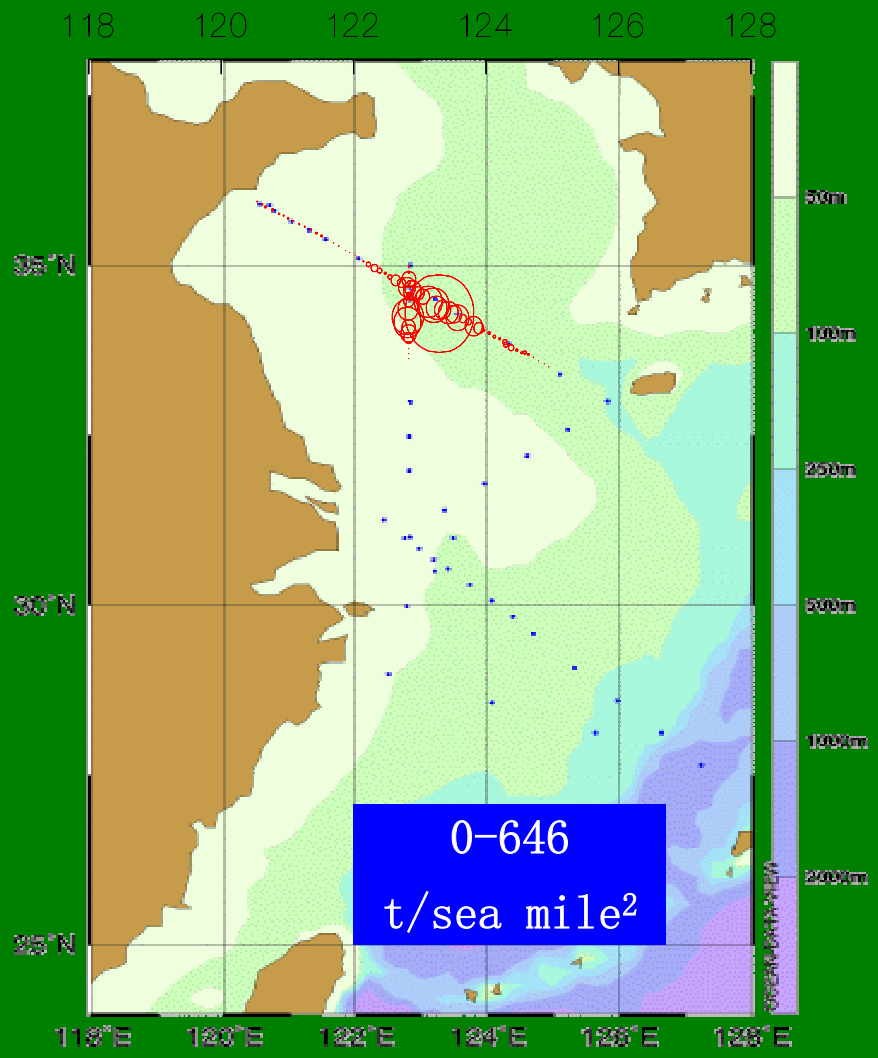
Distrib. of anchovy larvae & surface temp.



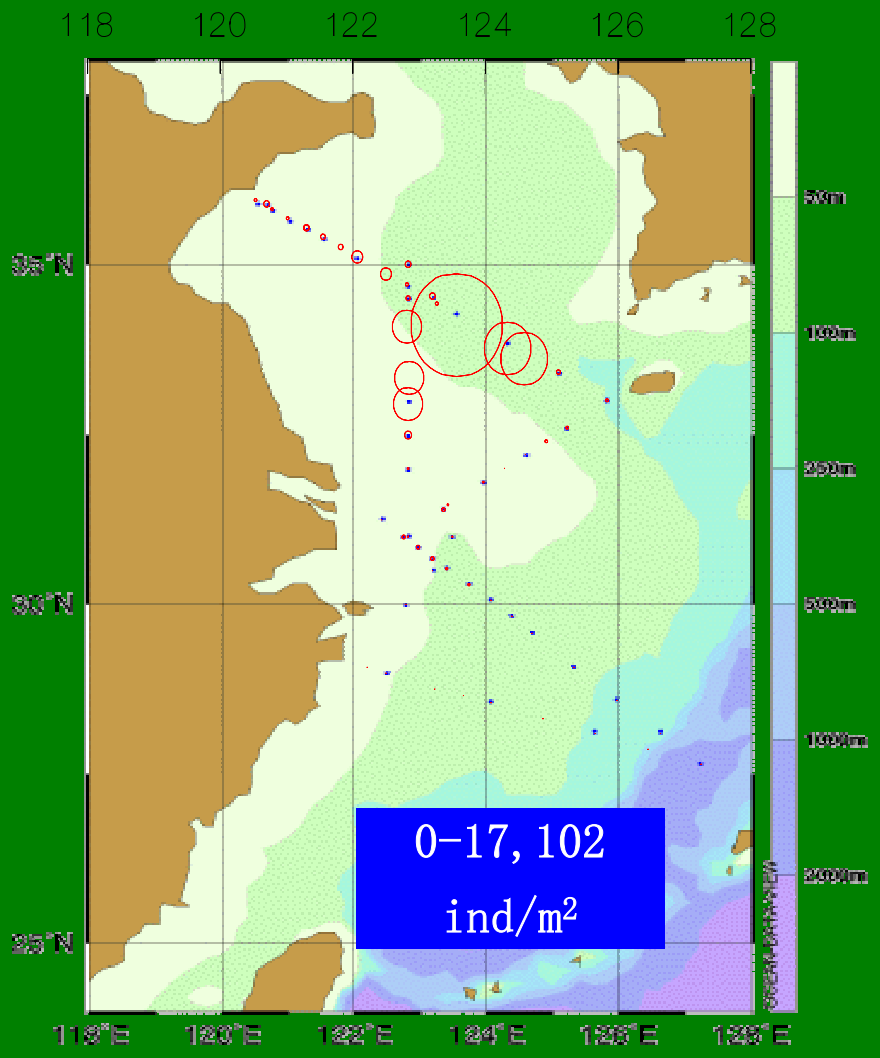


Vertical distrib. of anchovy larvae & temp.

2.1

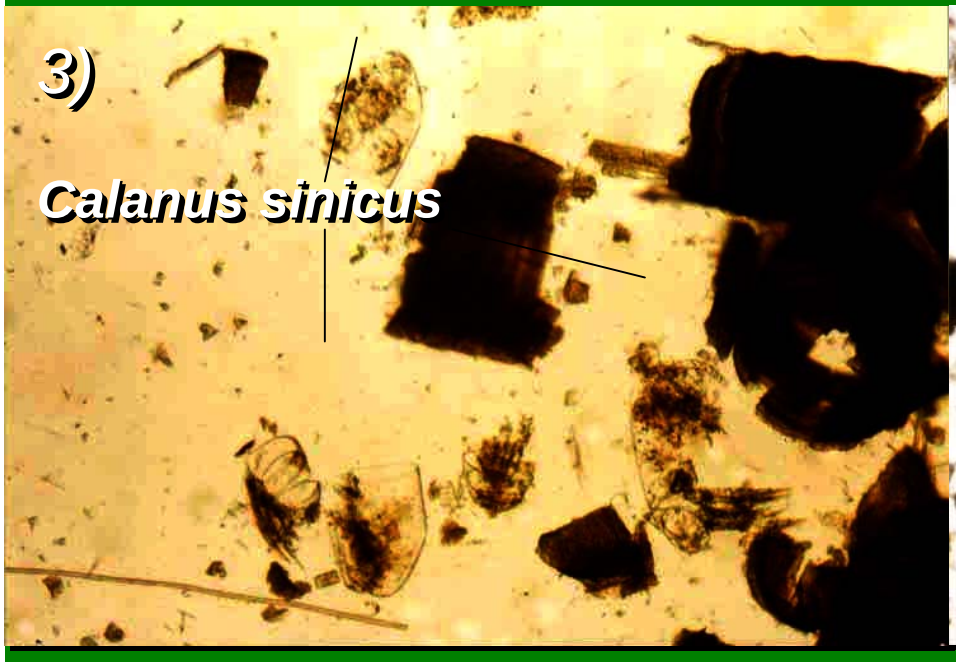


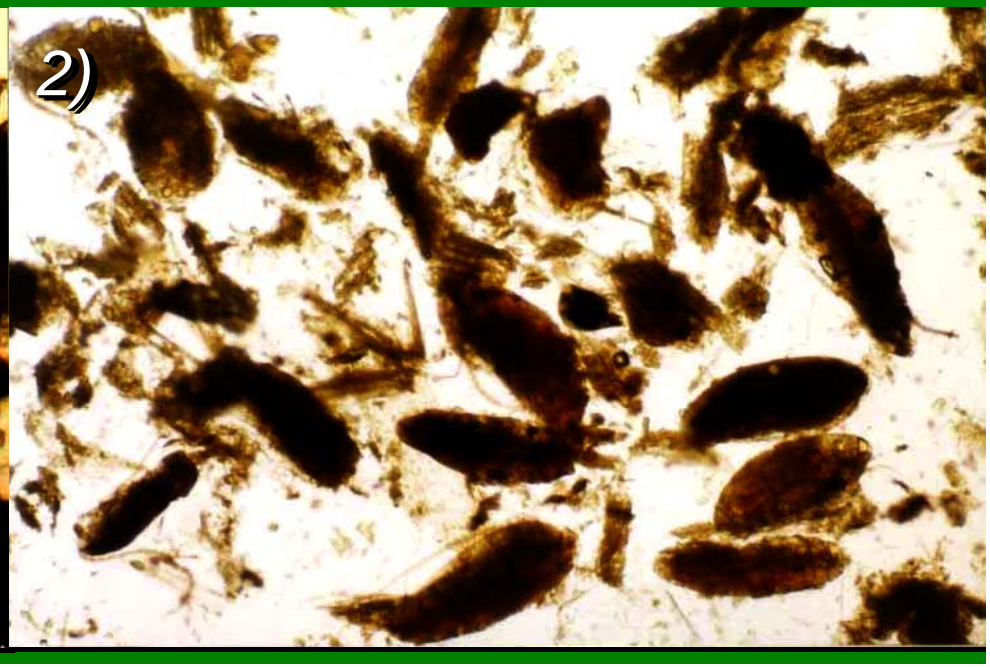
Distribution of the Anchovy in the summer (echo sounder)



Distribution of the *Calanus sinicus* in the summer

1) *Sagitta crasa* prey on anchovy larva
2) *Calanus sinicus* in the stomach of adult anchovy
3) *Calanus sinicus* in the gut of anchovy larva

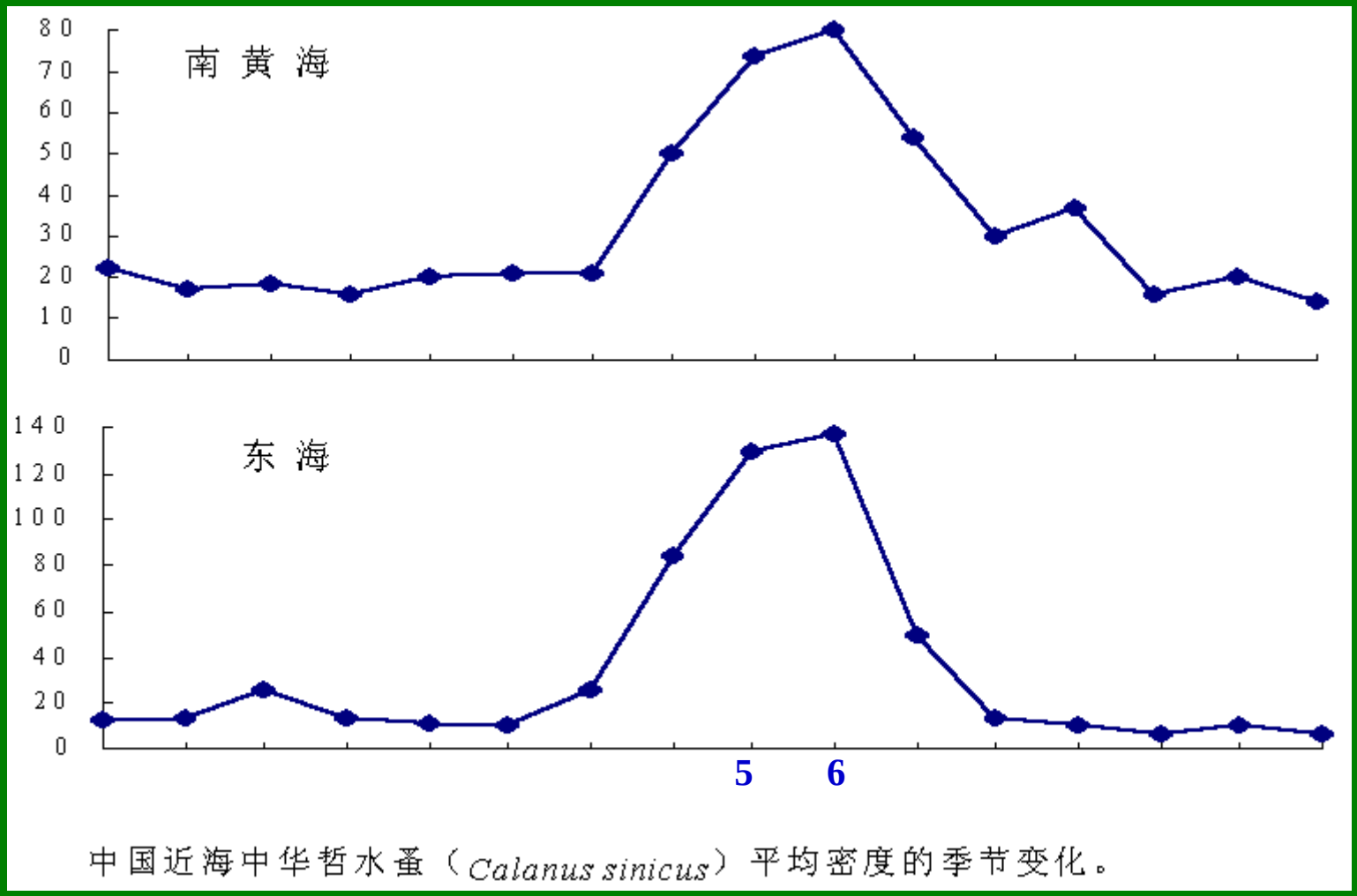




Major progress and result – 2.
Oversummering strategy of *Calanus sinicus*

- *C. sinicus* spawn in whole year, mainly in spring & summer.
- *C. sinicus* has marked spawning rhythm; its fecundity & hatch rate was not significantly affected by temperature, but hatching duration was affected.
- Field collected adults can spawn and hatch in lab.
- Feeding activity with high digestive enzyme and metabolism activity at low T.
- Activity of digestive enzyme decrease 3-4 times & respiration rate halved at high T.

- **Major progress and result – 2.**

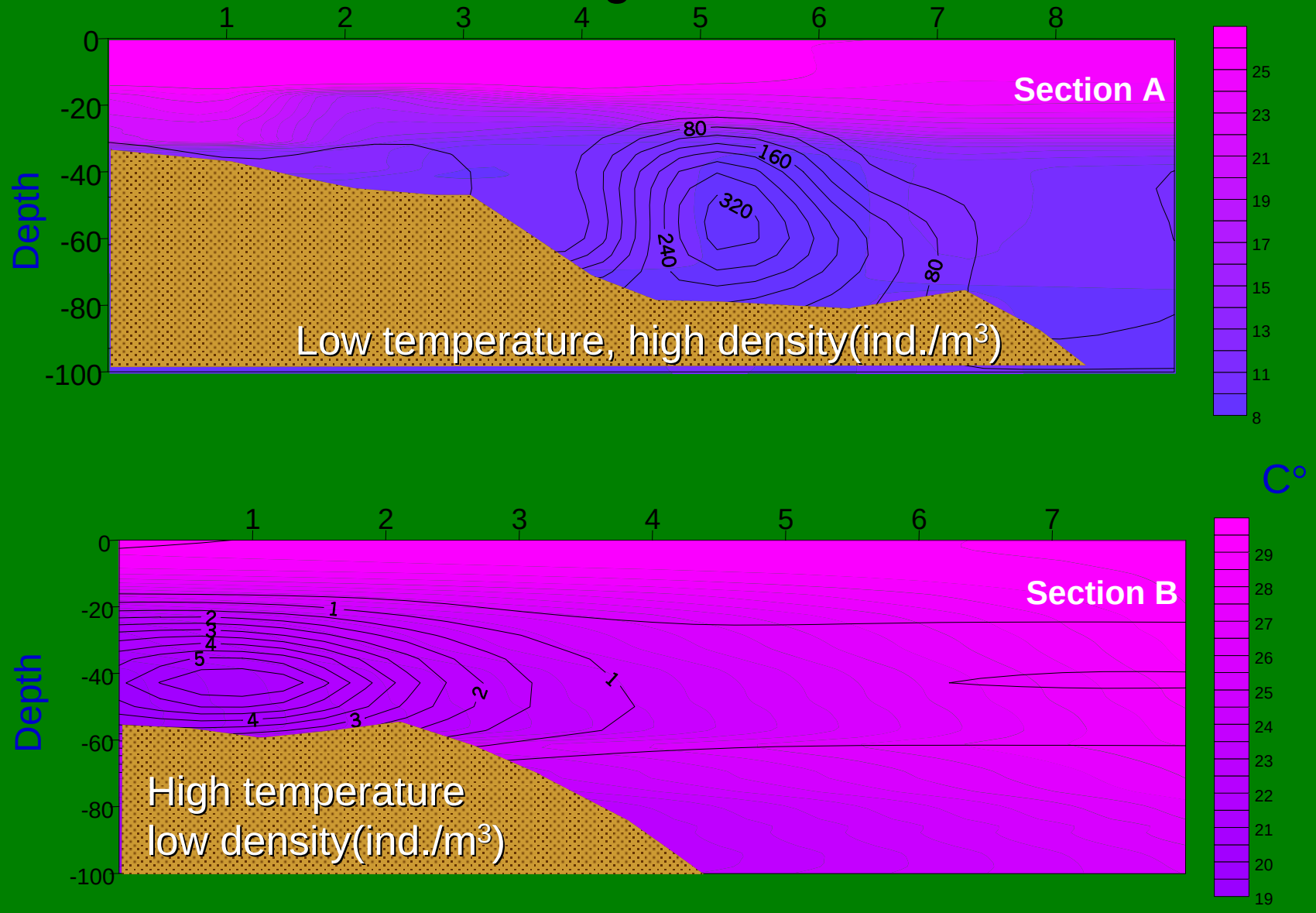


中国近海中华哲水蚤（*Calanus sinicus*）平均密度的季节变化。

Monthly mean density of *Calanus sinicus*

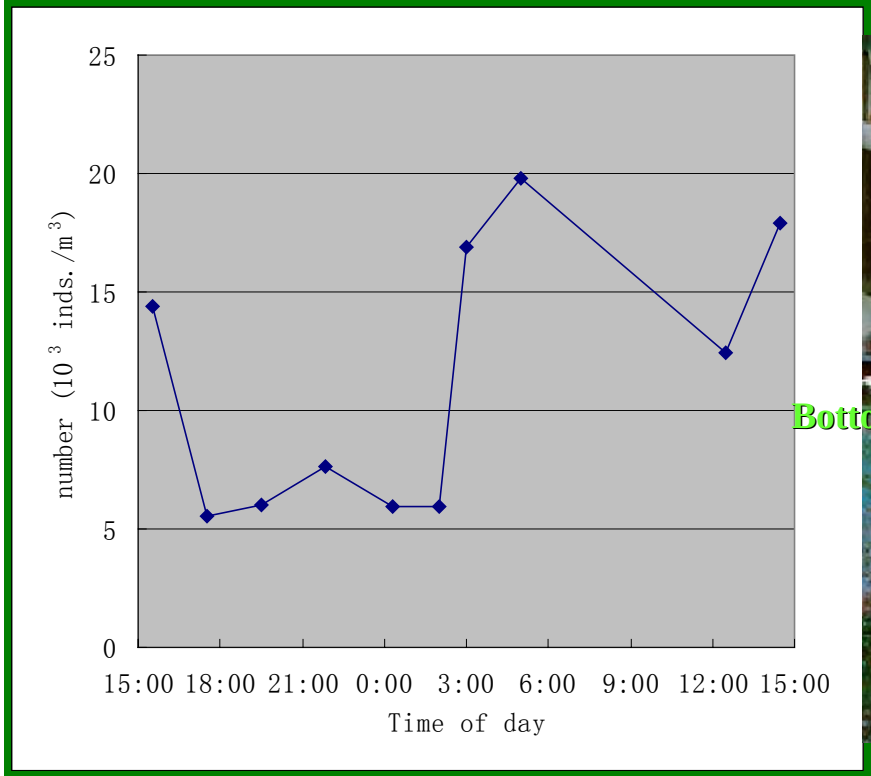
▪ Major progress and result – 2.

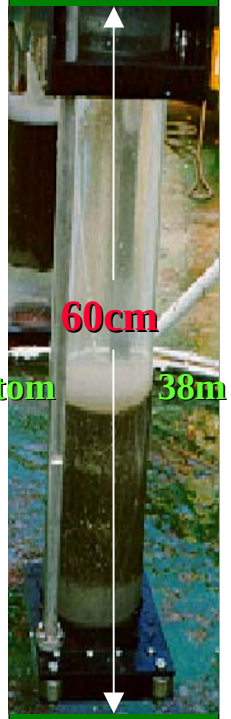
Vertical distribution of *C. sinicus* in Yellow Sea in August 1999.

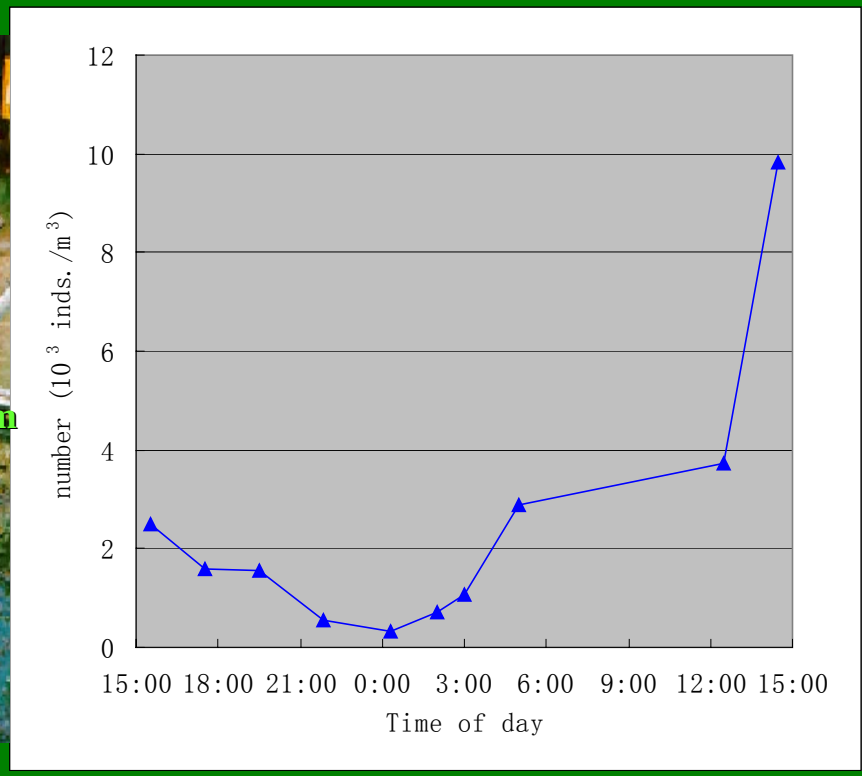


▪ **Major progress and result – 2.**

Zooplankton in overlaying bottom water
(Anchovy spawning ground, July, 2001)



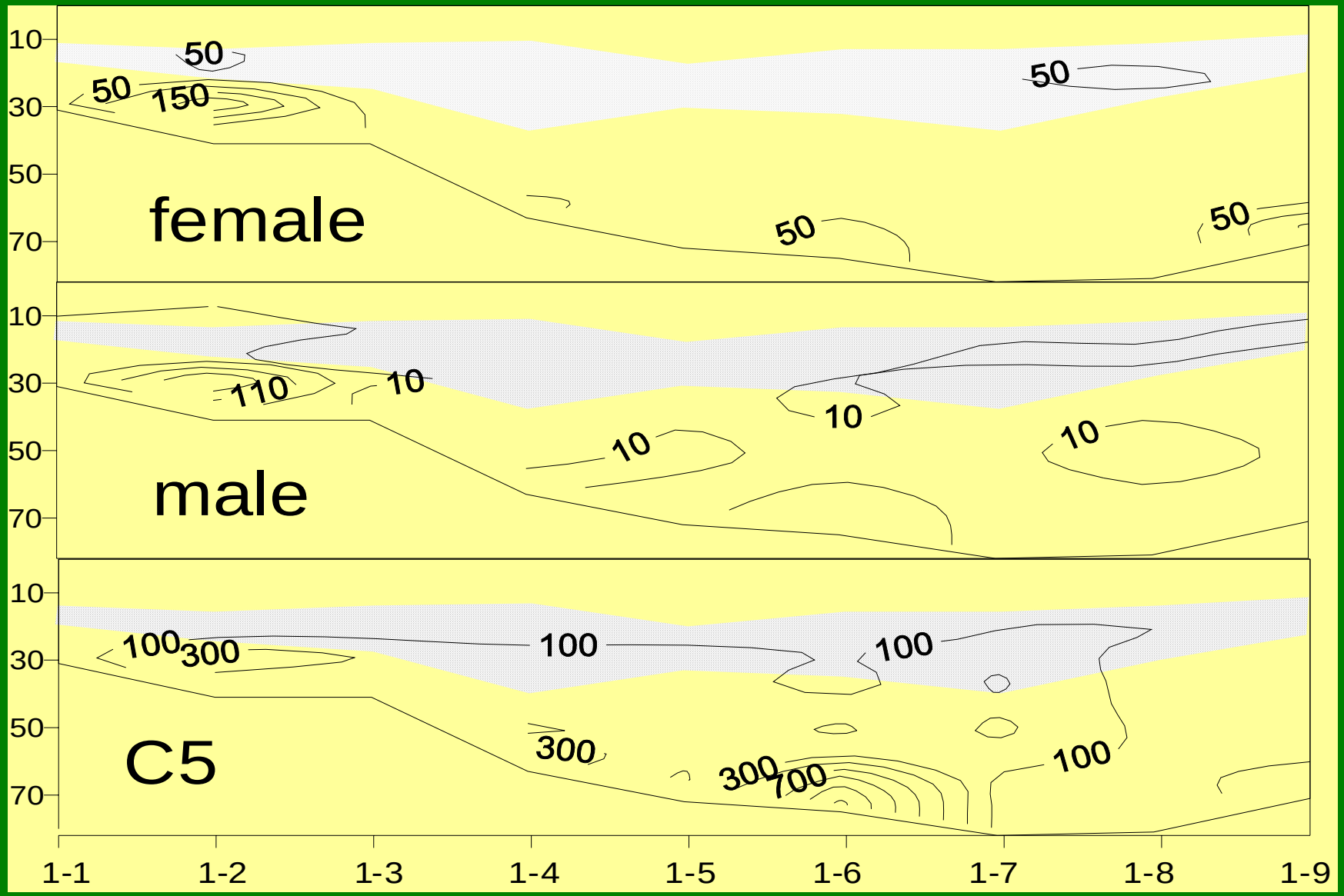




Total zooplankton

Calanus sinicus

Vertical distribution (ind/m^3) of adult and C5 of *C. sinicus* and its relation with the thermocline on a transaction investigated in 2001



Major progress and result – 3. Ecological efficiency at high trophic level

- Basic framework of simplified food web model for the spawning ground off Qingdao was developed
- Experimental setup for Bioenergetics studies on pelagic species (Spanish mackerel, chub mackerel, rednose anchovy, dotted gizzard shad, sand lance) was devised.
- Data on daily consumption, feeding periodicity, ecological conversion efficiency of some key species were obtained.
- About 20 fish & invertebrate species were studied, which showed that the bioenergetics parameters were dynamic & different with different species.

group fish experiments

individual fish experiments

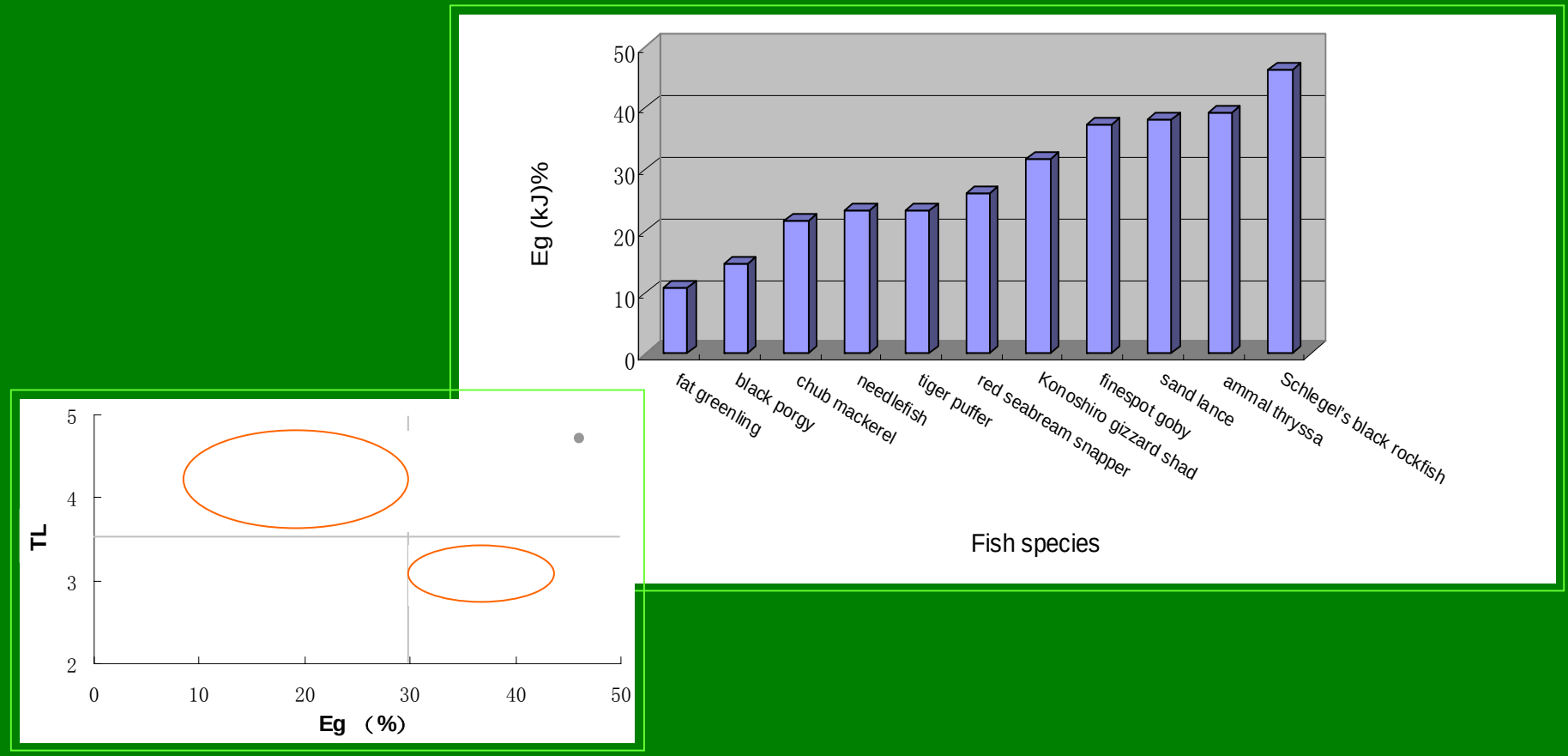
Ecological conversion efficiency at high trophic level

- **Bioenergetics parameters of about 20 fish & invertebrate species were studied.**

Mesocosm studies on Spanish mackerel

Evacuation rate measurements of chub mackerel

The ecological conversion efficiencies in marine fish present species-specific significantly.



High: 0.37-0.46; medium: 0.22-0.32; low: 0.11-0.15
(high TL with lower ECC; low TL with higher ECC)

Bioenergetics models of 7 fish

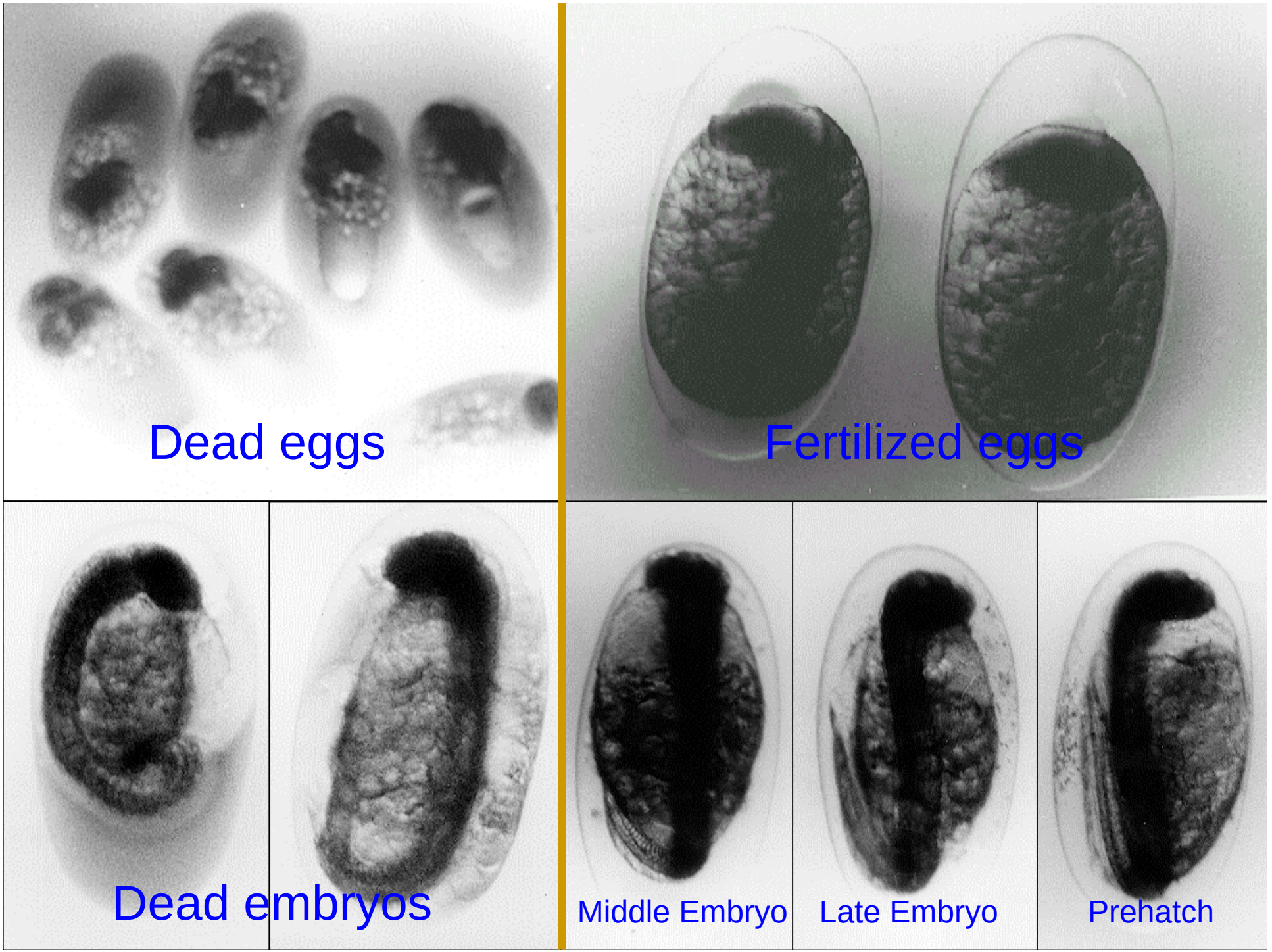
Species	Energy budget
Scomber japonicus	100C=0.8F+9.2U+68.4R+21.6G
Pagrus major	100C=2.7F+8.0U+63.2R+26.0G
Acanthopagrus schlegeli	100C=2.8F+8.9U+73.5R+14.8G
Sebastes schlegeli	100C=3.7F+5.9U+44.3R+46.1G
Chaeturichthys stigmatias	100C=9.7F+6.8U+60.4R+23.2G
Takifugu rubripes	100C=4.8F+6.8U+54.0R+34.5G
Hexagrammos otakii	100C=1.0F+8.9U+79.4R+10.7G

Where C=consumption, F=faeces, U=excretion, R=respiration, G=growth

5. Open problems

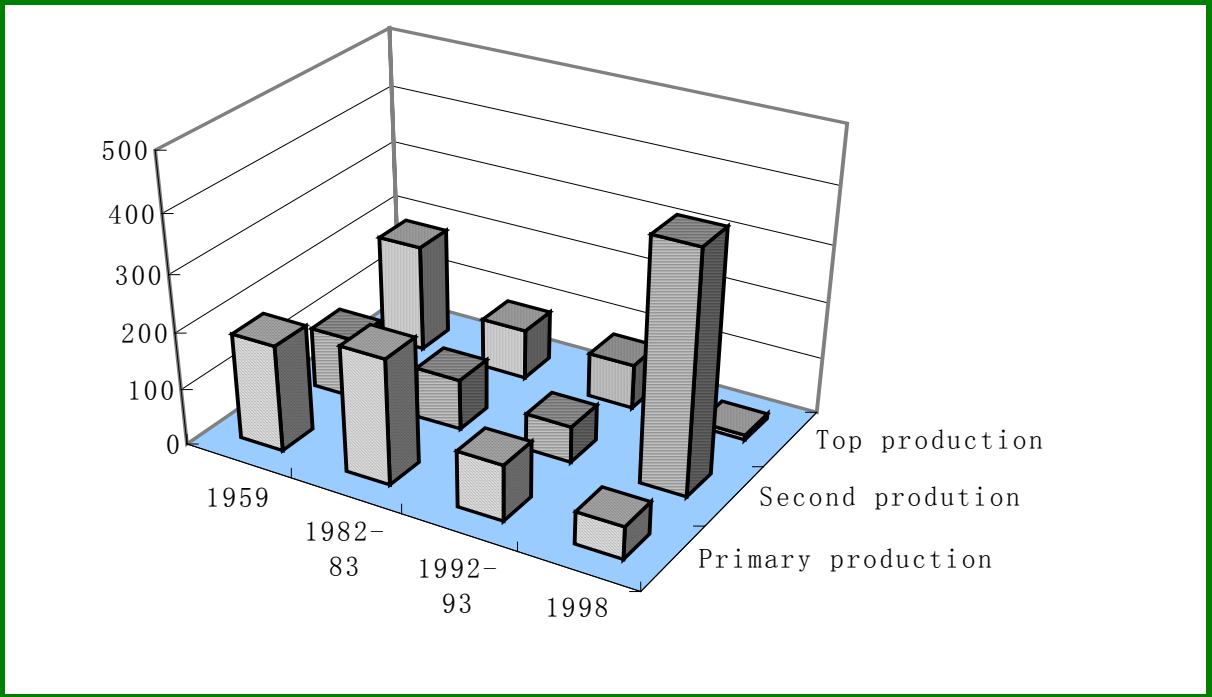
1. **Did Anchovy eggs die away prior or posterior to fertilization?**

- According to the plankton sampling, a great percentage of the dead eggs of anchovy in the spawning grounds of the Yellow Sea were found, a mean of 83% and up to 97%. Why ?
- Normally, mature fish eggs can conduct parthenogenetic cleavage to the multi-cell stages partially due to catalyzing via seawater. Morphologically, it is very difficult for us to tell the difference between the fertilized eggs conducting cleavage and the unfertilized eggs conducting parthenogenetic cleavage. Besides the morphological methods, any other ways to distinguish the above-mentioned differences?


Dead eggs
Fertilized eggs
Dead embryos
Middle Embryo
Late Embryo
Prehatch

2. May there exist a multi-control mechanism in the coastal ecosystem? How to demonstrate it !

• It is difficult to use any one traditional theory (bottom-up control or top-down control or wasp-waist control) to directly or clearly explain the long-tern variations of various level productions in the Bohai Sea.



Inter-decadal variations of the ecosystem production in the Bohai Sea


Thank you !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