

About the Basic Study Project: “Mechanism of Lakes Eutrophication in China”

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Foreword

In the recent decades, with economic development and intensifying of human activities, many lakes in China has been damaged, most of lakes are facing the problem of eutrophication. This article firstly gives an analysis of eutrophication status of Lakes in China, and then introduce the case study of Lake Taihu.

湖泊富营养化机理

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OUTLINE OF CHINA' LAKES

1、 Outline of China' Lakes

China is a country boasting of many lakes, with over 24,880 lakes. The most of lakes distributes in the East Plain region, Qingzang Altiplano region, Mengxin Altiplano region, Yungui Altiplano region, and Northeast Plain-hills region. All lakes are with a total storage capacity of 707.7 billion m³, of which freshwater storage capacity amounts to 225 billion m³. Besides, there are 86,825 reservoirs in China, with a total storage capacity of 413 billion m³. The two add to a total freshwater capacity of 638 billion m³, playing a major role in supplying drinking water for the people as well as water for industrial and agricultural production, and aquaculture, travel industry, improving climate, generating electricity etc..

GENERAL SITUATION OF LAKES

Lakes: over 24,880

Reservoirs: 86,825

Total Area: 70,988km²

Freshwater Storage capacity : 638 billion m³

Distribution:

- (1) The East Plain,**
- (2) Qingzang Altiplano,**
- (3) Mengxin Altiplano,**
- (4) Yungui Altiplano,**
- (5) Northeast Plain-hills**

2

EUTROPHICATION OF LAKES IN CHINA

In fact, eutrophication of lakes is often appeared over all the country, in China from 80's. It is calculated that economic loss of water pollution account for 1.5—3% of GDP, and more than hundred billion ¥. It has become the most important issues of water environment.

Main Envir. problems

Eco-destruction

Organic pollution

Shrinking of area

Eutrophication

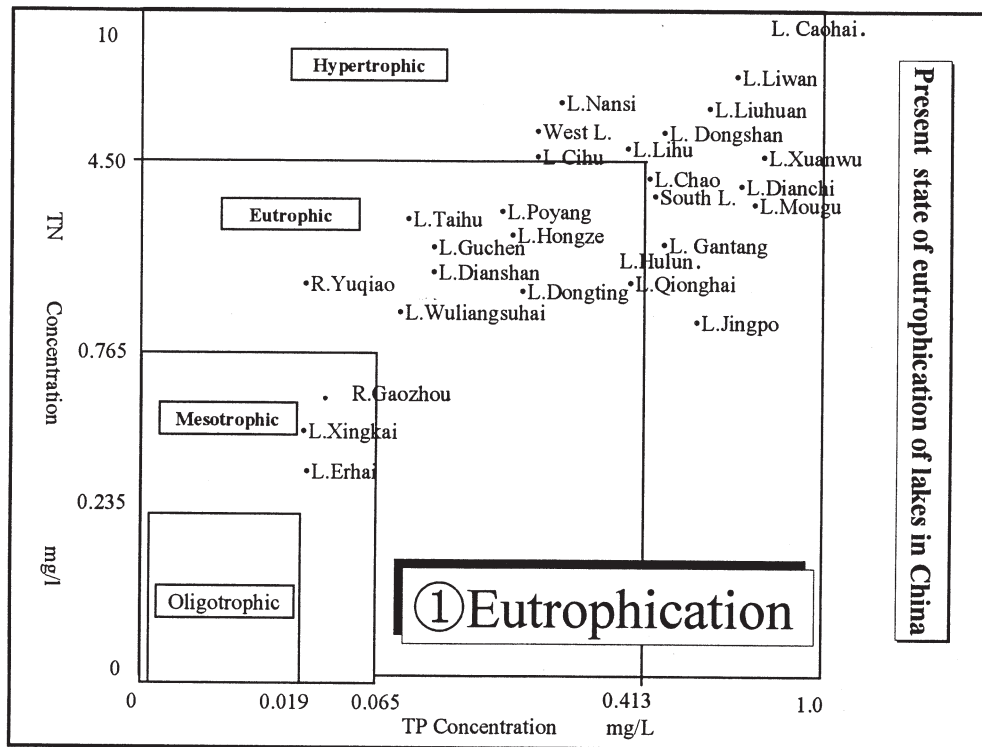
Salting of lakes
in the west

Owing to various natural geography and climate condition of lakes in China, in the recent several decades discharge of large quantities of pollutants and human activities of irrational exploitation, environmental problems of lakes in China shows complexity and diversity. There are five main environmental problems: eutrophication, pollution of organic pollutants, salting of lakes in the west of China, shrinking of area and reduction of water quantity of lakes and destruction of ecosystem. But at present eutrophication is the most important environmental problems in many lakes and thus brings a tremendous influence on sustainable development of society and economy in lake regions.



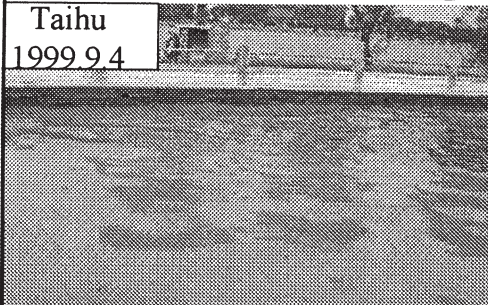
2.2. Region of Occured Eutrophication Heavily

Investigation of 1980s and 1990s shows eutrophic lakes was mainly located in the middle and lower stream of Changjiang River, Yungui Altiplano, part of Northeast Plain-hills and Mengxin Altiplano. But all the urban lakes almost have been in the eutrophic in China because the urban lakes are small and seriously destroyed by the urban wastewater.




② Water Bloom

Taihu
1999.9.4



Dianchi
In 2000 海埂



Water bloom of large area of water bodies in many lakes often is appeared, causing great environmental disaster. As a result, the cycling of the ecosystem of many lakes is damaged, causing great losses to production and people's life in lake regions.

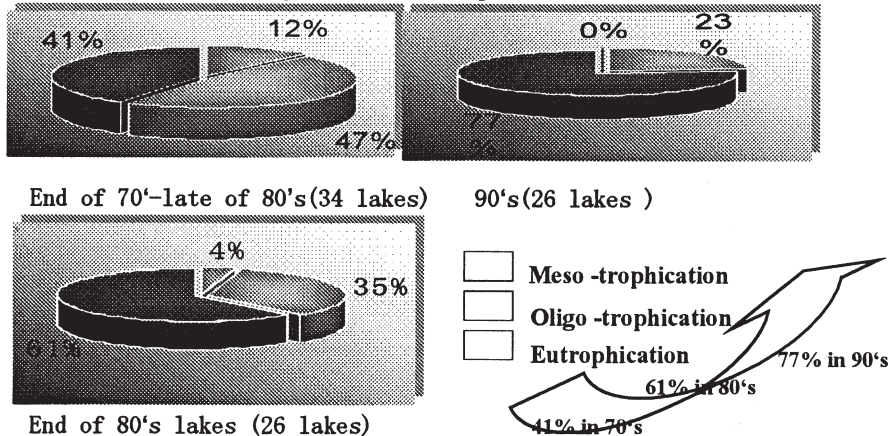
③ Eutrophic Area become larger and larger

It is calculated that lake area being in state of eutrophication have reached more 5000 km² of water body in Chinese lakes , area being in eutrophic level of P and N concentration have reached more 14,000 km² of water body in Chinese lakes.

State	2003	2010
Area being in state of eutrophication (km ²)	5000	6700
Area being in eutrophic level of P and N (km ²)	14000	

④ Develop rapidly

Eutrophication Development Trend



The data of investigation have shown that trend of eutrophication development in Chinese lakes is very rapid from End of 70'-late of 80's to 90's. Number of eutrophic lakes has increased by 77%.

2.2.4. Destruction of Eco-system

As a result of irrational development and predatory exploitation to lake resources, a lot of wetlands and beaches around the lake were disappeared, thus the integrality of the ecological structure along the lakeshore was damaged and its functions lost. At the same time, over harvesting of aquatic plant led to decrease biomass and distribution area of aquatic plant: its dominant species changed, community structure simplified, and aquatic plant resources degraded in some waters. Furthermore, water level decreases apparently due to excessive outflow, which give a serious threat to the ecological environment of many lakes in China.

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3

Mechanism of Lakes Eutrophication in China

Project 1:

Mechanism on process of lake eutrophication and formation of blue alga bloom in shallow lakes

Key study Area:

Shallow lake region in middle and down reaches of the Yangtze River.

Lakes

Map of the five lake region in China

2. Targets

- **In the aspect of theory: Open out the mechanism on formation of eutrophication and of water bloom in shallow lakes a, the Yangtze River.**
- **In the aspect of method: Build up academic basis of lake ecosystem restoration; point out the management rudder, evaluation means and guideline system of our lake ecosystem.**
- **In the aspect of technology: Point out the new ways, technologies, and model cases for the prevention and control lake eutrophication.**

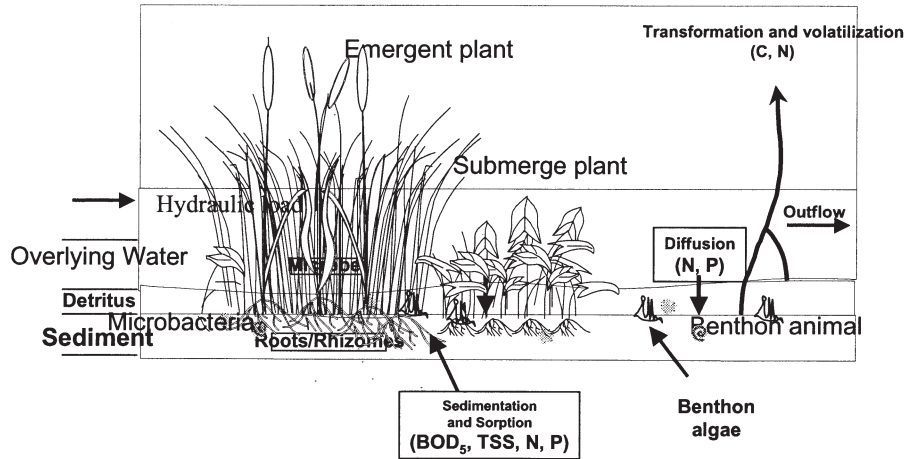
4. Primary Study Contents

- 1) Geo-chemical behavior of nutrient elements and its dynamics in eutrophic lakes.**
- 2) Sedimentary dynamics of nutrient elements in middle and down reaches of the Yangtze River and simulation of eutrophic processes in lab. and in sites.**
- 3) Study on relationship between lake eutrophication and characteristics of its drainage ecosystem**
- 4) Study on effects of human activity on the lake eutrophication**
- 5) Intimate responding mechanism of macrophytes, ecosystem function and mechanism of stable transformation of lake**
- 6) Mechanism of formation of blue algae bloom and its dynamics**
- 7) The producing mechanism, control and damage study on the major Cyanobacteria toxin and Disgustful smell**
- 8) The scientific basis of lake eutrophication control and ecosystem management**

Project 2:

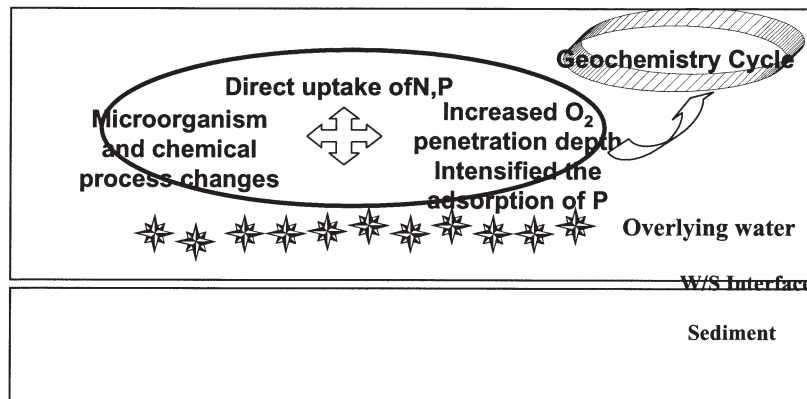
Ecosystem and its affects of the interface between S &W in shallow lakes

(4) Ecosystem on the interface between S & W



A lot of study results showed, there are organism phase at the water-sediment interface, it includes benthon animal, benthon alga, microorganism, detritus and emergent plant and its roots. Nutrient flux and its exchange are altered by the presence of these organism, at same time micro-environment at the interface of water-sediment are also altered with organism.

Effects of benthic diatom on the nutrient cycling at the water/sediment interface

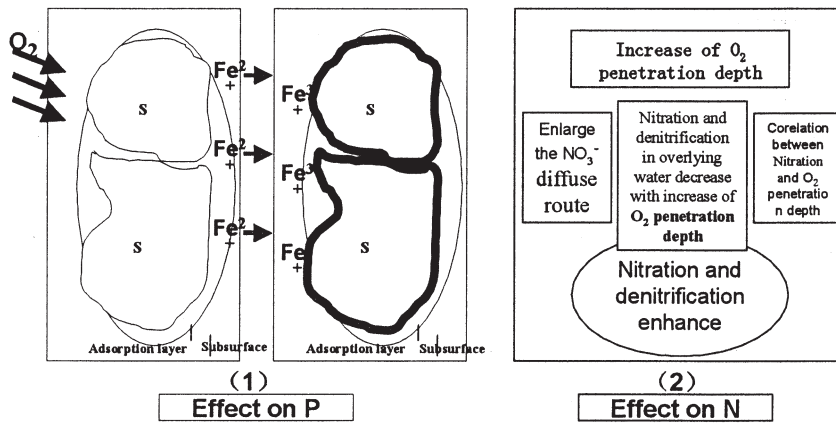


- Nutrient flux from the sediments decrease by uptake by benthic diatom;
- O₂ penetration depth increase due to the photosynthesis of benthic diatoms;
- Nutrient cycle in lake was altered by the changes of interface microorganism and chemical process

(1) Effects of benthic alga on the interface of S & W

According to our investigations to the Taihu Lake in 2003 and 2004, the microsystem structure changes with the different trophic level. In eutrophic lake with the TP concentration of sediment more than 1000mg/kg, the major benthic organism is microorganism and some species to be able to bear pollution; In the healthy lake with the TP concentration of sediment less than 500mg/kg, the major benthic organism is benthon animal, benthon alga and microorganism.

Increased effect of O₂ penetration depth at W & S interface



Based on the previous structure model of two dimensions of sediment/water interface, current study mainly focus on the N,P adsorption/desorption on the sediment surface, physi-chemical characteristics of sediment, N and P species analysis and so on. But in fact, micro-ecosystem at the water-sediment interface has very important effect on its surrounding environmental conditions, such as pH, DO and nutrient metabolism.

Primary Study Contents

(1) Feature change of interface between Sediment & Water
in the presence of organism

(2) Geo-chemical behavior of interface between Sediment & Water
in the presence of organism

(3) P and N forms of interface between Sediment & Water
in the presence of organism

(4) Ecosystem affects on the interface between S & W in the
presence of organism

(5) Study methods of the interface in the presence of organism

Project 3:

Study on control theory of Lake eutrophication

GG Lake eutrophication control theory

Core of the theory : to combine pollution source control with ecological restoration is the core of the theory

- To combine pollution source control with ecological restoration
- The “three-circle” theory for ecological restoration
- The engineering treatment and management
- To protect lake from the point of view of the whole drainage
- To combine pollution source control with ecological restoration

Primary Study Contents

- (1)How to combine pollution source control with ecological restoration
- (2) How to combine pollution source control with ecological restoration
- (3)How to protect lake from the point of view of the whole drainage
- (4)How to combine pollution source control with ecological restoration