Approaching Coastal Aquaculture from an Ecosystem Perspective

M. Rawson[1], Chen[2] C., Ji R.[1], Zhu[3] M., Wang[4] D., C. Yarish[5], J. Sullivan[1]

[1] Georgia Sea Grant College Program, School of Marine Program, The University of Georgia,
Athens, GA 30602-3636 U.S.A.
[2] University of Massachusetts, Dartmouth, MA 02744-1221
[3] First Institute of Oceanography, State Oceanic Administration, Qingdao 266003, P.R. China
[4] Hainan Marine Development, Planning, & Design Research Institute, Haikou, P.R. China
[5] University of Connecticut, Stamford, CT 06901-2315

OBJECTIVES

- To encourage integrated aquaculture approaches in coastal management
- To illustrate the use of ecosystem modeling to aid coastal management of aquaculture

AQUACULTURE LOCATIONS

- Closed systems – no effluents
- Ponds - effluents
- Semi-enclosed water – Bays (Our focus)
- Offshore systems – 30-50 m

EUTROPHICATION

- Adding nutrients and organic matter
- Eutrophication negative and positive
- Sources –
  - Natural, i.e. Upwelling, Rainfall
  - Human, i.e. Sewage, Stormwater & Agricultural runoff, Fed aquaculture

Aquaculture Types

- Fed aquaculture - fish pens, shrimp ponds
- Extractive aquaculture - scallops and seaweeds

- Adds organic matter, increases bacteria and plankton, uses oxygen
- Decrease plankton numbers & nutrients, respire oxygen/carbon dioxide

Integrating Aquaculture Systems

- Integrating types of aquaculture - POLYCULTURE
- Bay-wide planning through ICM
- Using Ecosystem Models to SIMULATE effects of management decisions

Fed Aquaculture

- Shrimp Ponds

- Fate of Feed
- Nutrients- P, N
- Blooms/Oxygen
- Effluent

- Holowitz & Holowitz, 2000
- Boyd & Weddig, 1997

Fed Aquaculture

- Fish Pens
- Fate of feed
- Sedimentation
- Oxygen

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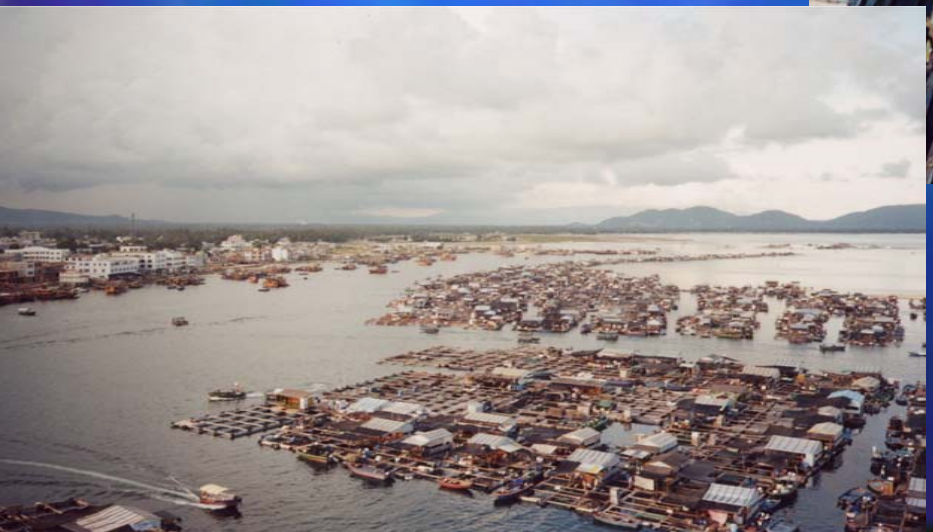


Extractive Aquaculture

- Seaweeds

- Nutrients
- Clear water
- Respire

Extractive Aquaculture

- Cleaning Fishes

- Plankton feeders -
- i e. Paddlefish

- Bottom feeders -
- i e. Mullet, Tilapia

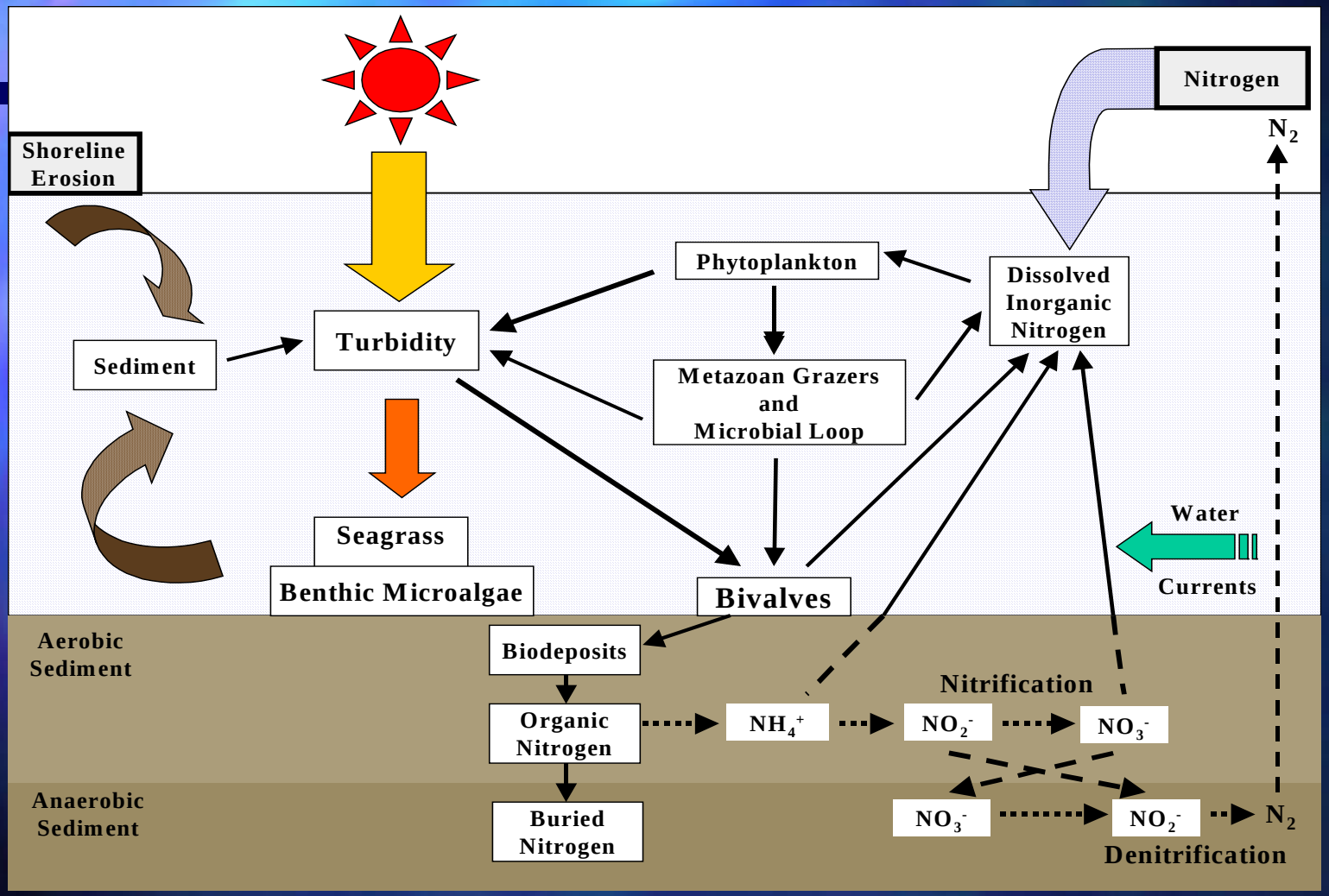
- Advantage - Extract plankton & nutrients
- Disadvantage - waste & respire

Extractive Aquaculture

- Bivalve Mollusca

- Plankton
- Nutrients
- Pollutants
- Respire

Extractive Process



R. Newell
R. Newell

Hainan Island, P.R.C.

Location of Xincun Lagoon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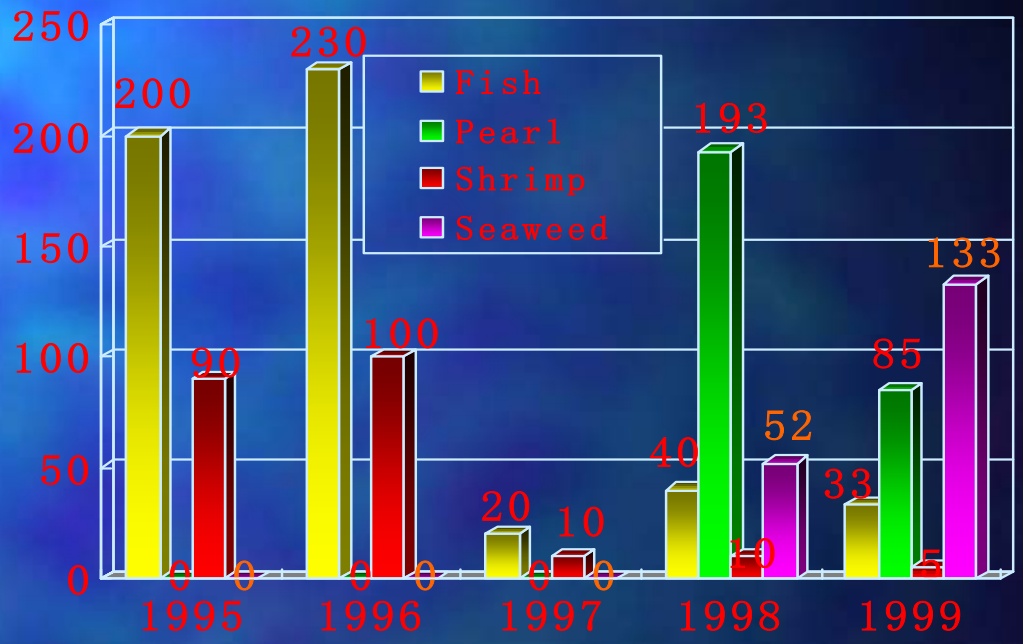
4129
73100
Rawson


8 5'00
Rawson

Xincun *Kappaphycus sp*. Culture Areas

Aquaculture industry in Xincun

- Culture species
  养殖种类
- *Fish Cages* 网箱养鱼
- *Pearl* 珍珠
- *Shrimp* 虾
- *Seaweed* 海藻



Culture Area in Xincun Lagoon

Unit: Hectare

Fish cage culture area declined because of severely eutrophication of water quality in 1997.

Existing Sources of Pollution
现有污染源

- *Fish cage culture* 网箱养鱼

  nearly 5000 tons of organic pollutant annually

  每年近5000吨有机污染物

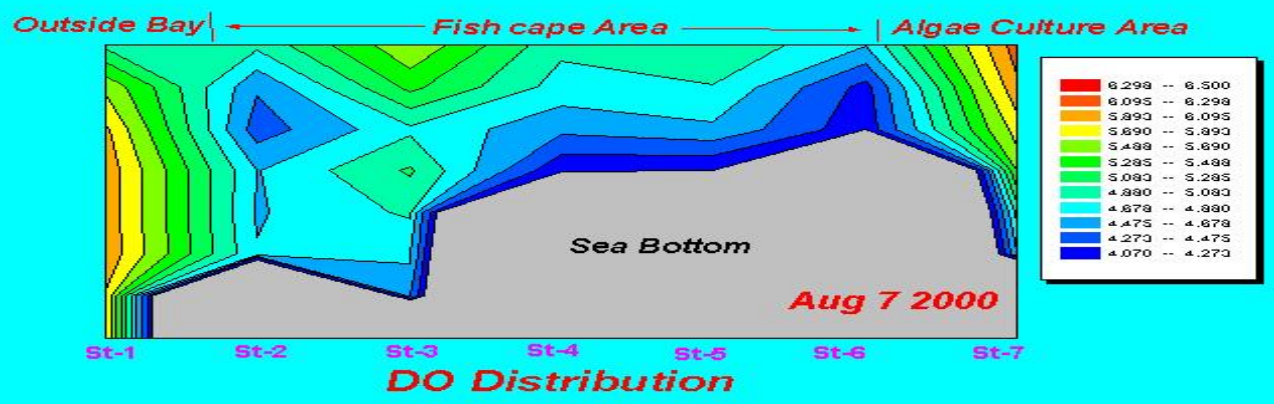
- *Sewage discharging* 污水排放

  nearly 400 tons of COD annually

  每年近400吨COD

- *River* 河流

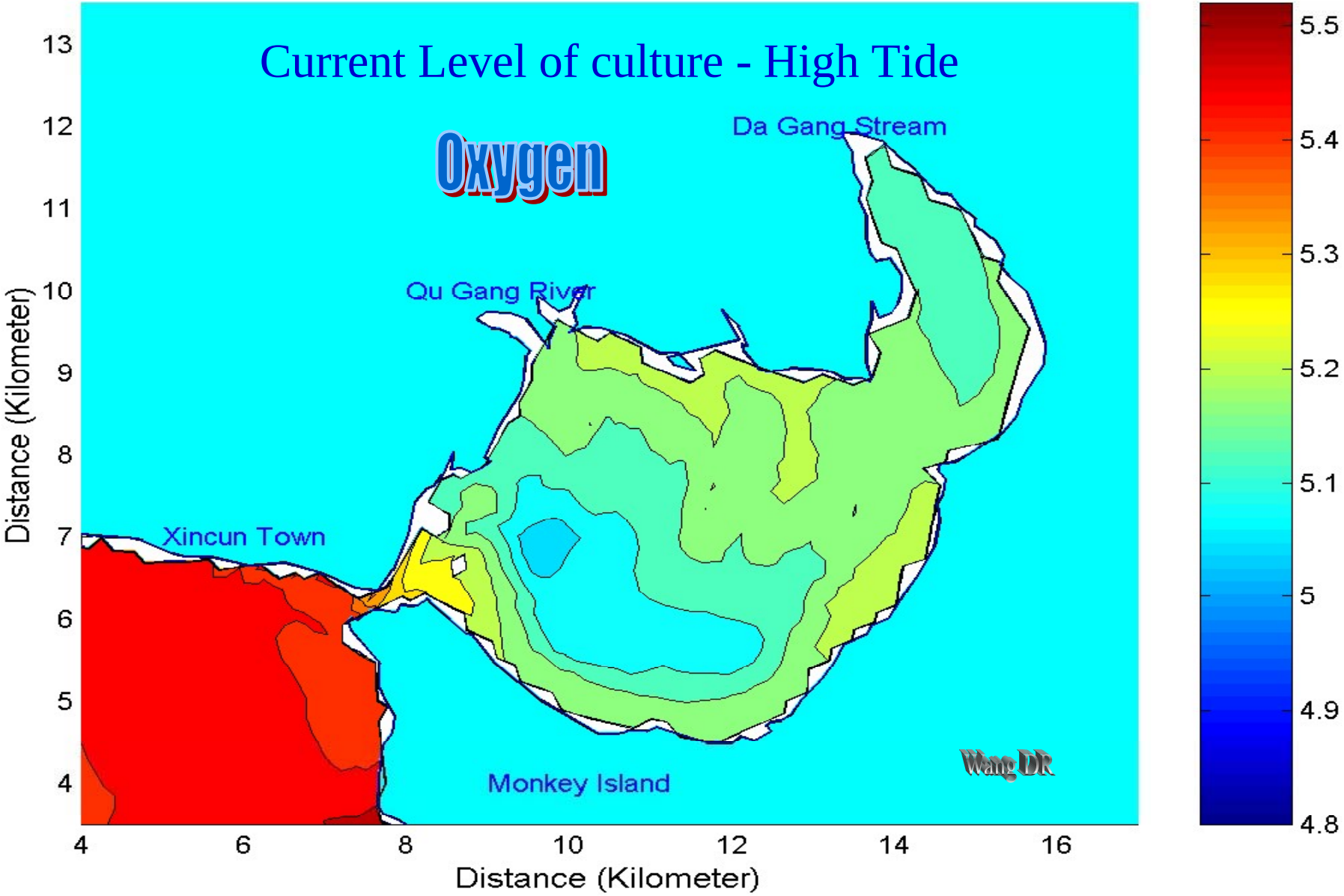
Distribution of DO and Its Influencing factors



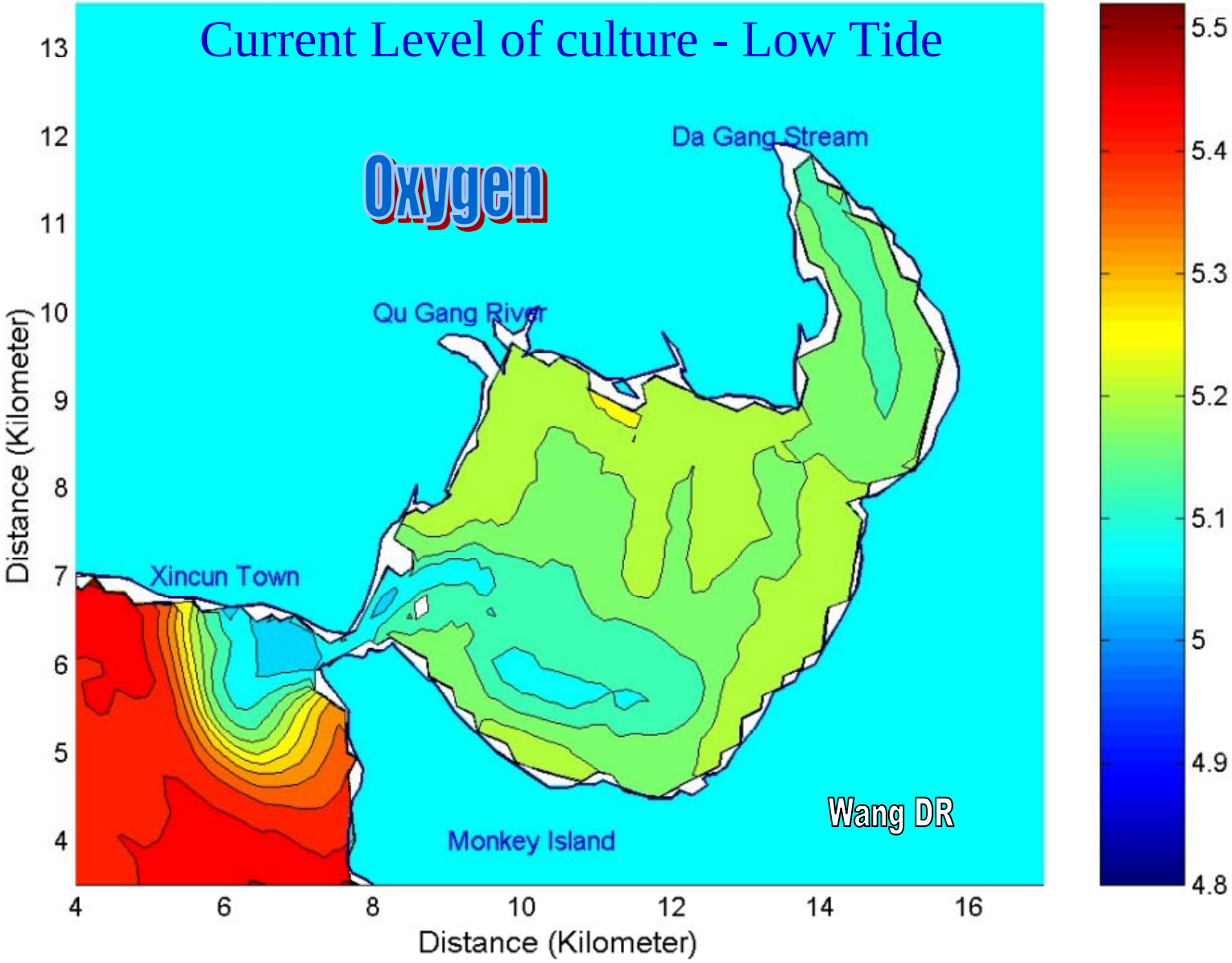
The Profile of Dissolved Oxygen

- DO is low in fish cage culture area
- Low DO is the main Eutrophication problem in Xincun Lagoon

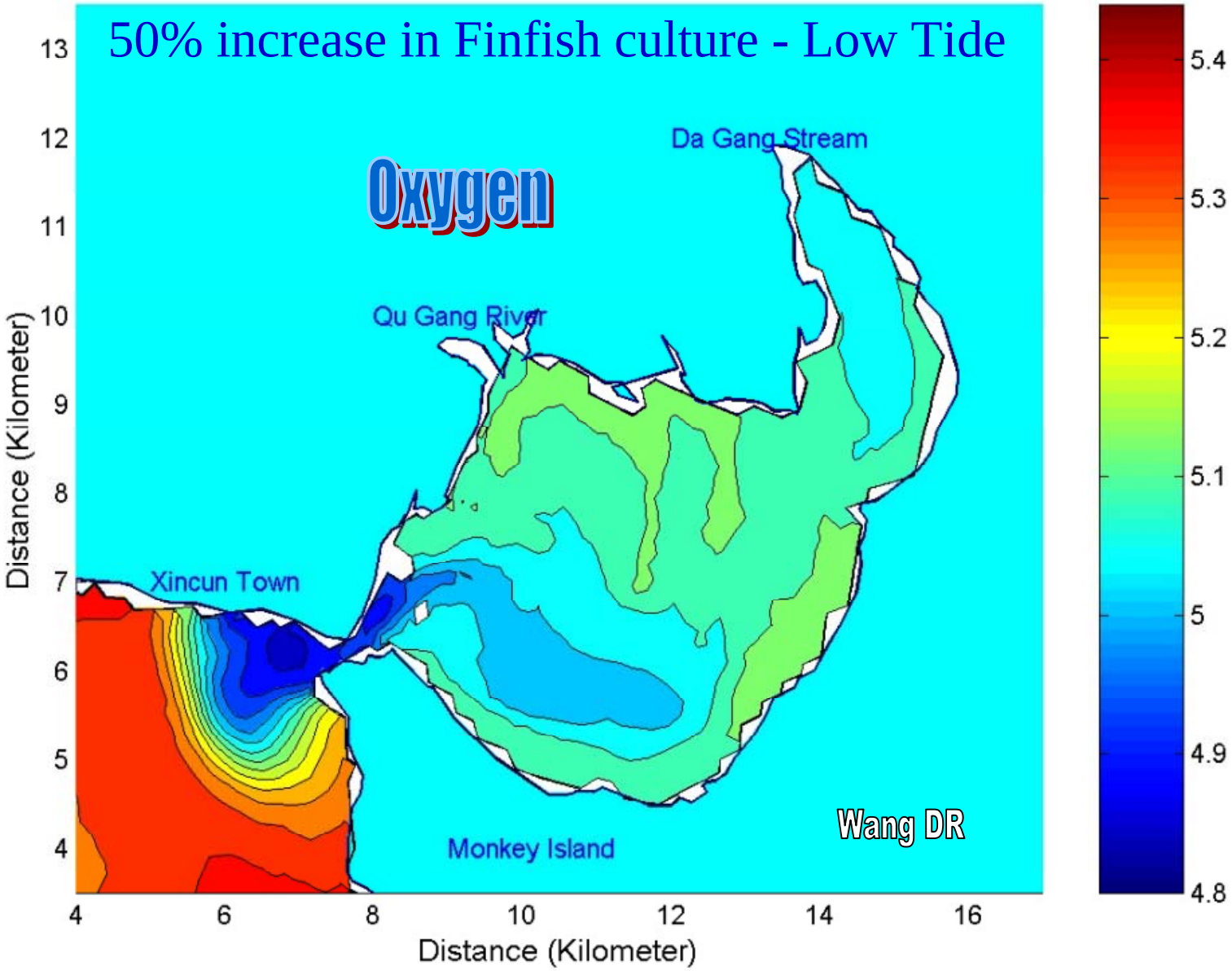
Current Level of culture - High Tide



Current Level of culture - Low Tide



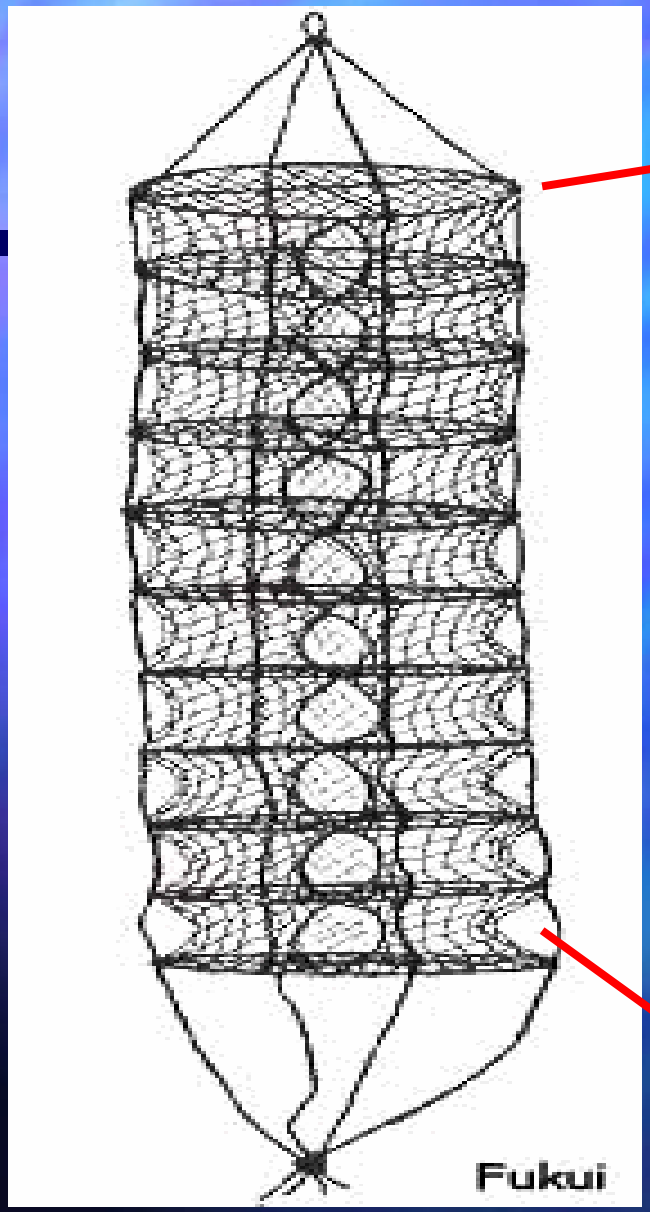
50% increase in Finfish culture - Low Tide



Jiaozhou Bay

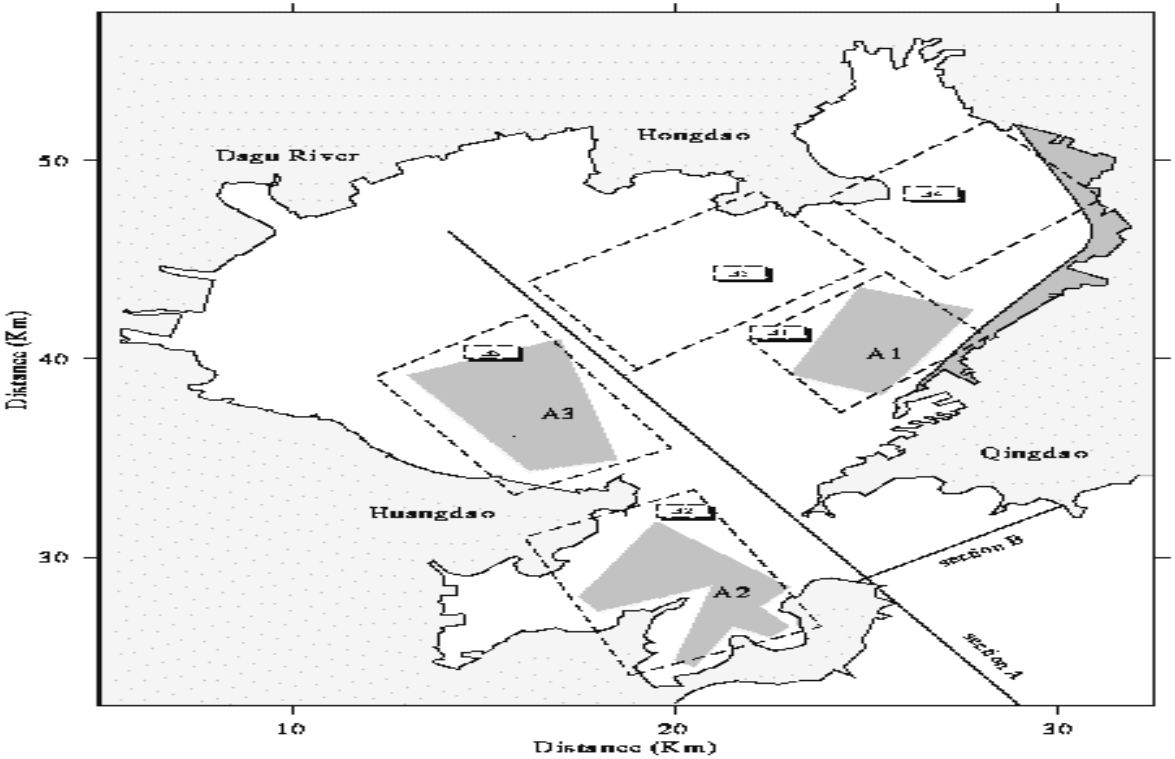
The SPOT Satellite Image

The Local scallop species (*Chlamys farreri*)

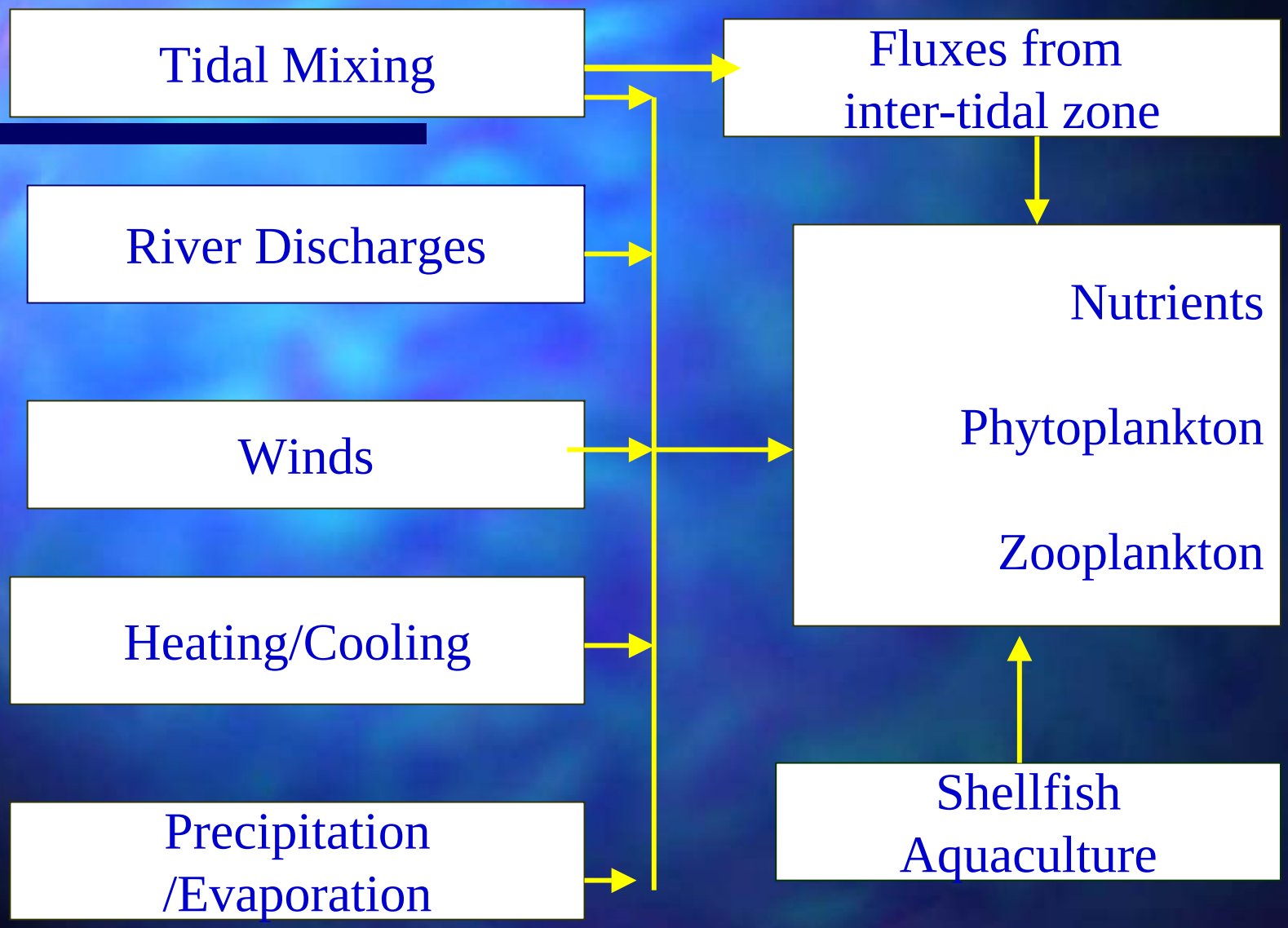

Fukui


W. Pennell

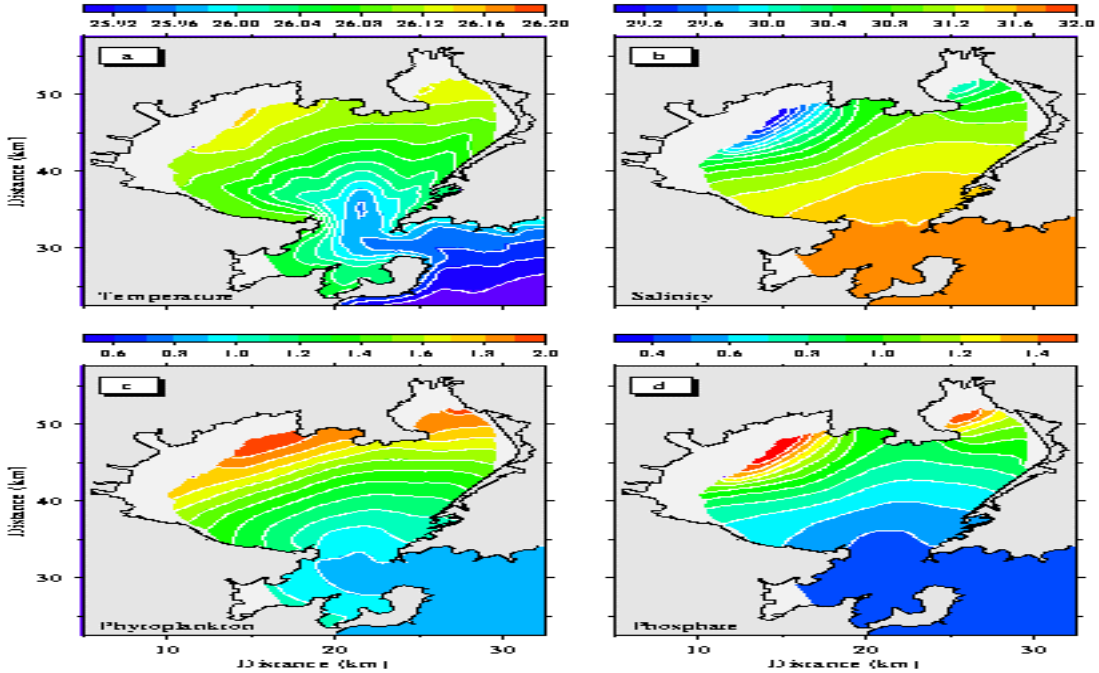
- Shellfish aquaculture areas (gray-filled);
- Selected flux estimation regions (dashed boxes);
- Sections for the model-data comparison (solid lines)



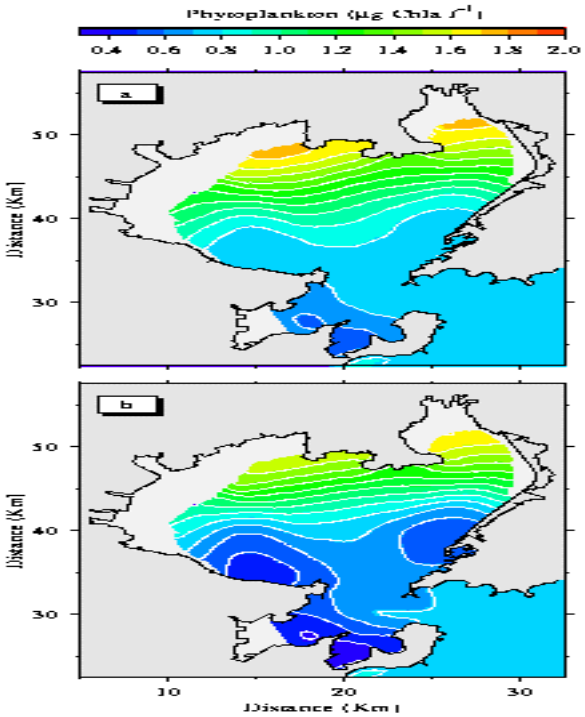
Conceptual Model



Tidal-cycle averaged surface distributions of temperature, salinity, phytoplankton, and phosphate. (Tide, River Discharge, and A Southeasterly Wind)



Tidal-cycle averaged surface distributions of phytoplankton with the shellfish culture

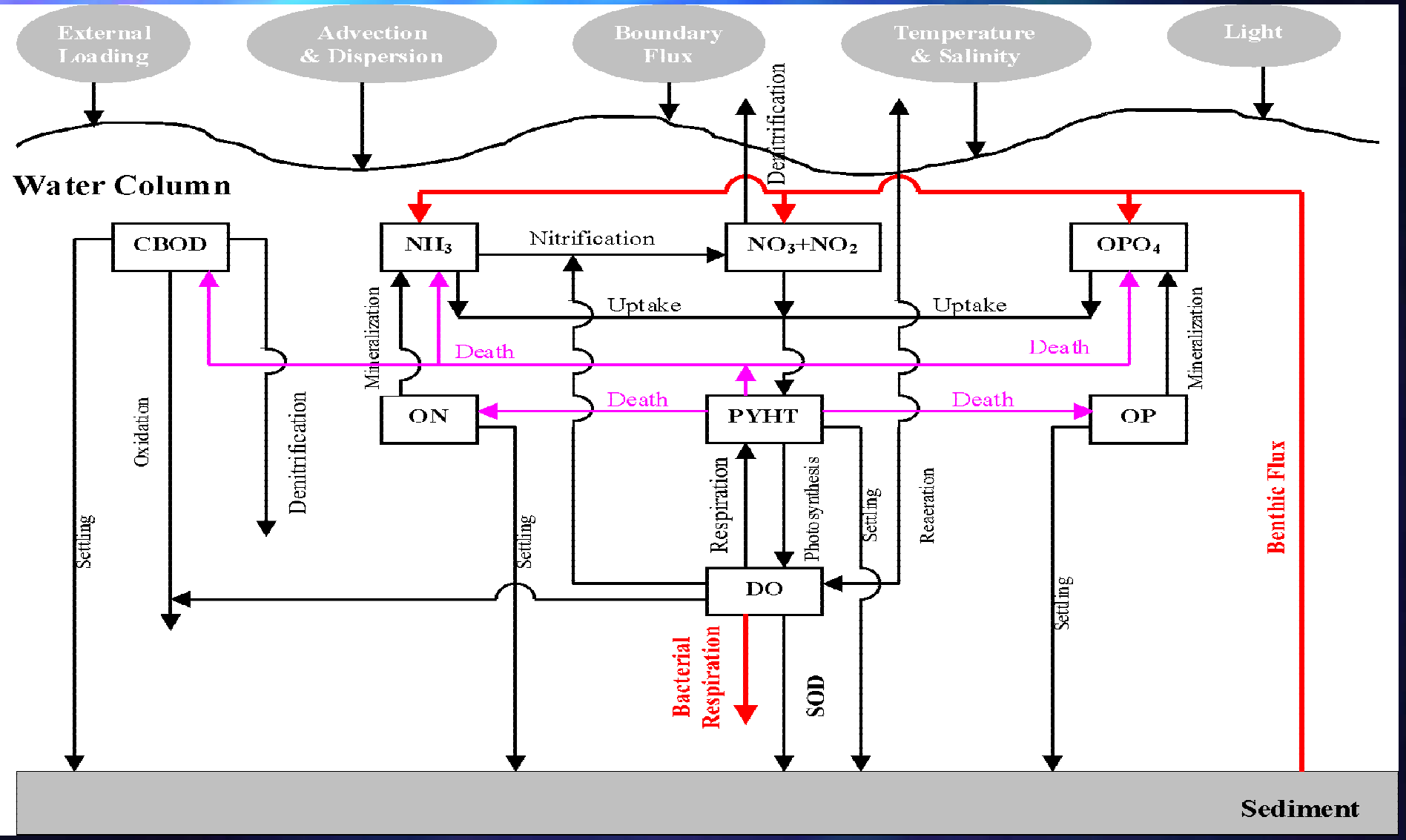


Shellfish culture density:

12 inds./m^3

24 inds./m^3

The Water Quality Model



Benthic Processes