The On-going Eco-hydrological & Eco-hydraulic

Research Programs

for Improvement of Three Gorges Reservoir Operation

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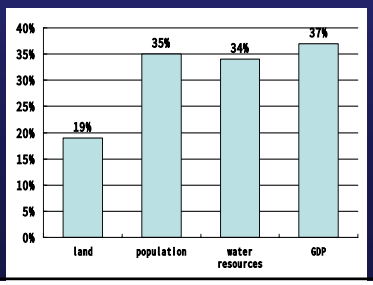
PART ONE

BACKGROUND

Yangtse River

- ✓ Yangtse River ---- the largest river in China
- ✓ 34% water resources, 900 billion cubic meters water discharged into the Sea
- ✓ 19% land (24% plowland), 35% population, 37% GDP in the basin
- ✓ Most abundant bio-diversity zone in China



Three Gorges Project

- ✓ The largest hydropower project in the world
- ✓ The dam is 185 m, the total storage capacity is 39.3 billion m3, and the annual electricity generation is 84 billion kilowatt-hours
- ✓ To gain a great comprehensive benefit on flood control, hydropower generation and navigation improvement

Environemtal Impacts

- ✓ Natural environment and social environment
- ✓ Positive impacts, such as:
  - Substitute 50 million tons of coal annually, reducing 10 million tons of CO2, 1 million tons of SO2, and lots of other waste gases
  - Prevent highly populated downstream area from flooding
- ✓ Negative impacts, such as:
  - Huge Migration
  - Land submergence
  - River block and natural flow alteration
  - Habitat damage

Measures for Yangtse River Improvement and Habitat Restoration

Measures	Remarks
Nature reserve	12 nature reserves
Soil & Water Conservation	ongoing
closed fishing seasons	Remarkable effects
Sustainable fishery mode	Under research
Pollution control	better management needed
Eco-friendly dam operation	Important ,Under research
……	

We need eco-friendly dam operation!

Yes , but how?

Examples of Concerned Eco-hydraulic & Eco-hydrological needs

Example 1---- The Chinese Sturgeon

- ✓ one of the rare and endangered aquatic animals, known as a living fossil
- ✓ used to migrate upstream into Jinsha River for propagation.
- ✓ After the construction of Gezhouba dam in 1980, it takes the near downstream water area as spawning site.
- ✓ questions: (1) suitable hydraulic conditions for spawning? (2) How does three gorges dam operation affect Chinese sturgeon's spawning?

Examples of Concerned Eco-hydraulic & Eco-hydrological needs

Example 2 ---- Eutrophication Control

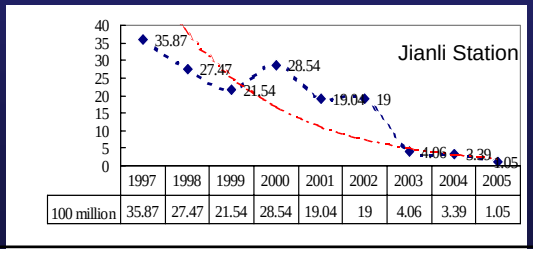
- ✓ nutrient contents are much higher than standards
- ✓ no “algae bloom” occurred before
- ✓ since water level rises up to 135 meters in 2003, “algae bloom” happens every year.
- ✓ questions: (1) how does tributary eutrophication respond to flow conditions? (2) does flood discharge restrain algae accumulation in tributaries annually?

Alage bloom in a tributary (March, 2006)

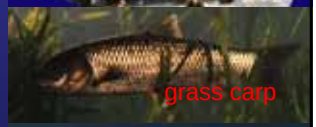
Examples of Concerned Eco-hydraulic & Eco-hydrological needs

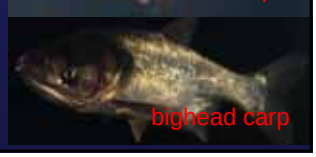
Example 3 ---- Four Major Economic Fish

- ✓ Questions : (1) what is the appropriate flow conditions for the “ four major economic fish” habitat restoration? (2) how large and how long should an artifical flood be made to stimulate the four major economic fish’s spawning?



	1997	1998	1999	2000	2001	2002	2003	2004	2005
100 million	35.87	27.47	21.54	28.54	19.04	19	4.06	3.39	1.05





PART TWO

ONGOING PRAGRAMS



Program 1: The effects of hydrological and hydrodynamic changes caused by hydropower projects on important living resources

- Sponsored by: National Nature Science Foundation of China
- Research period: 2005—2008
- Fund: 1.3 million Yuan

– **Living Resources Objects of Research** : Chinese sturgeon, four major economic fish

– **Hydropower projects**: Three Gorges dam and Gezhouba dam

– **Research Scope** : reservoir + downstream + river mouth = 2300 km or so

– **Research Goals**

- To understand the hydrological changes of Yangtse River
- To clarify the water temperature distribution changes along the river
- To illustrate the eco-hydraulic conditions for Chinese Sturgeon's spawning
- To assess the status of existing habitats for four major economic fish

– Technical Difficulties

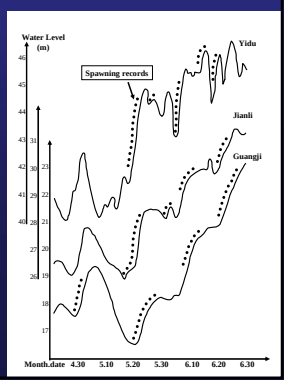
- Lack of long-term monitoring data, especially for “four major economic fish”
- Little knowledge of the life processes or characteristic phenomena of the concerned living organisms

– Methodology

- History data analysis
- Field monitoring
- Laboratory study
- Numerical modeling

Primary Results of Program 1

- A Spatially Distributed Hydrological Model for Yangtse River Basin
- An eco-hydrological index system for Yangtse River
- Only when flood waters swell, “Four major economic fish” spawn. Meantime, the Increasing rates of Q and Z, flood swelling time, and interval of floods affect the spawning scale
- The number of days of flooding downstream of Three Gorges dam should maintain 15-30 (from April to June annually) for keeping a normal scale of spawning



Primary Results of Program 1

- The exact locations of Chinese Sturgeon spawning sites: up spawning site and lower spawning site
- the hydrodynamic characteristics of Chinese Sturgeon spawning sites: moderate bottom velocity(1-2m/s), vertical upwards velocity
- Since Three Gorges reservoir began to store water, the spawning time of Chinese Sturgeon trends to delay by 20 days

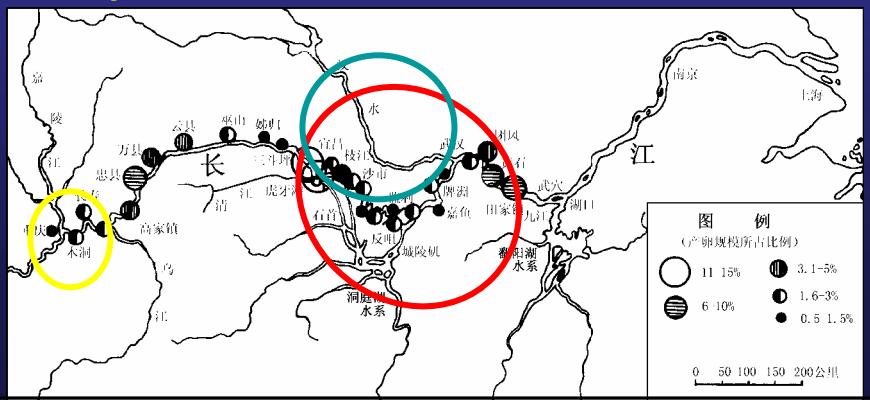
Program 2: Artifical Floods for the Spawning of "Four Major Economic Fish"

- **Sponsored by: China Three Gorges Project Corporation**
- **Research period: 2006—2008**
- **Fund: 1.1 million Yuan**
- **As a supplement to Program 1**

– **Living Resources Objects of Research** : four major economic fish

– **Hydropower projects**: Three Gorges dam

– **Research Scope** : downstream + upstream + Han River



– **Research Goals**

- To understand the response of four major economic fish's spawning to hydrological changes
- To assess the possibility of four major economic fish's spawning in the near upstream waters of Three Gorges reservoir
- To provide eco-hydrological data for making "artifical floods"

– **Research Progress**

- Field investigation
- Yangtze River suffers rare drought in flood season in 2006

Program 3: Demands of Water Quality Protection of Three Gorges Reservoir for the Improvement of dam operation

– **Sponsored by: China Three Gorges Project Corporation**

– **Research period: 2006—2008**

– **Towards tributary "algae bloom" control**

– Research Goals

- To find out the relationship between “algae bloom” and hydrodynamic characteristics in the tributaries of Three Gorges reservoir
- To understand the needs of tributary flow adjustment for water quality improvement
- To study the feasibility of tributary flow adjustment and put forwards suggestions

– Research Scope : Typical Tributaries

- Xiangxi River: phosphorite production zone
- Daning River: tourist attraction
- Zhushan River: urban river

–Technical Difficulties

- Few hydrological monitoring stations

–Methodology

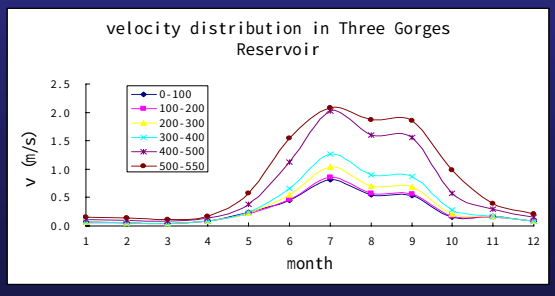
- Spatially distributed hydrological model
- History data analysis : 135-139 m
- Field monitoring: 145-156 m
- Hydrodynamic modeling

–Research Progress

- Preparation Stage

–Preliminary investigation results

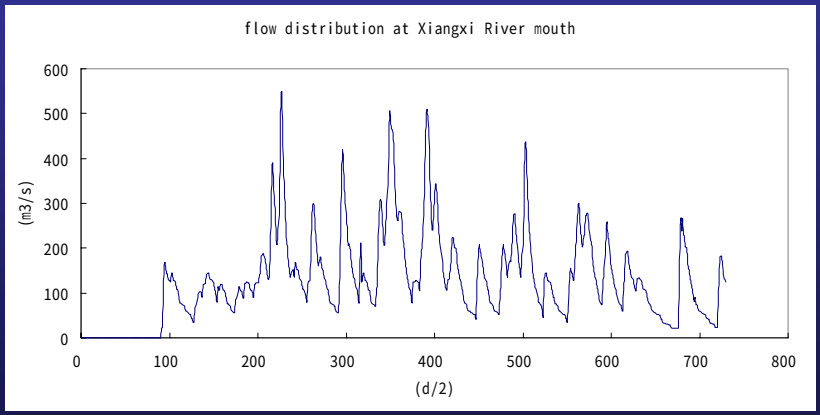
- Velocity distribution in Three Gorges Reservoir



(typical hydrological year=1999, storage level = 156 m)

– Preliminary investigation results

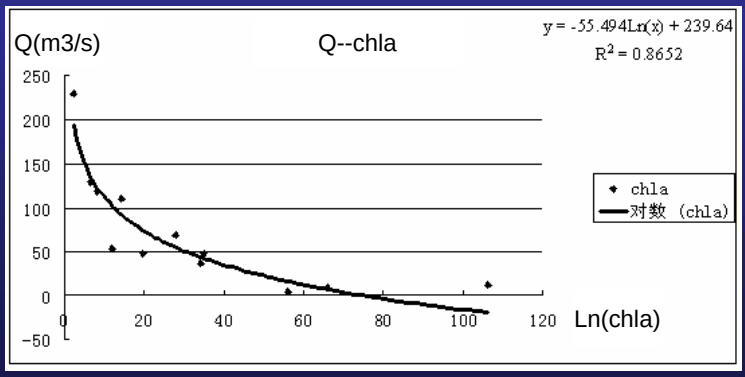
- Tributary flow



(typical hydrological year=1998 , storage level = 156 m)

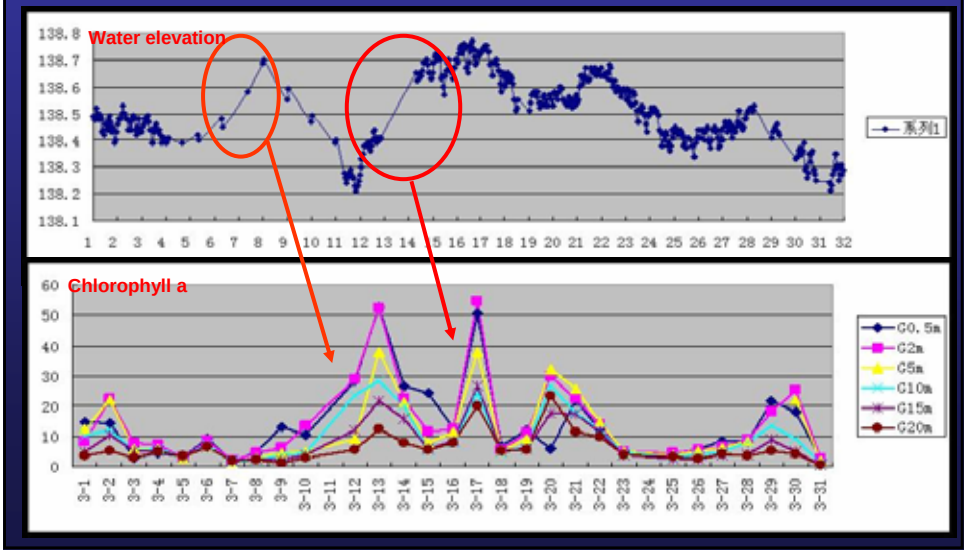
– Preliminary investigation results

Response of Chlorophyll a to tributary flow



– Preliminary investigation results

- Response of Chlorophyll a to water elevation change



Thank You !