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Inspirations to river restoration from fish habitat studies

Towards Waterfront and Watershed Restoration

Jianhua LI
Tongji University
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汇报提纲

1. Background
2. Distribution pattern and threats of fish biodiversity
3. types and characteristics analysis on instream habitat
4. Inspiration and Conclusions

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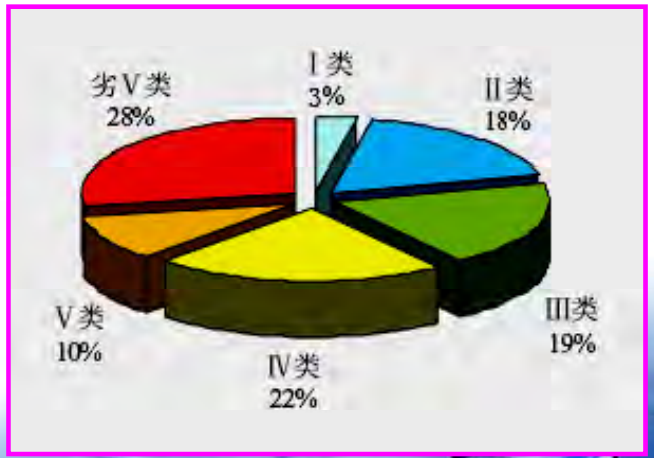
1. Background

Back ground

Serious Water pollution

Class I~III	40%
Class Ⅳ	22%
Class Ⅴ	10%
Below Class V	28%



Back ground

The Chinese EPA annual reports (MEP, 2008) show that pollution loads in parts of the Yangtze have increased in recent years, especially in the lower reaches & in smaller tributaries (Xue et al., 2008). Only 31% of water samples, mainly from the upper Yangtze, are of first or second class quality, and much of the lower Yangtze is third class or poorer.

Back ground

Water Quality of the Yangtze River Waters (MEP, 2007)

Back ground

Current Comprehensive Treatment of Small & medium-sized rivers

------- Pollution control and flood control is as the core

Habitat degradation

- Water pollution
- Hydraulic engineering P.
- Excessive use of resources

Unreasonable river treatment

- Focus on flood control and irrigation project
- Focus on water pollution control project

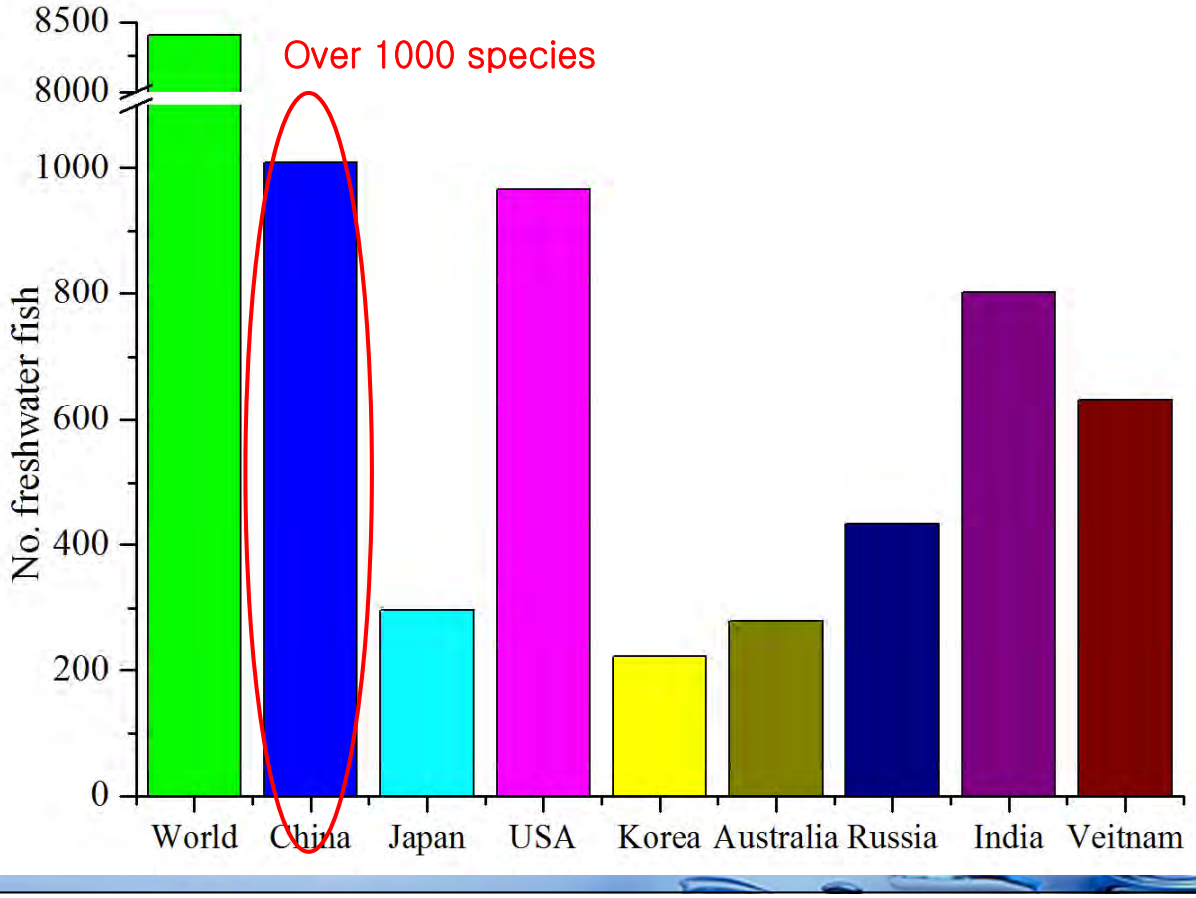
Insufficiency For habitat protection

Lack for habitat research

- Different scales and types
- Habitat and fish relations

Freshwater fish in different countries

www.Fish base.org



Endangered Species Loss

Shad 长江鲥鱼（ *Tenualosa reevesii* Richardson）

migratory species for spawning。 The State first-grade protected species.

鲥鱼属硬骨鱼纲、鲱鱼目、鲱科、鲥属。1988年被列入中国国家重点保护野生动物名录中第一级的保护物种。为溯河产卵洄游性鱼类，成鱼生活在近海，产卵场主要分布于长江支流。

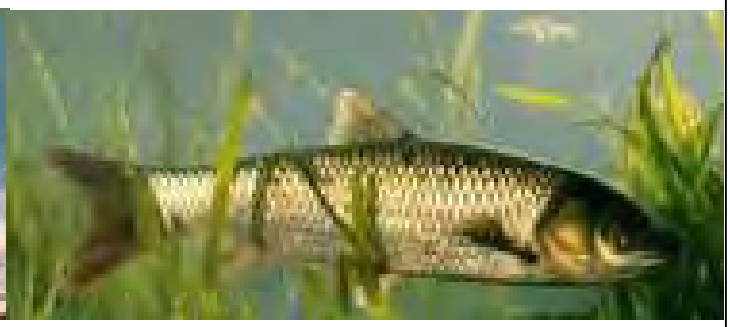
Chinese sturgeon中华鲟（*Acipenser sinensis*）

中华鲟俗称鲟鱼、鳇鱼，属鲟形目、鲟科、鲟属。**1988年被列为国家一级保护动物**。每年7月～8月，成熟亲鱼从河口溯河上游到长江上游产卵繁殖，仔鱼随波逐流至长江下游和河口滩涂索饵肥育生长，幼鱼移至浅海区生长，直至达性成熟。

The four major chinese carps

四大家鱼

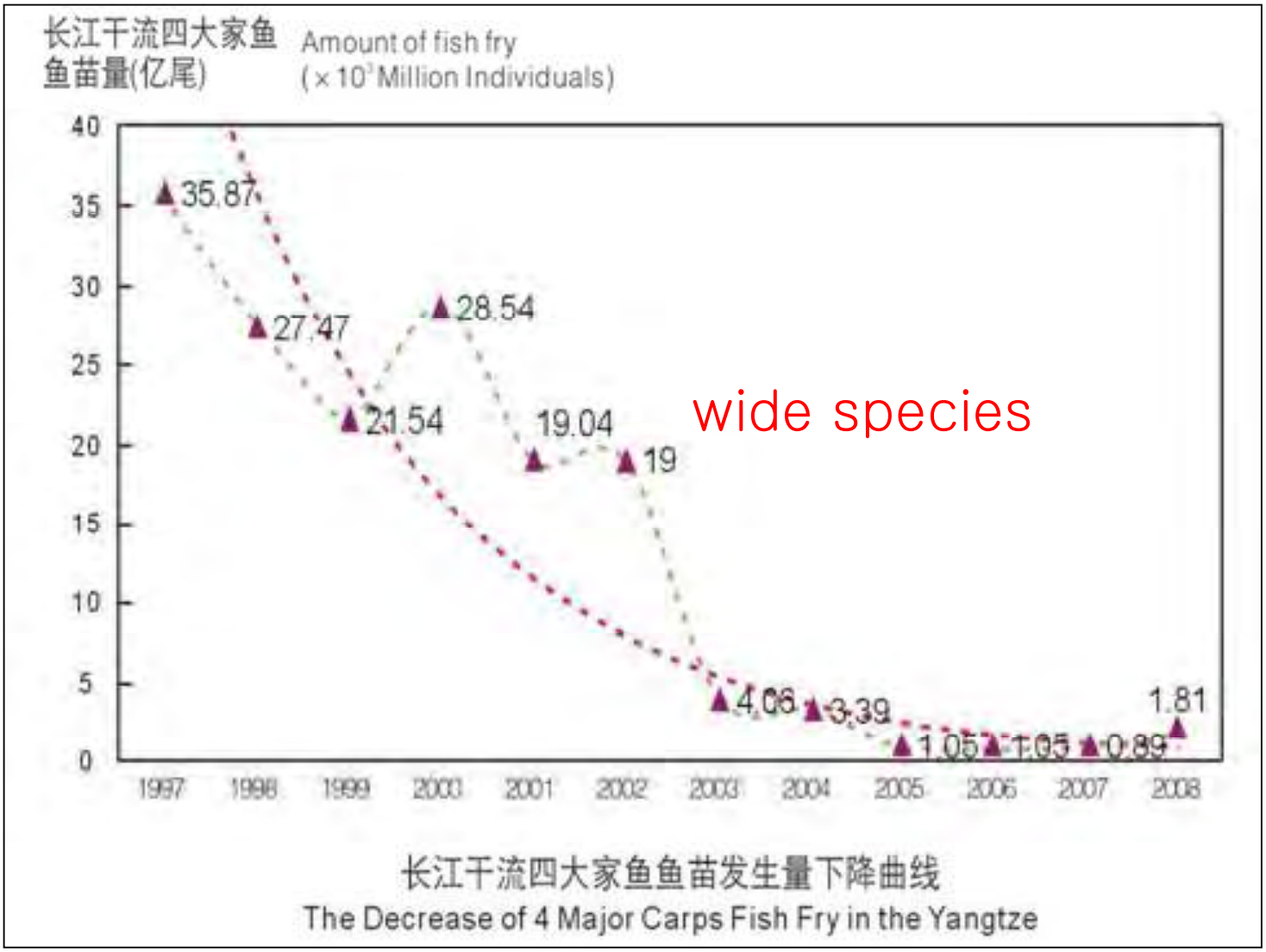
青鱼 *Mylopharyngodon piceus*



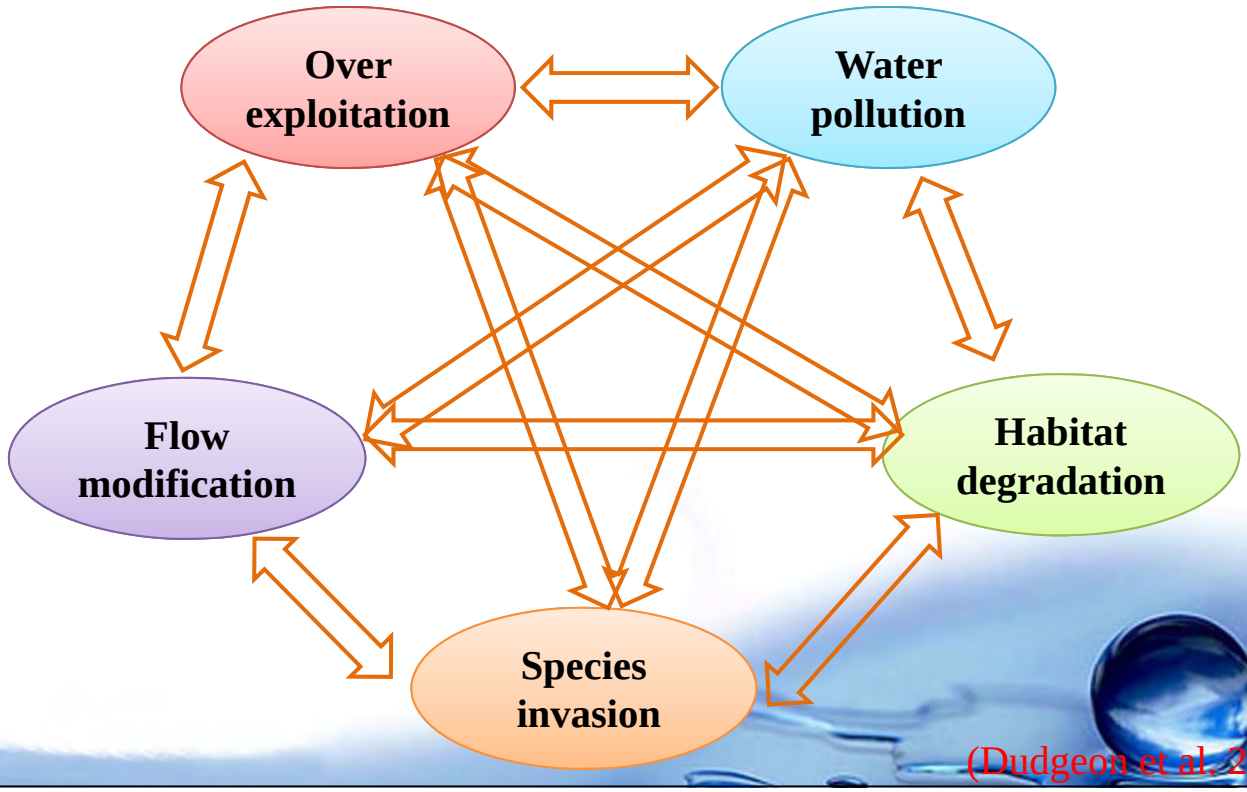
草鱼 *Ctenopharyngodon idellus*

鲢 *Hypophthalmichthys molitrix*

鳙 *Hypophthalmichthys nobilis*



Threats to fish biodiversity in China



(Dudgeon et al. 2006)

Unreasonable river treatment founded in the research field

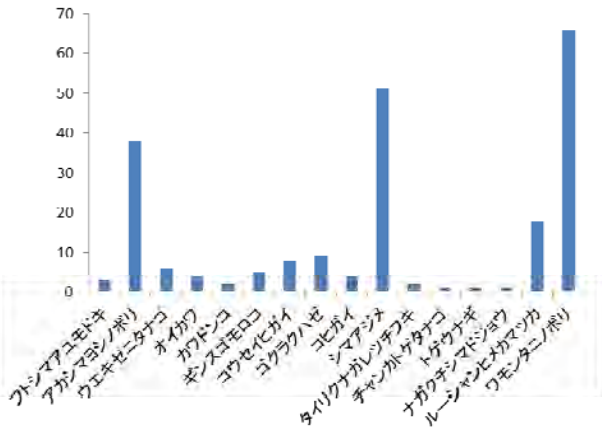
东苕溪现场调查

Species diversity decreased

东苕溪栖息地类型与鱼类多样性研究

Hotspot to Silent-spot…..a case at St. 168 in Tiaoxi Rover

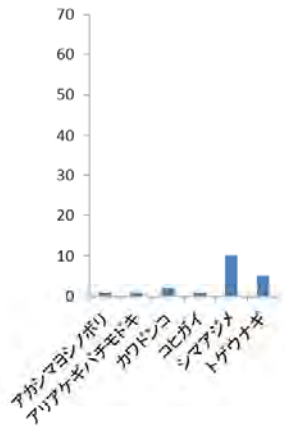
Oct. 2009



15species, 216 individuals

「Here is the HOTSPOT!」

Oct. 2010



6 species, 20 individuals

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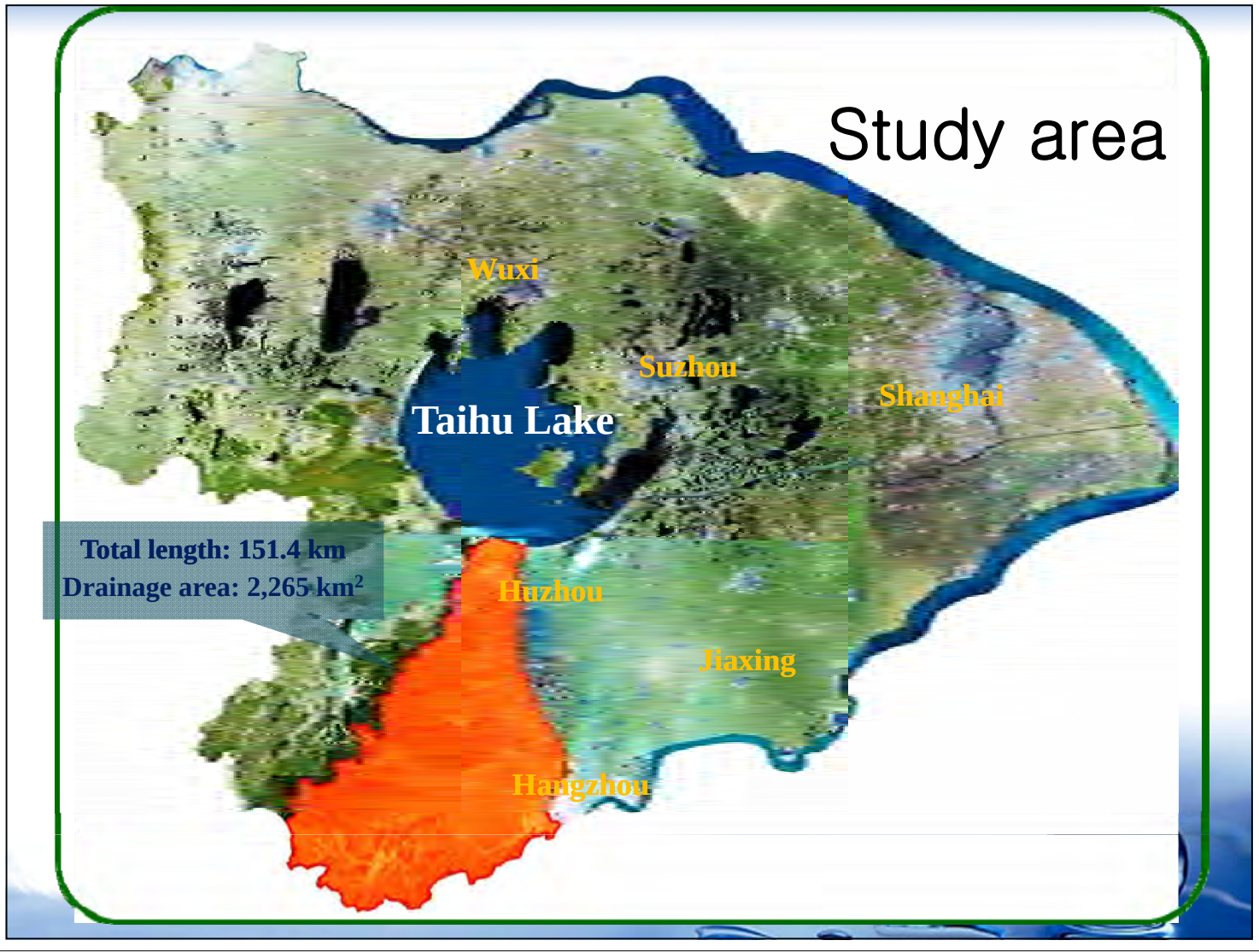
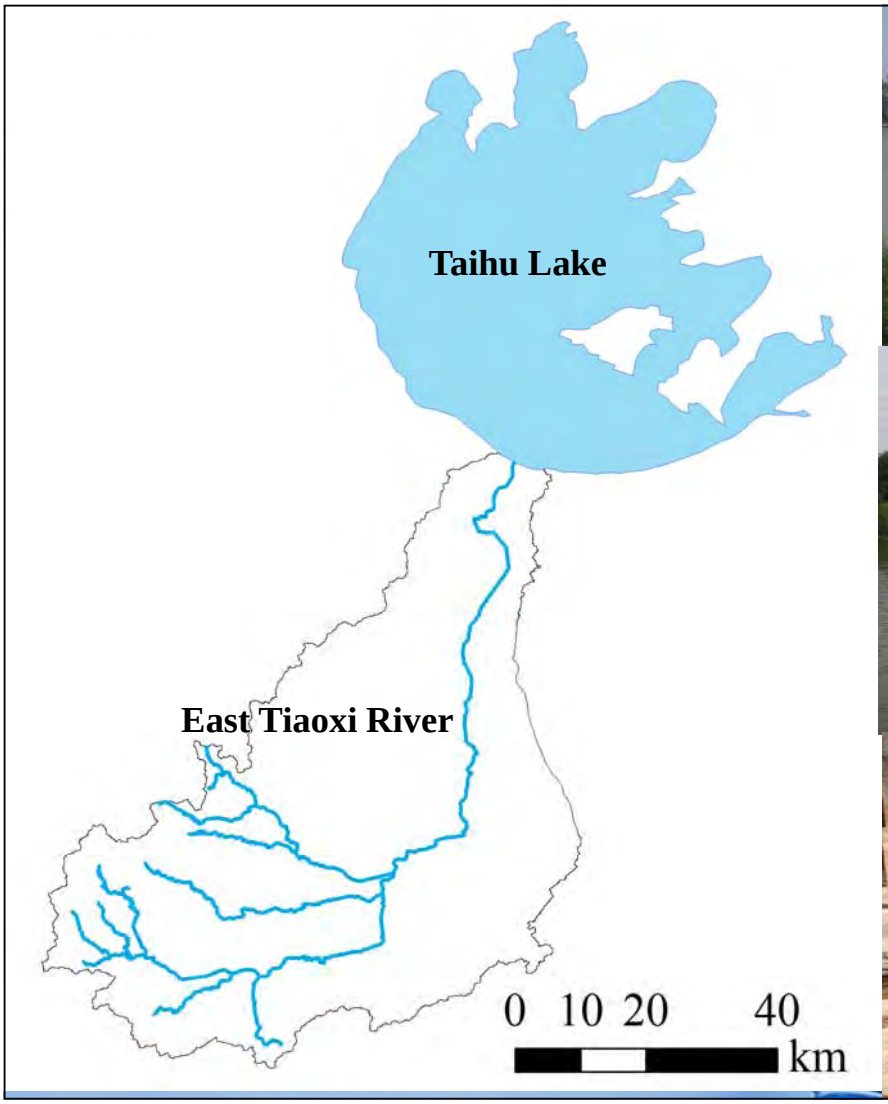
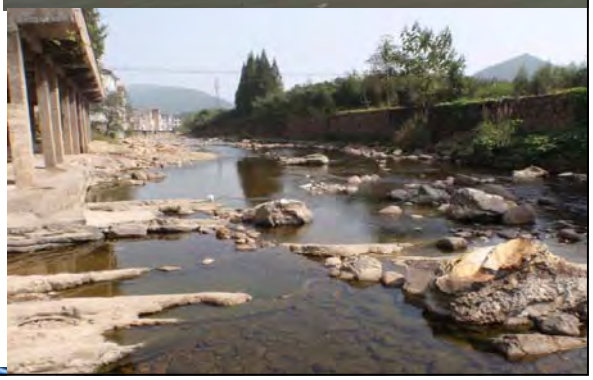
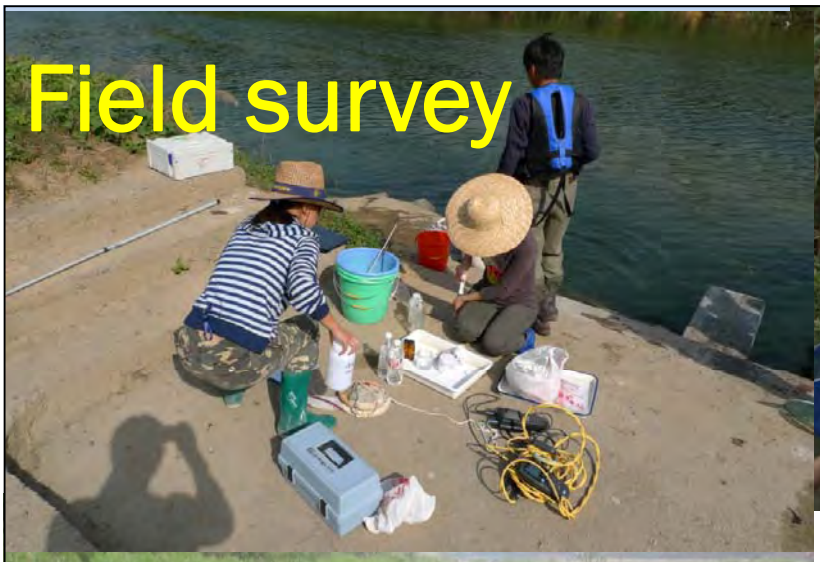
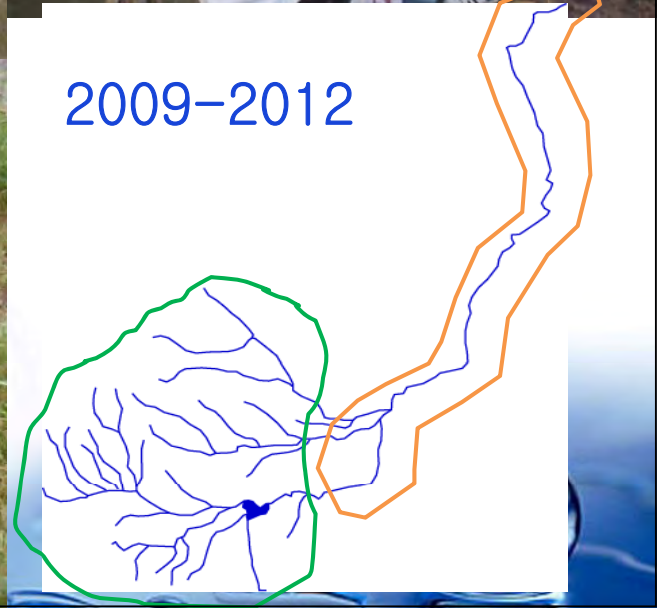
2. Distribution pattern and threats of fish biodiversity in East Tiaoxi river



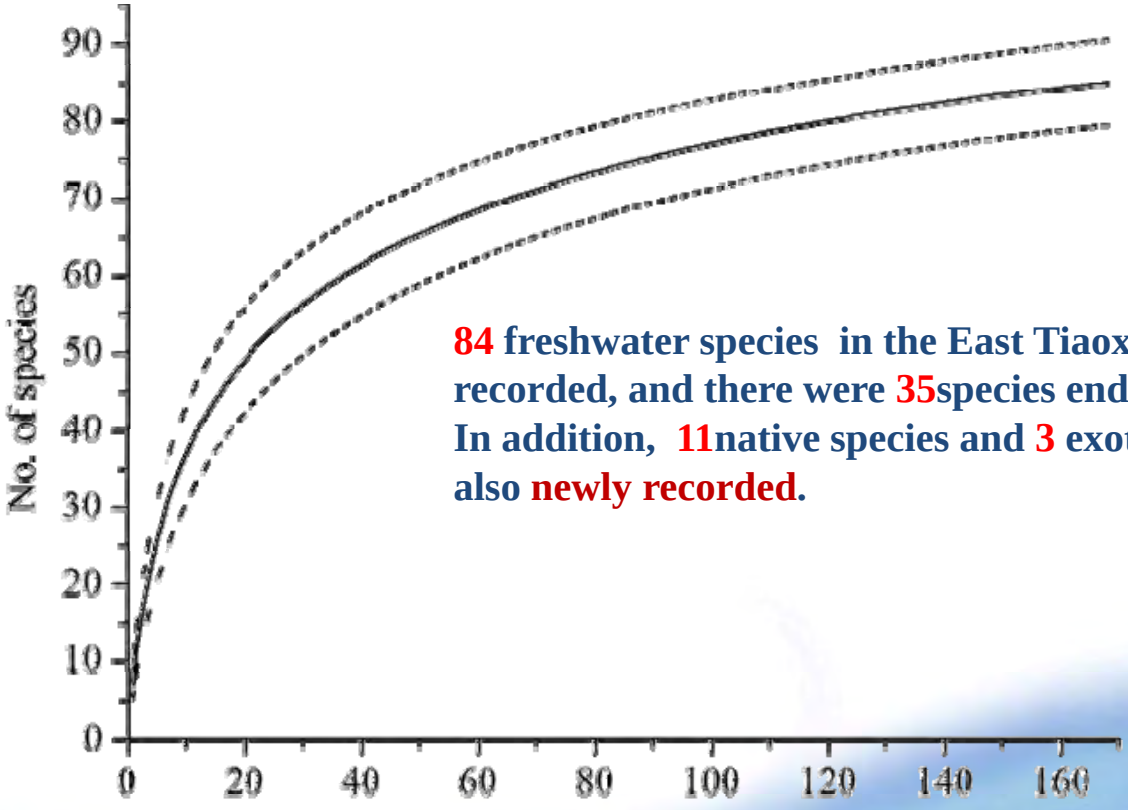

Taihu Lake
East Tiaoxi River
0 10 20 40
km



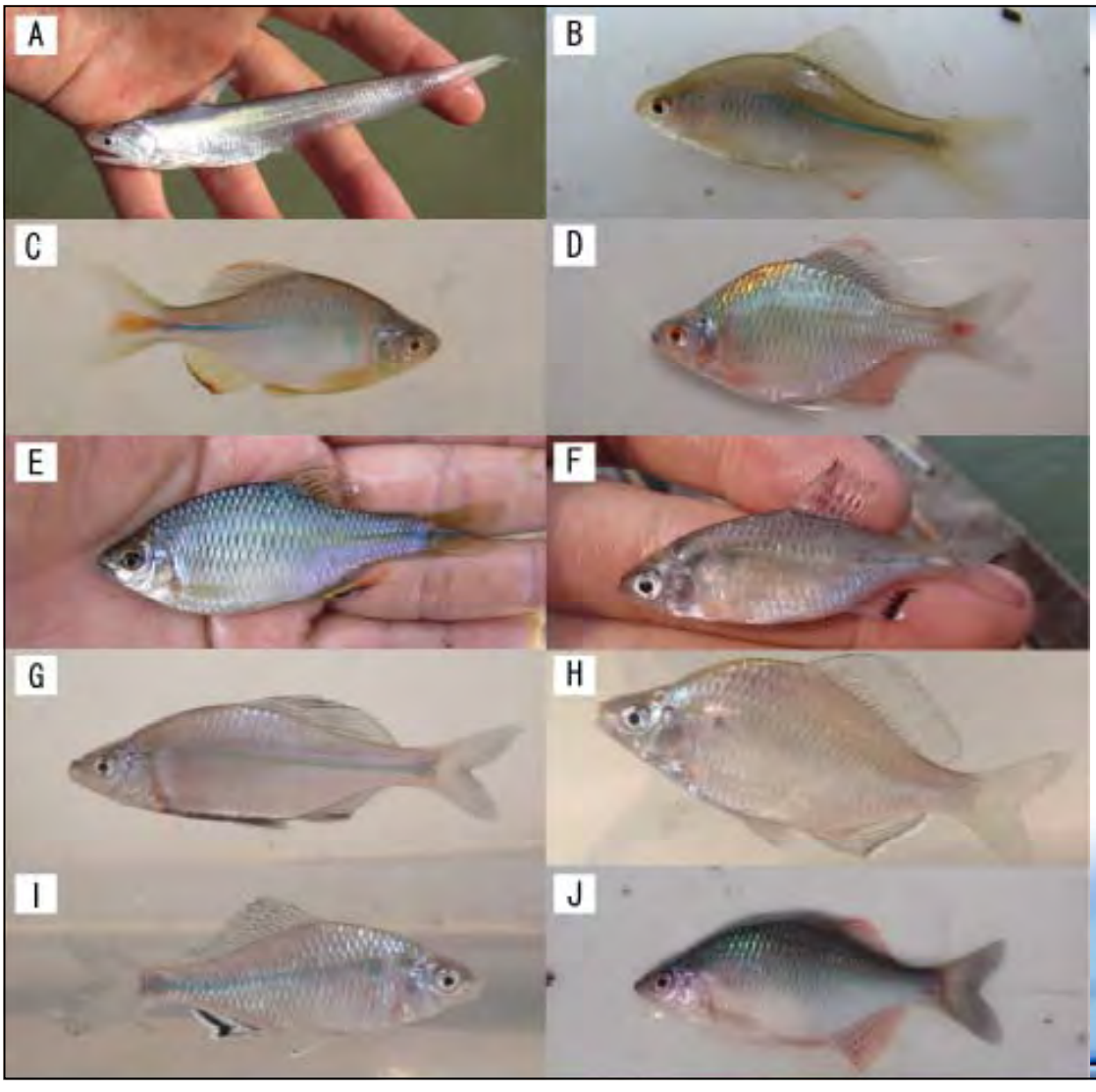

Field survey


2009–2012

2.1 Fish fauna and threats

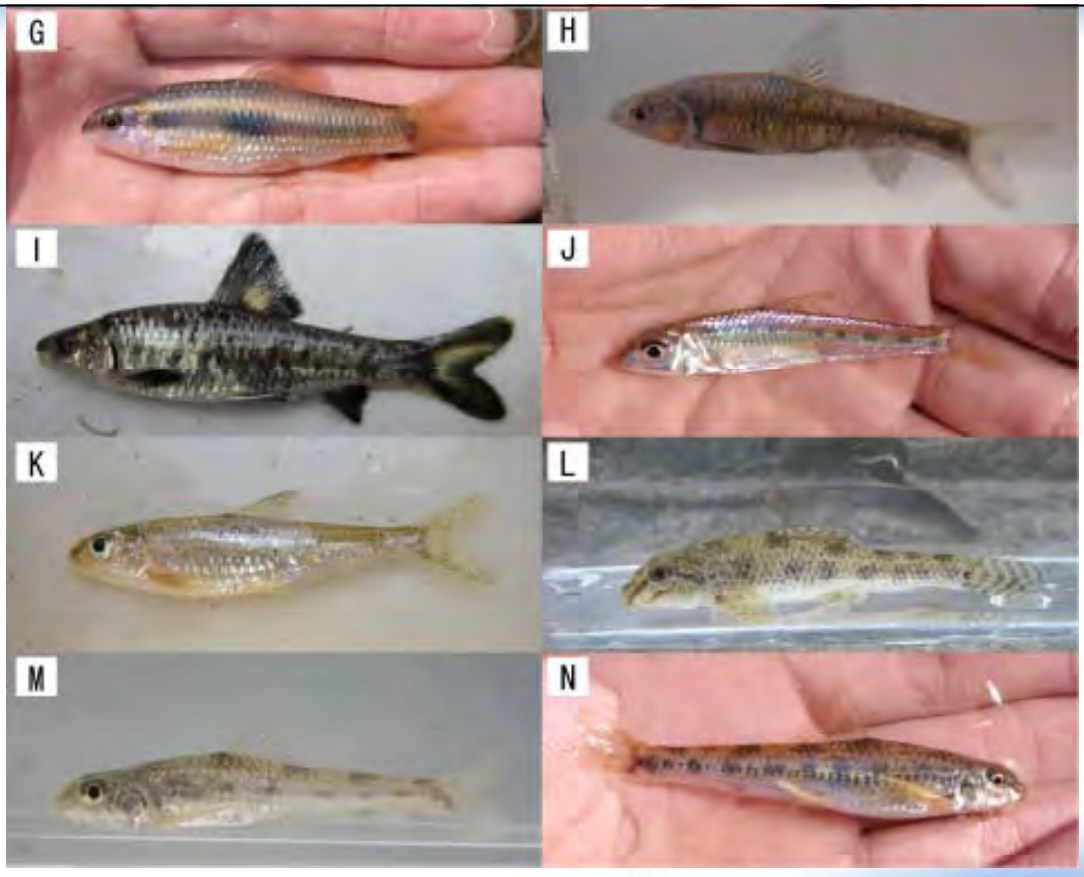


84 freshwater species in the East Tiaoxi River were recorded, and there were 35species endemic to China. In addition, 11native species and 3 exotic species were also newly recorded.

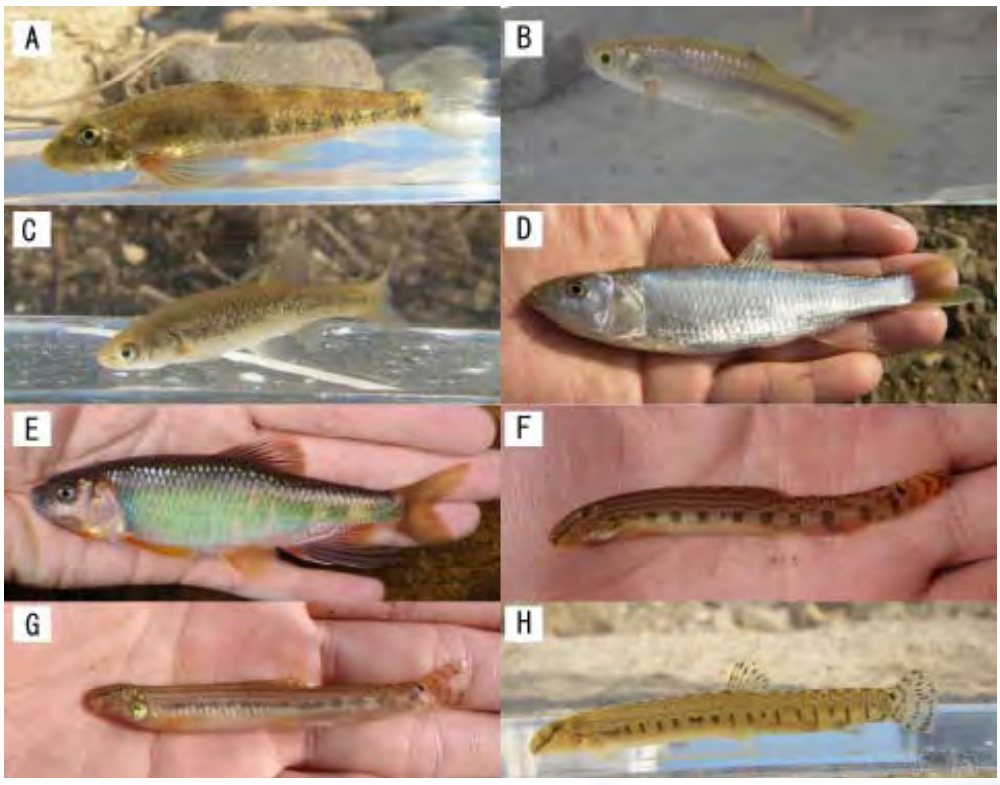


A: *Coilia ectenes*
B: *Rhodeus fangi*
C: *R. sinensis*
D: *R. ocellatus*;
E: *Tanakia himantegus*
F: *Acheilognathus gracilis*
G: *A. imberbis*
H: *A. macropterus*
I: *A. tonkinensis*
J: *A. barbatulus*;

アナゴ 6

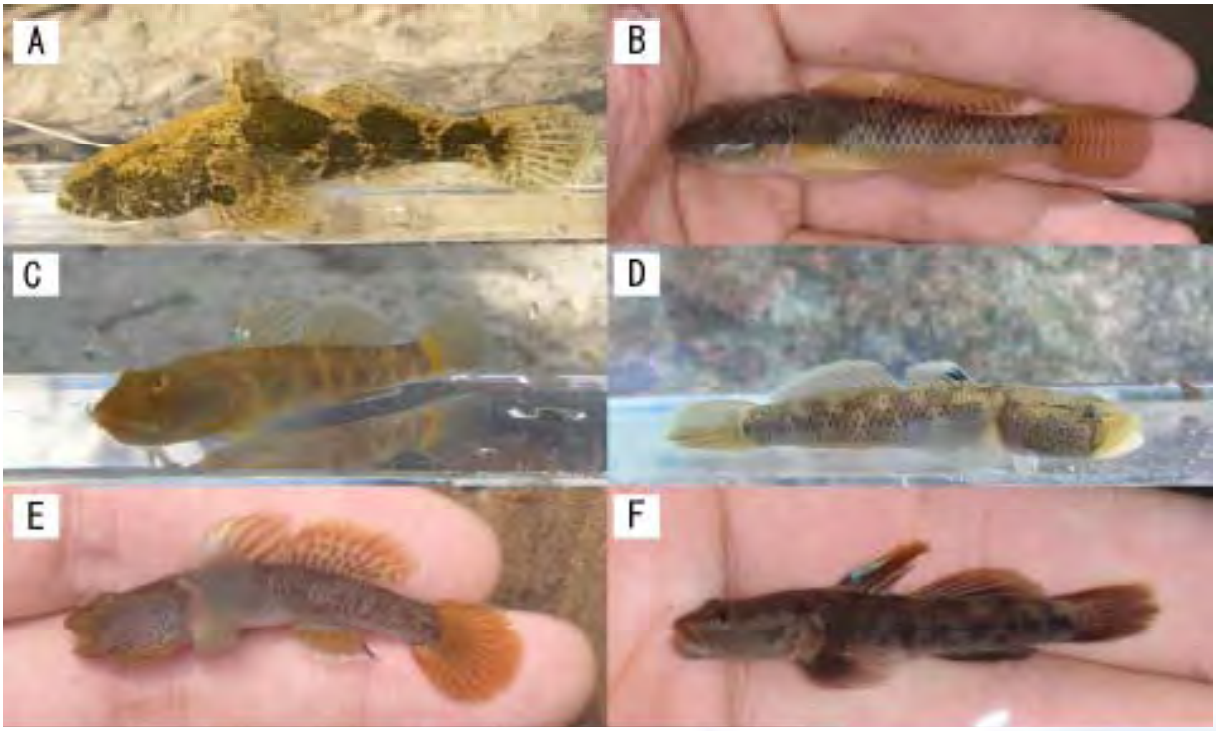


G: *Sarcocheilichthys parvus*; **H:** *Sarcocheilichthys kiangsiensis*; **I:** *Sarcocheilichthys nigri pinnis*; **J:** *Squalidus argentatus*; **K:** *Squalidus wolterstorffi*; **L:** *Abbottina rivularis*; **M:** *Microphysogobio fukiensis*; **N:** *Microphysogobio kiatingensis*;



A: *Huigobio chenhsiensis*; **B:** *Aphyocypris chinensis*; **C:** *Rhynchocypris oxyceph alus*; **D:** *Opsariichthys bidens*; **E:** *Zacco platypus*; **F:** *Cobitis sinensis*; **G:** *Cobiti s dolichorhynchus*; **H:** *Newaella laterimaculata*;

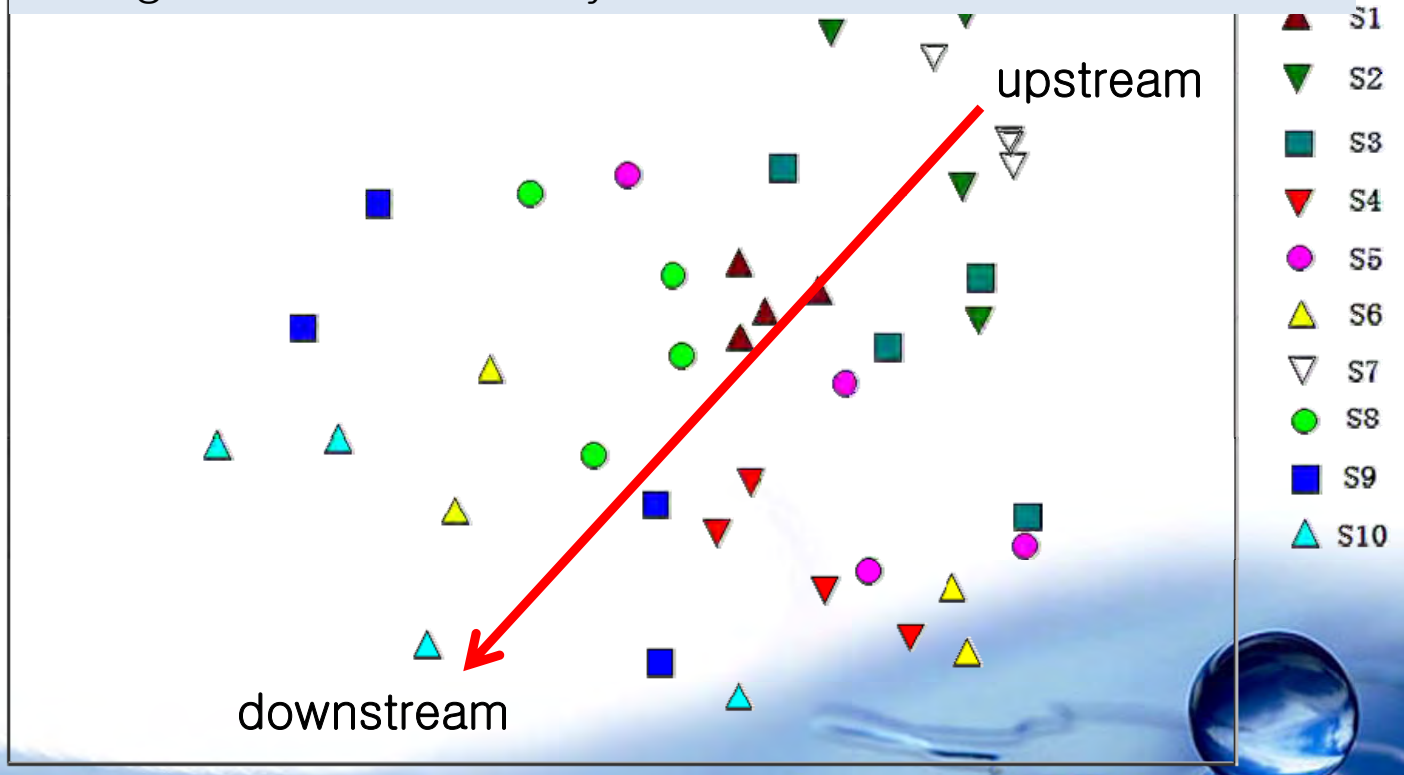
K: *Leptobotia tchangi*; **L:** *Vanmanenia pingchowensis*;
M: *Vanmanenia stenosoma*; **N:** *Liobagrus styani*



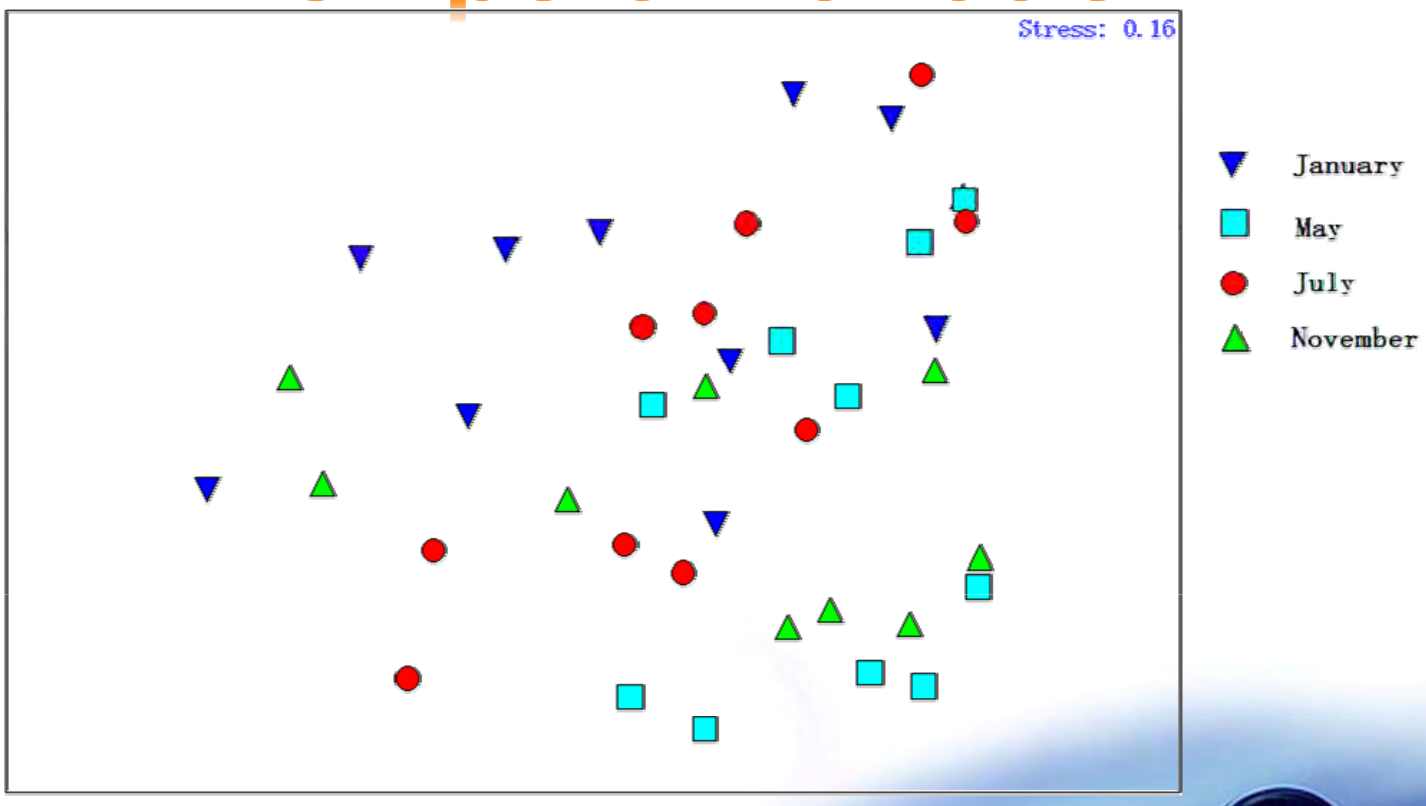
A: *Odontobutis potamophila*; **B:** *Rhinogobius guirinus*;
C: *Rhinogobius cliffordpopei*; **D:** *Rhinogobius multimaculatus*;
E: *Rhinogobius* sp. 1; **F:***Rhinogobius* sp. 2

Spatial variation

The ordination of spatial variation displayed a gradual change in fish community structure



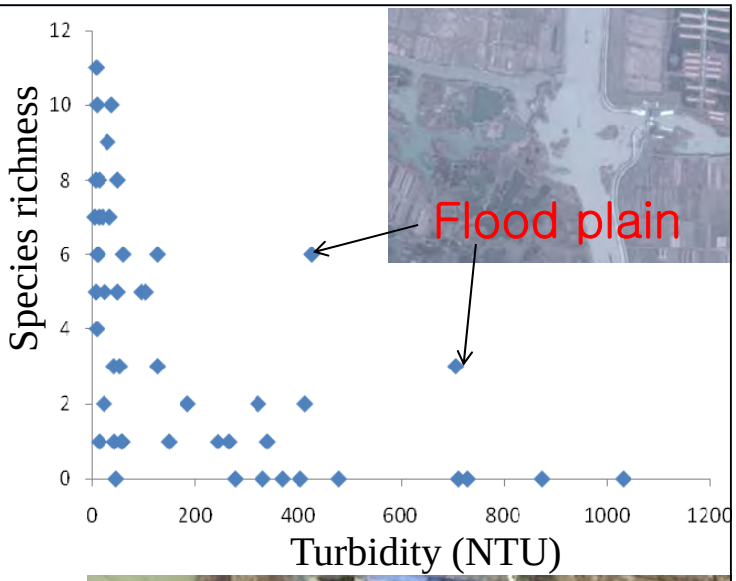
Temporal variation

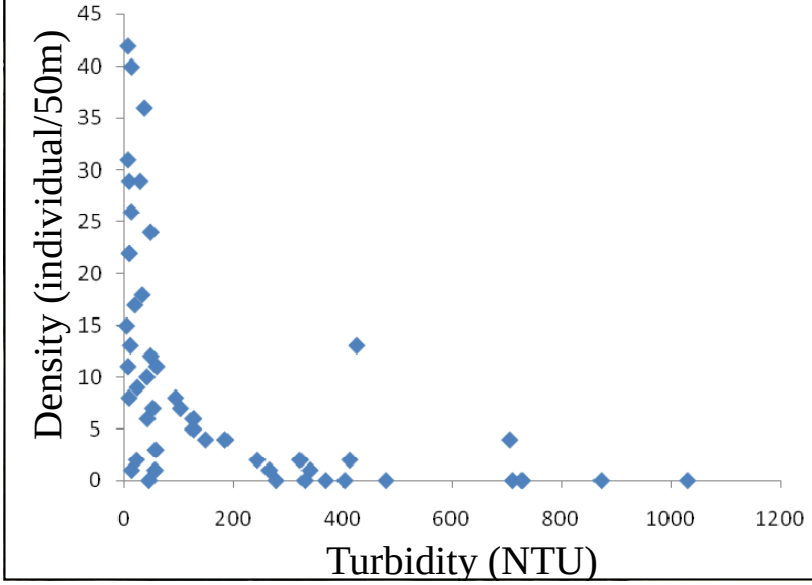


The ordination of temporal variation showed little apparent change associated with seasons

Relationship between fish community and environmental variables in the middle-- lower reaches

Turbidity vs. fish community





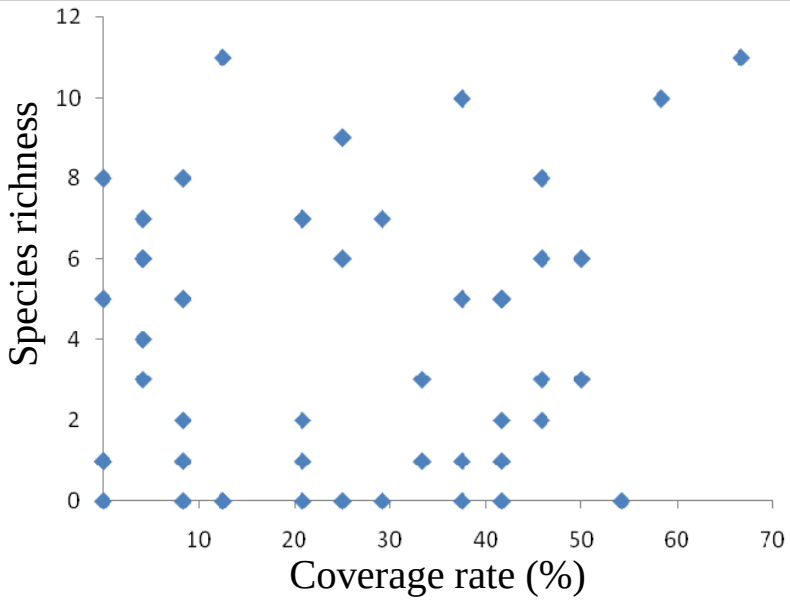
Result of **multiple regression model** to predict **water turbidity** in the East Tiaoxi River, China, in which the effective predictors were selected by the stepwise method (R^2 = 0.70)

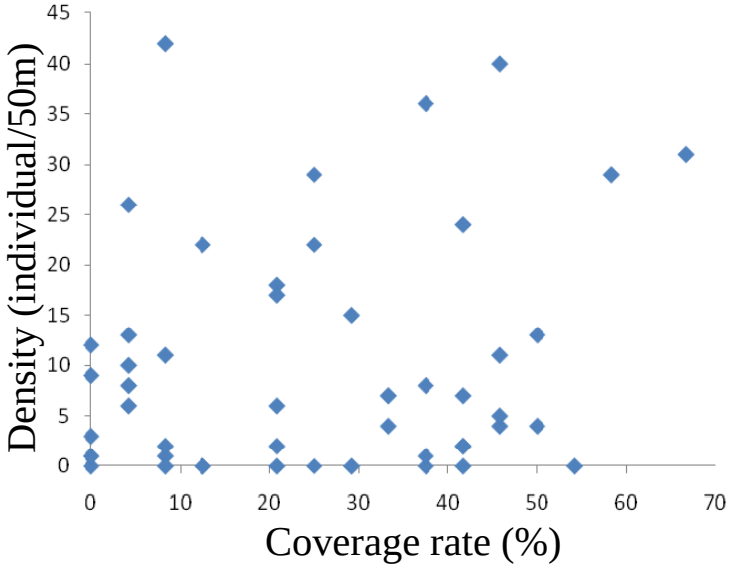
Predictors	Coefficient	SE	*t* value
Interception	2.12	0.25	8.46***
Ship traffic (ship/hour)	0.058	0.010	**5.702*** **
River width (m)			
Distance form the Taihu Lake (km)	-0.010	0.004	-2.405*
Mutual interaction between ship traffic and river width	-0.00033	0.00009	-3.628**

Probability levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

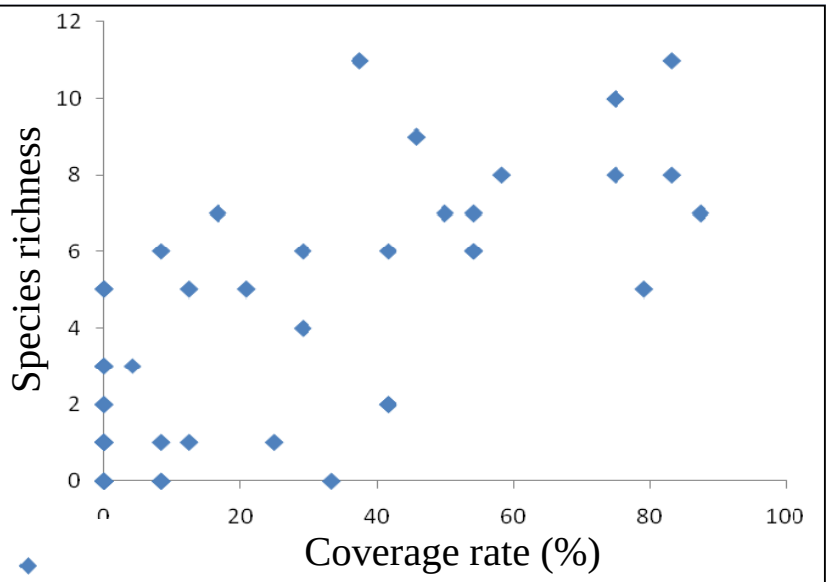
Multiple regression result showed that ship traffic was positively significantly related to water turbidity, while the distance from the mouth was negatively rel −ated to turbidity.

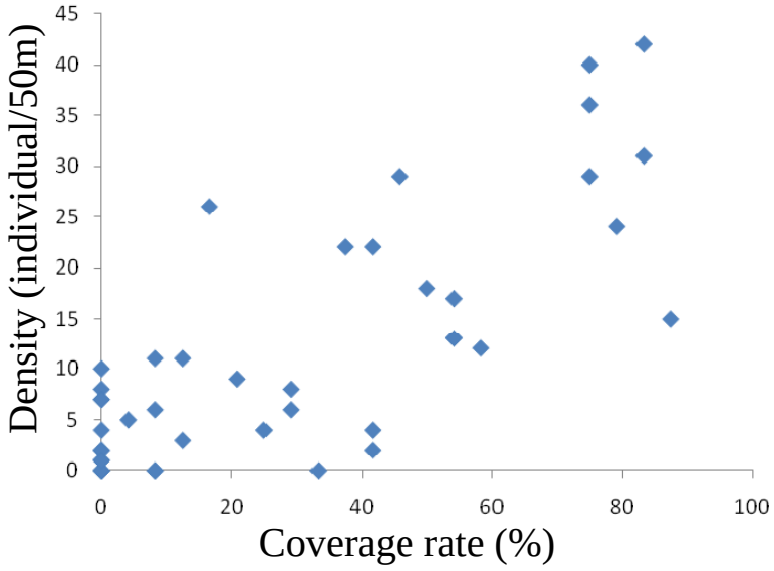
Emerged plants vs. fish community



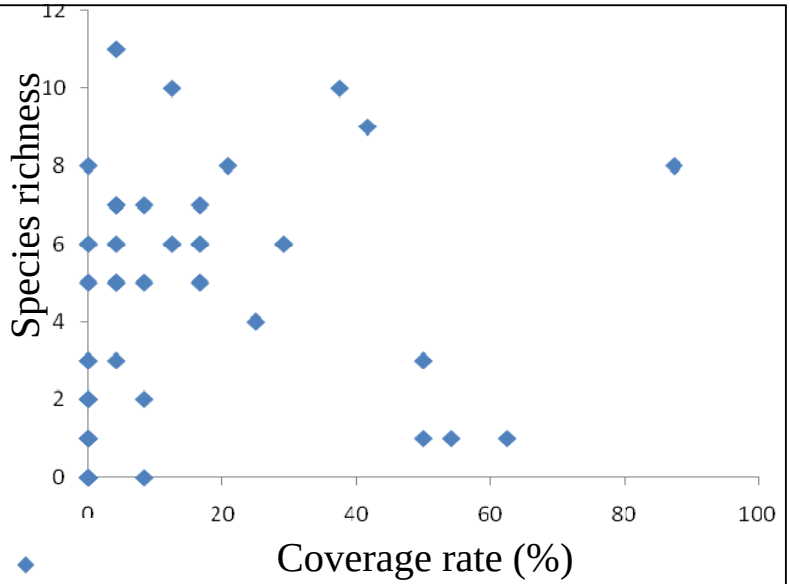


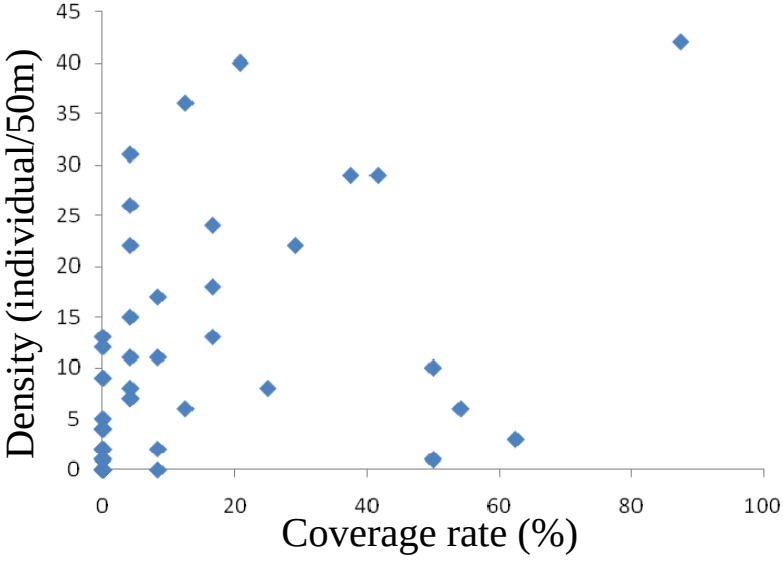
Submerged plants vs. fish community



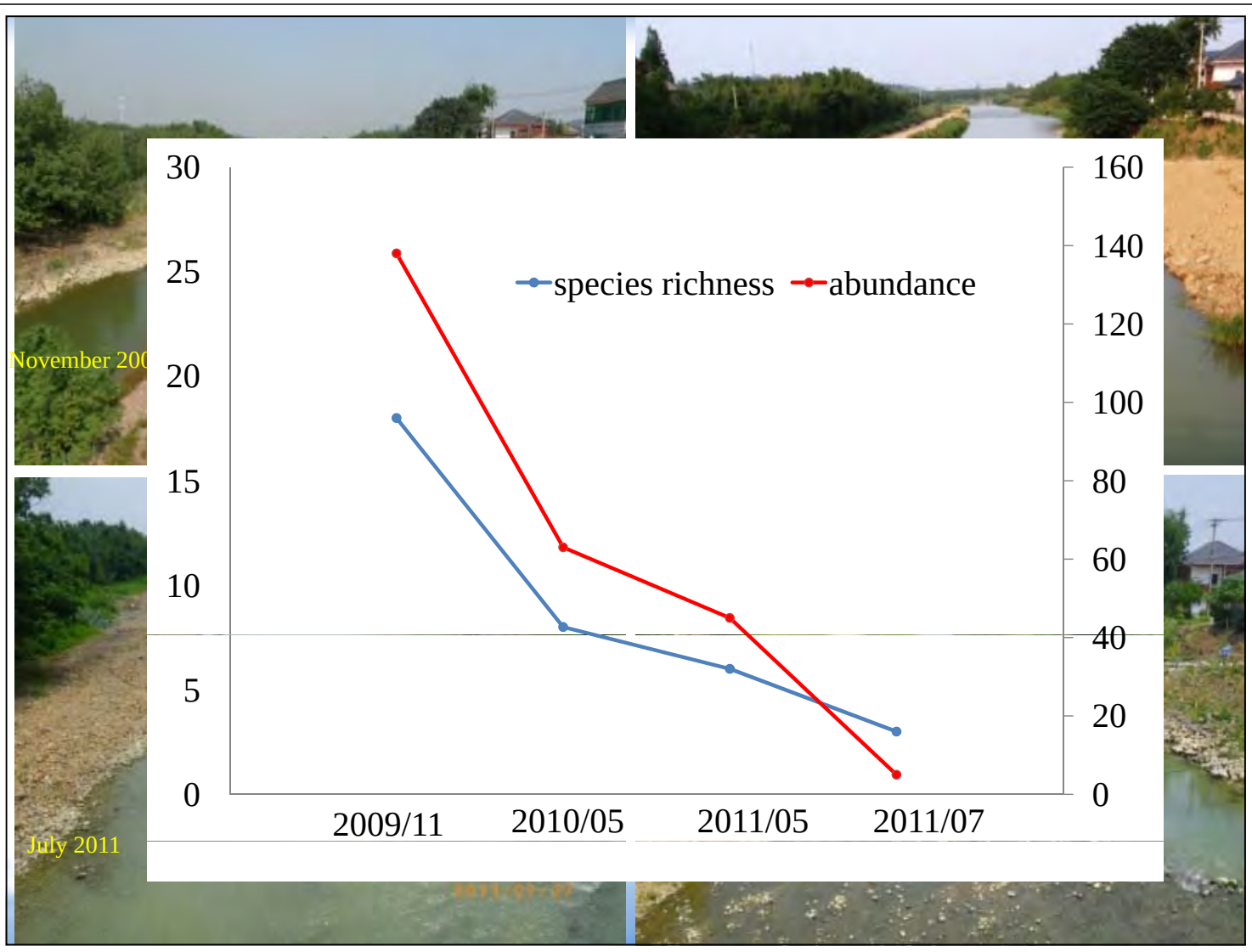


Floating plants vs. fish community

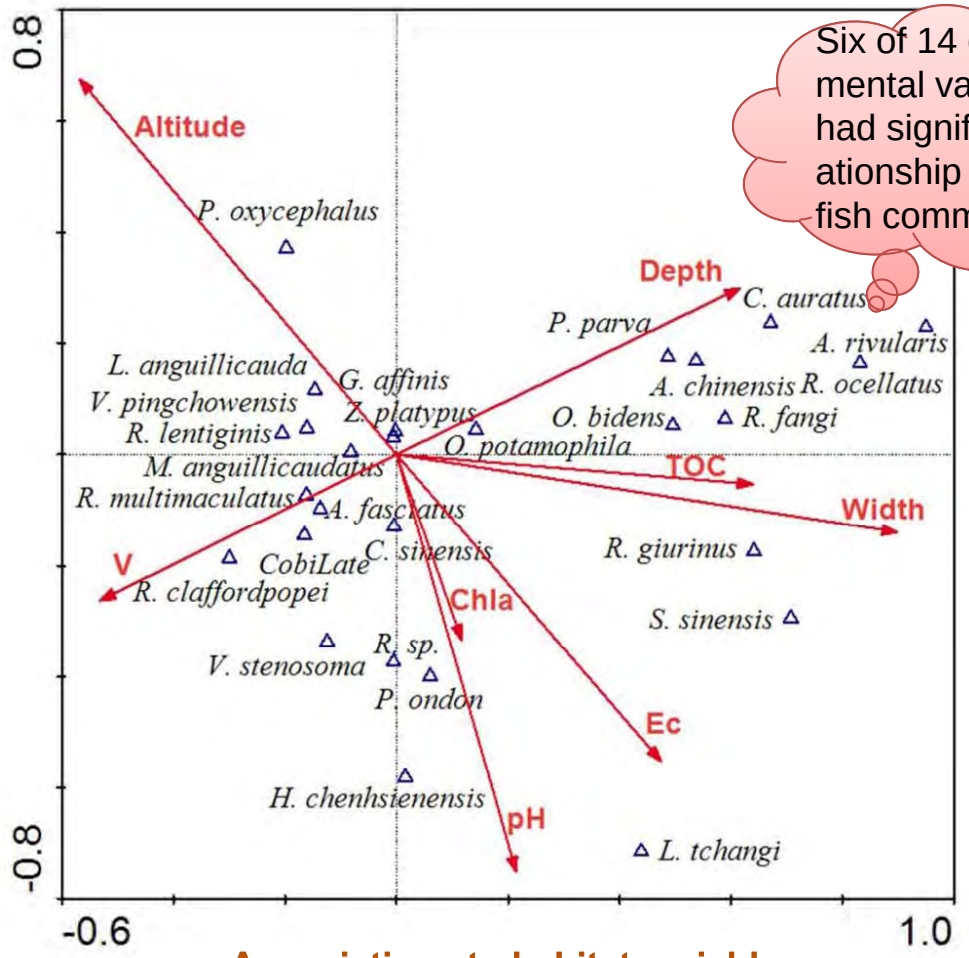





September 2010
May 2011


November 200
July 2011
30
25
20
15
10
5
0
160
140
120
100
80
60
40
20
0
species richness
abundance
2009/11
2010/05
2011/05
2011/07

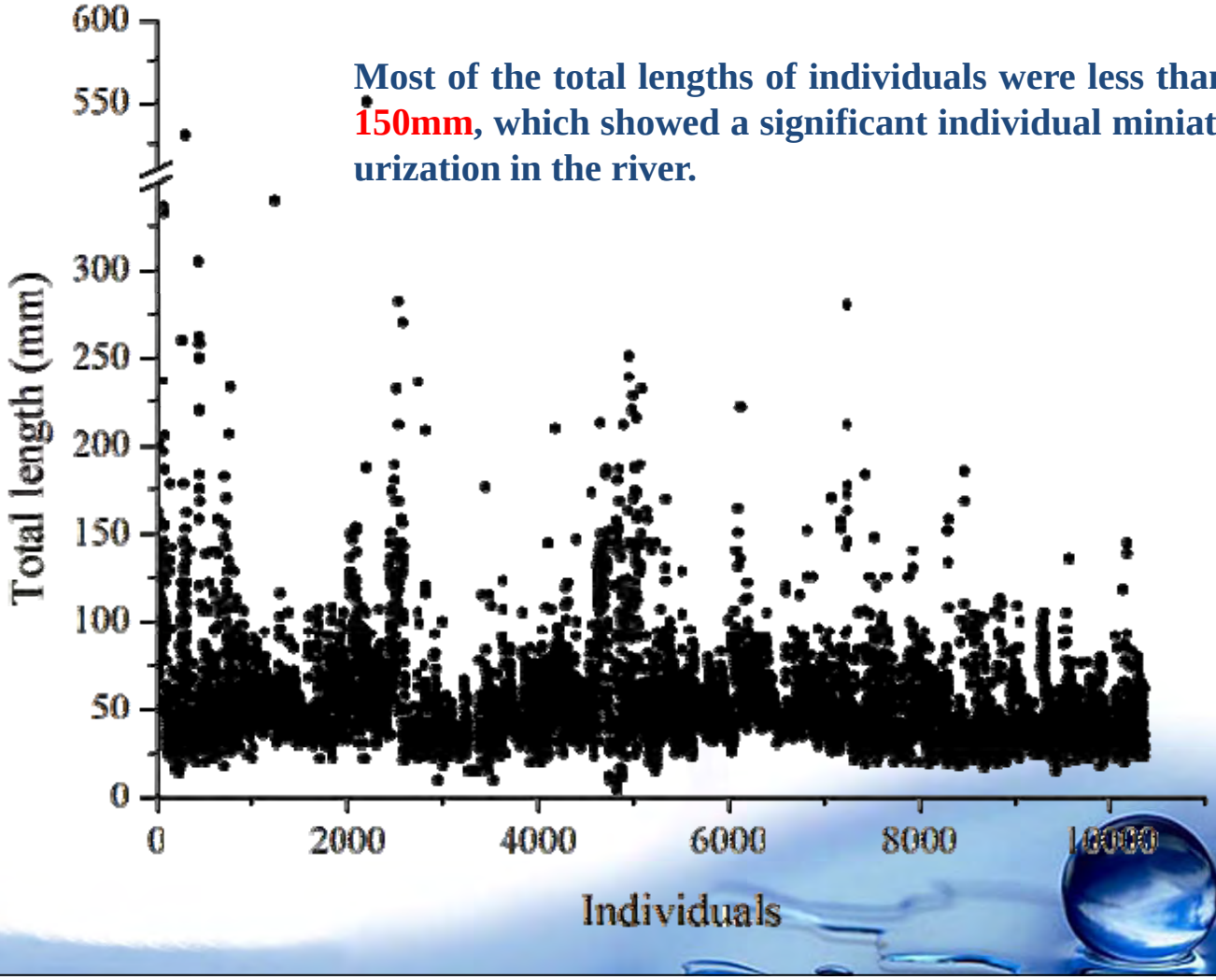
北苕溪鱼类群落结构与环境因子的CCA排序图



Six of 14 environ mental variables had significant rel ationship with the fish communities

Associations to habitat variables

Overfishing



Most of the total lengths of individuals were less than 150mm, which showed a significant individual miniaturization in the river.

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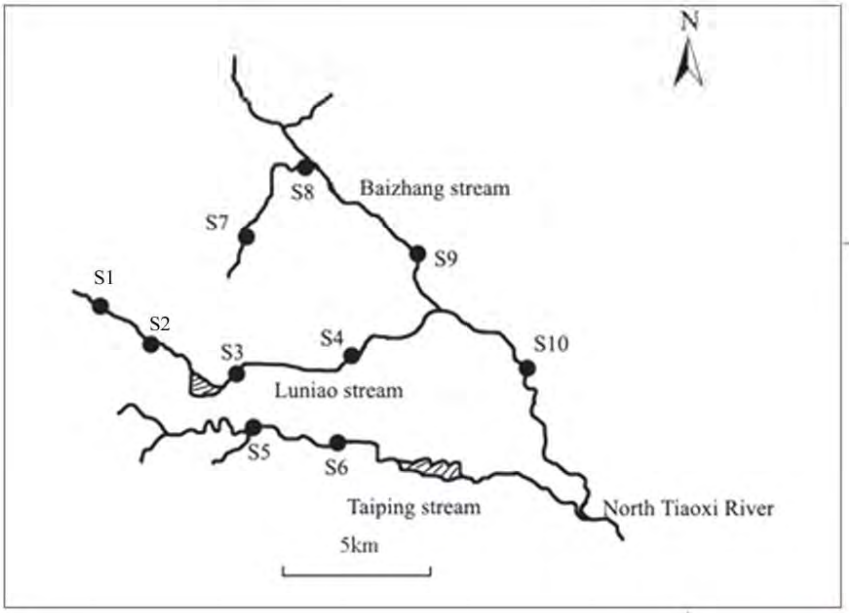
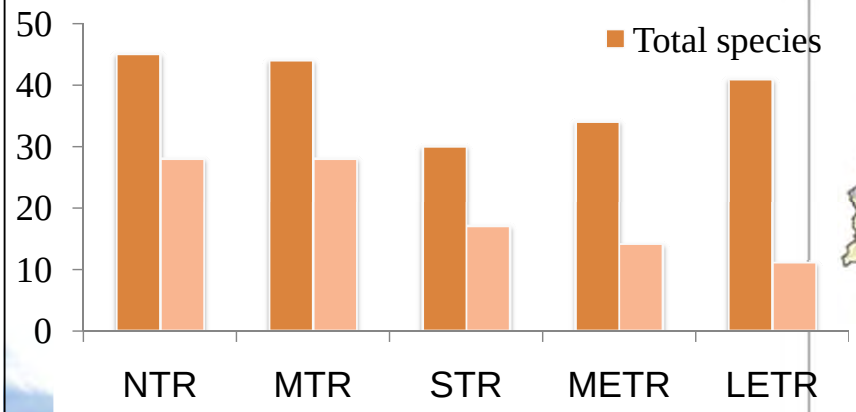
3. types and characteristics analysis on instream habitat

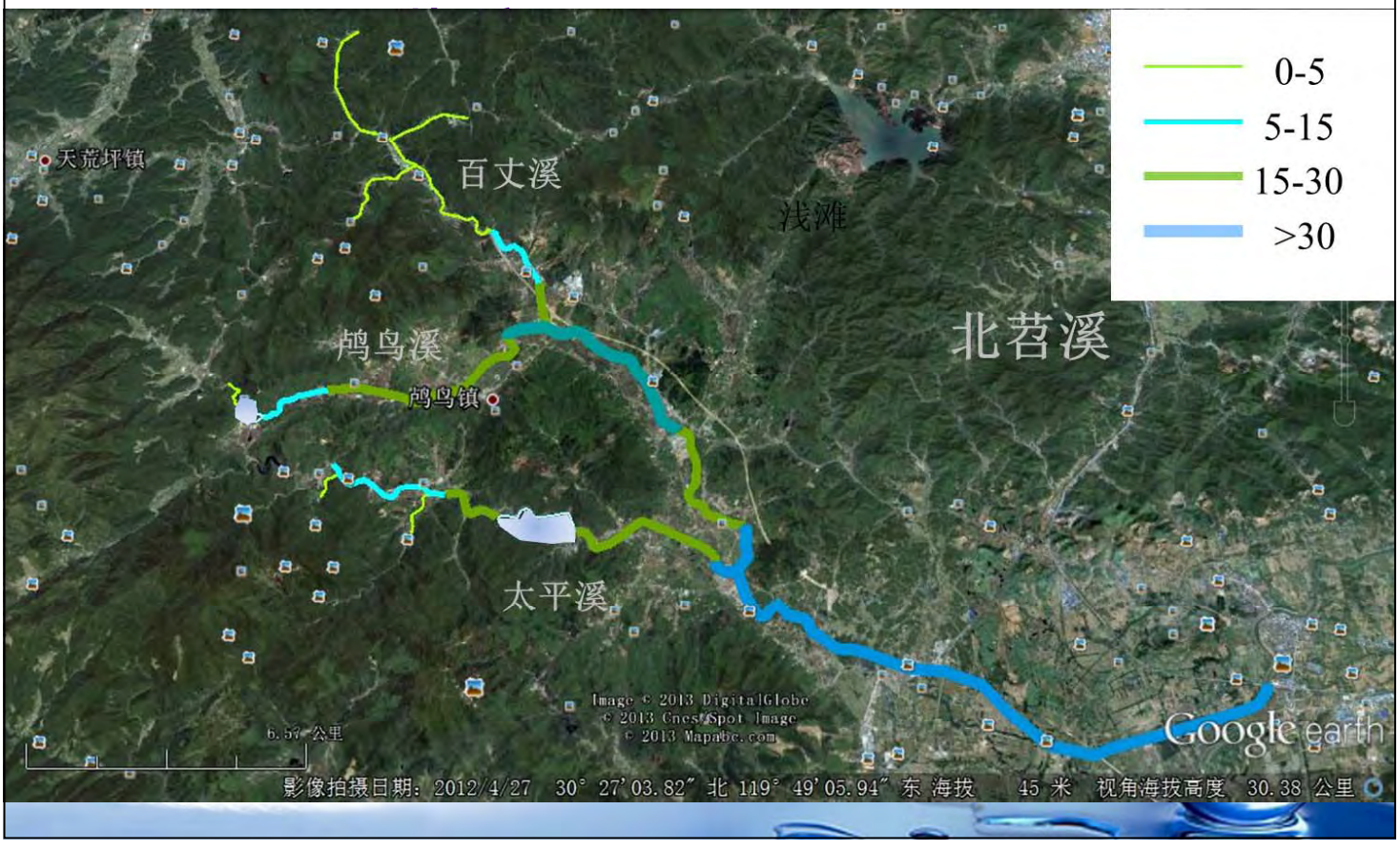
Study area





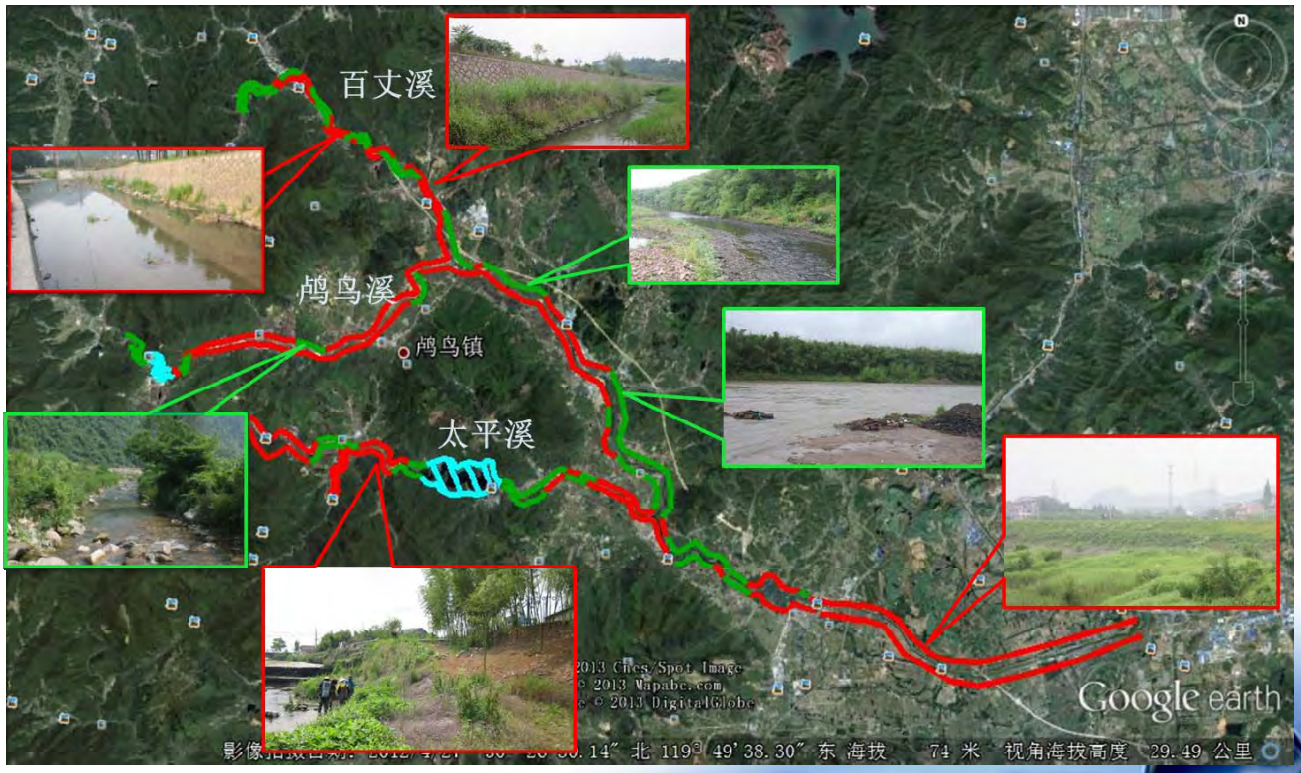
Habitat research

Survey region



Habitat research

Revetment type:



- 人工护岸比例为71.45%

Habitat classification

Still water H. 静水栖息地

Slow flow H. 缓流栖息地

Rapids H. 急流栖息地

Alluvial H. 冲积栖息地

Pool 水潭

Waterfall 瀑布潭

Wash 河滩洼地

特征：

- 大块岩石阻挡
- 大型树木倾倒
- 弯曲处水流冲击

- 流速：7.83 cm/s
- 水深：33.92 cm
- 底质：7.14 cm

Habitat classification

Still water H. 静水栖息地 | Slow flow H. 缓流栖息地 | Rapids H. 急流栖息地 | Alluvial H. 冲积栖息地

Pool 水潭 | Waterfall 瀑布潭 | Wash 河滩洼地

特征：

- 坡度陡
- 阶梯—深潭格局

- 流速：7.66 cm/s
- 水深：36.45 cm
- 底质：20.85 cm

Habitat classification

Still water H. 静水栖息地 | Slow flow H. 缓流栖息地 | Rapids H. 急流栖息地 | Alluvial H. 冲积栖息地

Pool 水潭 | Waterfall 瀑布潭 | Wash 河滩洼地

特征：

- 洪水泛滥，低洼处积水
- 深浅与洼地形状

- 流速：0
- 水深：32.08 cm
- 底质：3.42 cm

Habitat classification

Still water H. 静水栖息地 | **Slow flow H.** 缓流栖息地 | **Rapids H.** 急流栖息地 | **Alluvial H.** 冲积栖息地

Shallow 浅流 | Slow flow 岸边缓流 | Backflow 回流

特征：

- 水流缓慢，小颗粒沉积
- 表面干扰少
- 底质颗粒易附着藻类

- 流速：12.79cm/s
- 水深：27.75 cm
- 底质：8.07 cm

Habitat classification

Still water H. 静水栖息地 | **Slow flow H.** 缓流栖息地 | **Rapids H.** 急流栖息地 | **Alluvial H.** 冲积栖息地

Shallow 浅流 | Slow flow 岸边缓流 | Backflow 回流

特征：

- 河床迁移形成
- 河道宽度越大，面积越大

- 流速：5.56 cm/s
- 水深：15.57 cm
- 底质：8.07 cm

Habitat classification

Still water H. 静水栖息地 | Slow flow H. 缓流栖息地 | Rapids H. 急流栖息地 | Alluvial H. 冲积栖息地

Shallow 浅流 | Slow flow 岸边缓流 | Backflow 回流

特征：

- 石块、树根、大型树枝等
- 内部流速不均匀
- 受水流变化明显

- 流速：10.75 cm/s
- 水深：26.26 cm
- 底质：3.49 cm

Habitat classification

Still water H. 静水栖息地 | Slow flow H. 缓流栖息地 | Rapids H. 急流栖息地 | Alluvial H. 冲积栖息地

Riffle 浅滩 | Shoal 险滩

特征：

- 水流冲击大颗粒石块
- 上游与水潭相连
- 无藻类附着于底质

- 流速：21.20 cm/s
- 水深：18.56 cm
- 底质：12.63 cm

Habitat classification

Still water H.
静水栖息地

Slow flow H.
缓流栖息地

Rapids H.
急流栖息地

Alluvial H.
冲积栖息地

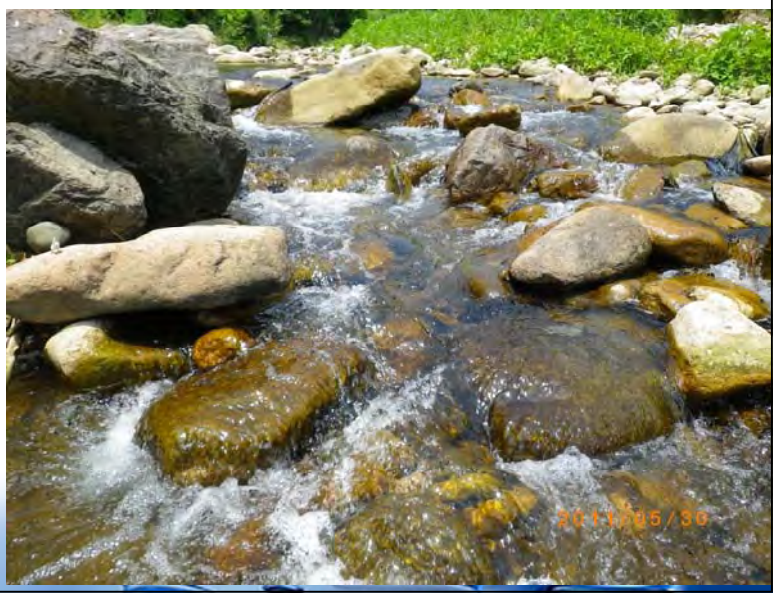
Riffle
浅滩

Shoal
险滩

特征：

- 上游陡坡地段
- 水流紊乱
- 底质以圆石、巨石为主

- 流速：116.15 cm/s
- 水深：22.15 cm
- 底质：24.70 cm



Habitat classification

Still water H.
静水栖息地

Slow flow H.
缓流栖息地

Rapids H.
急流栖息地

Alluvial H.
冲积栖息地

Washland
河漫滩

Shoal
沙洲

特征：

- 洪水冲积而成
- 底质以小颗粒砂石为主
- 水生植被生长良好

Habitat classification

Still water H. 静水栖息地

Slow flow H. 缓流栖息地

Rapids H. 急流栖息地

Alluvial H. 冲积栖息地

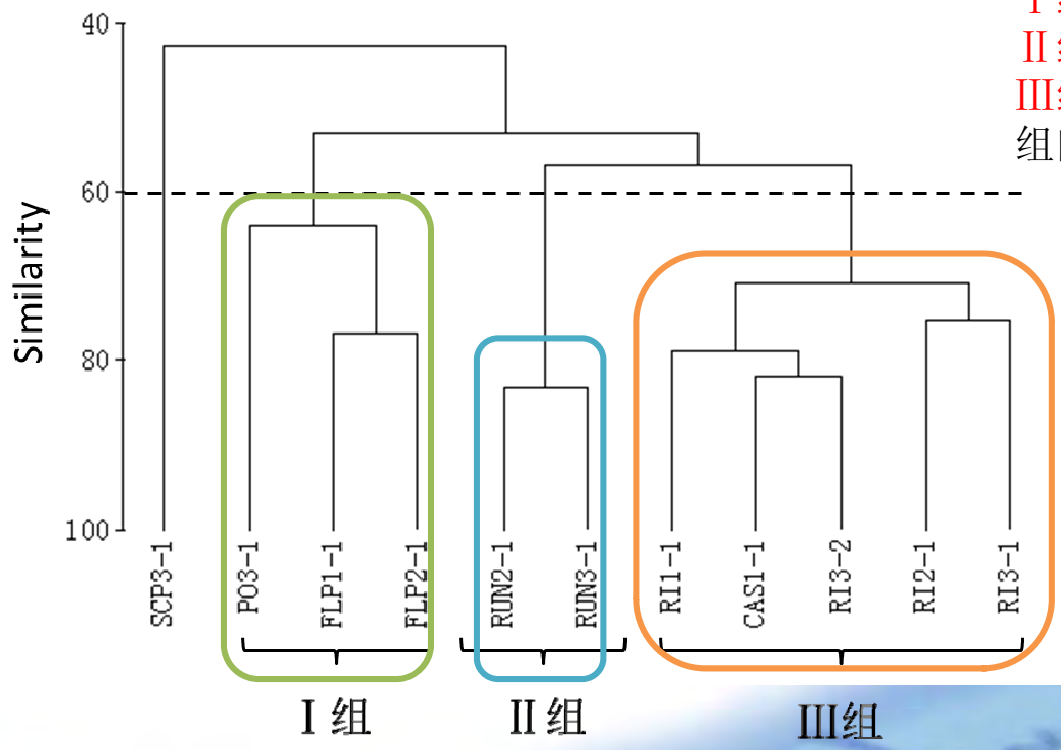
Washland 河漫滩

Shoal 沙洲

特征：

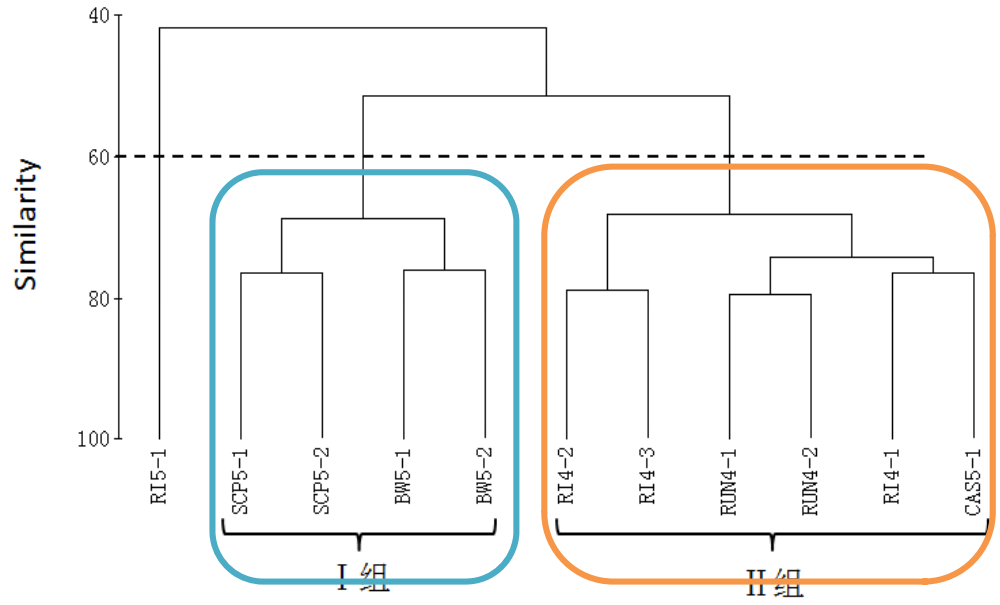
- 弯曲河段沙土沉积
- 洪水冲击石块形成河中沙洲
- 部分水生植被生长良好

clustering analysis



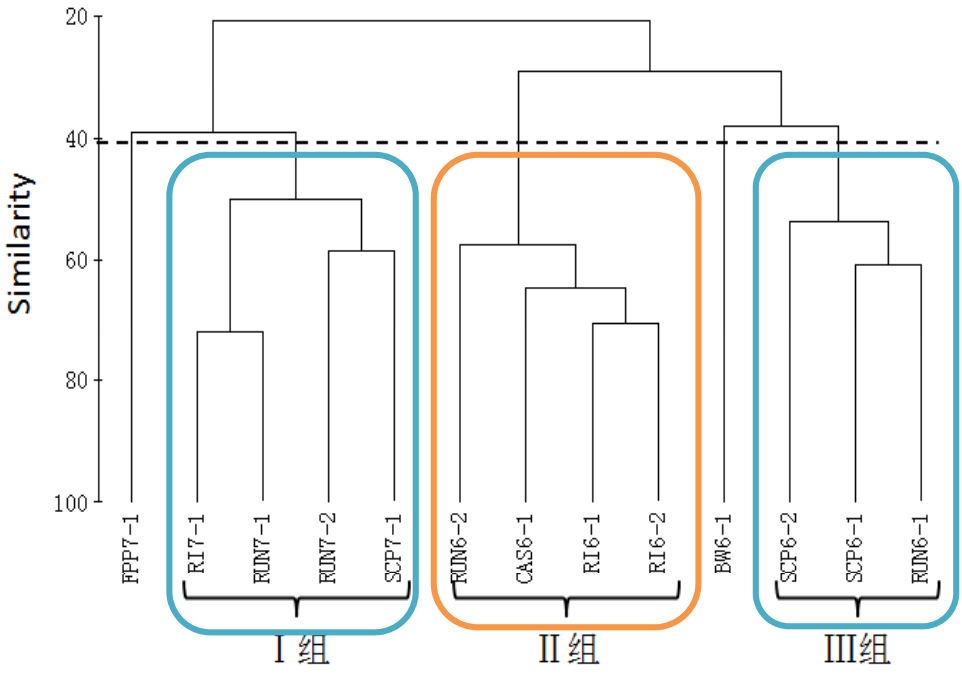
I 组为静水栖息地
II 组为缓流栖息地
III组为急流栖息地
组间差异较明显

clustering analysis



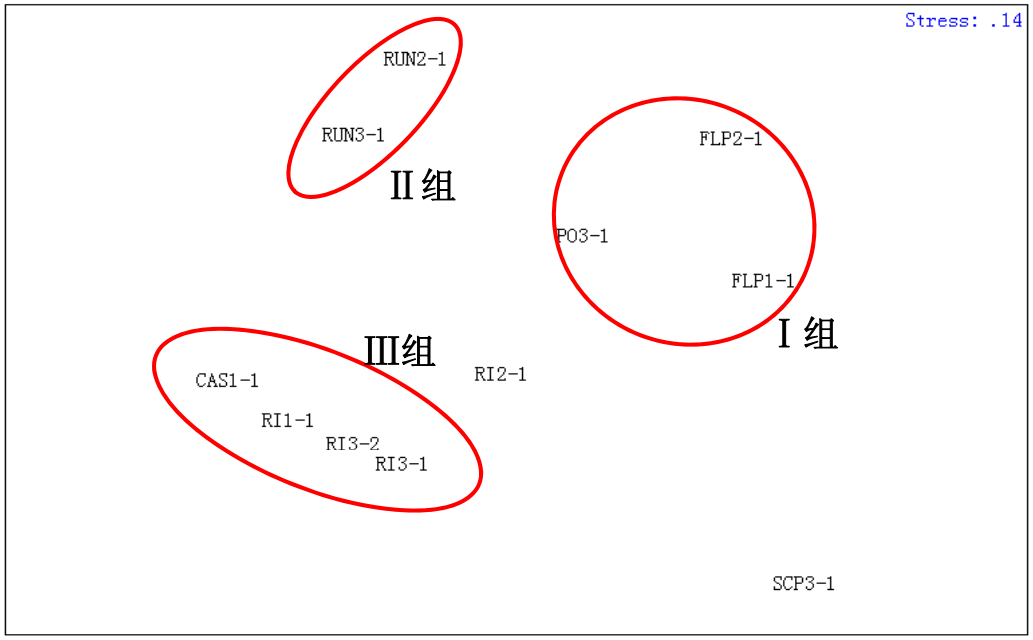
I 组为缓流栖息地
II 组为急流栖息地为主
组间差异较明显

clustering analysis



I 组为S7缓流栖息地
II 组为S6急流栖息地
III组为S6缓流栖息地
组间差异较明显

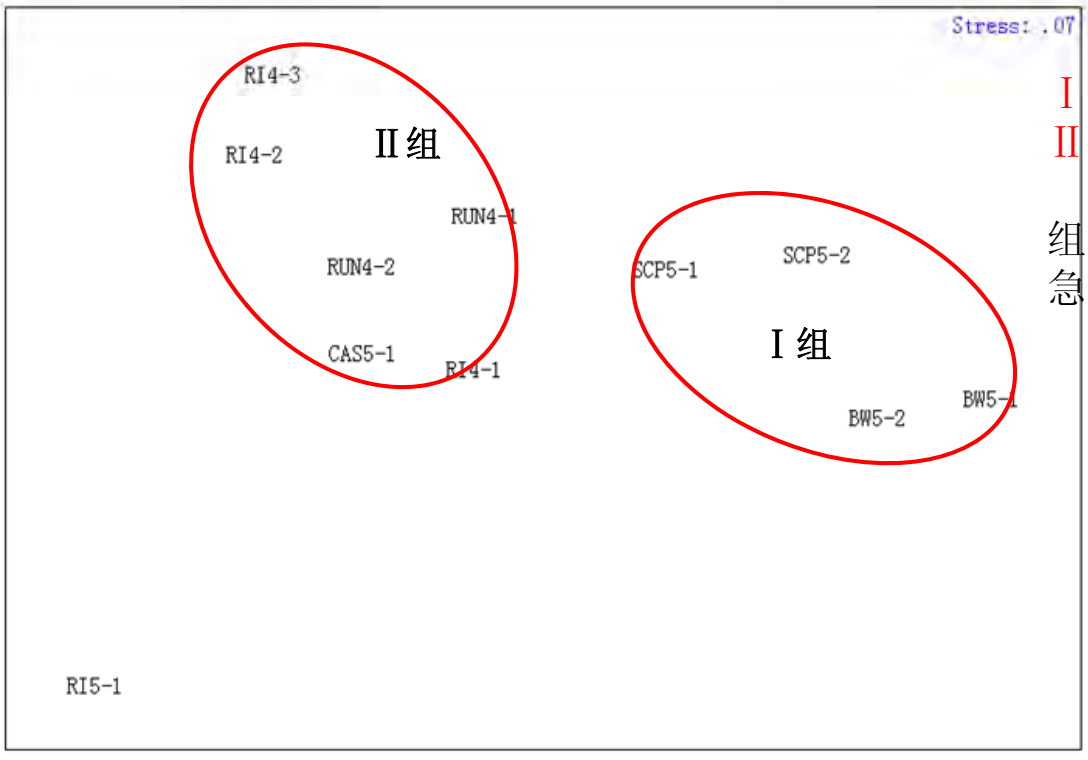
MDS ordination analysis



Ⅰ组为静水栖息地
Ⅱ组为缓流栖息地
Ⅲ组为急流栖息地

组内相似度：
急流>缓流>静水

MDS ordination analysis



Ⅰ组为缓流栖息地
Ⅱ组为急流栖息地为主

组内相似度：
急流>缓流

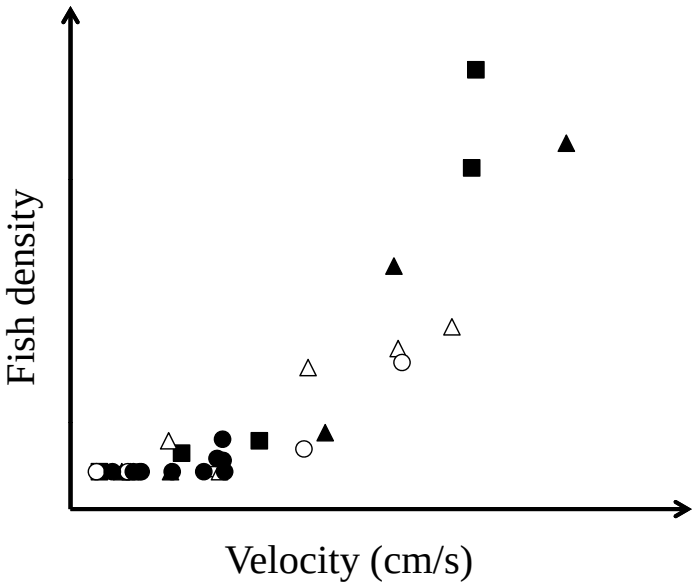
MDS ordination analysis

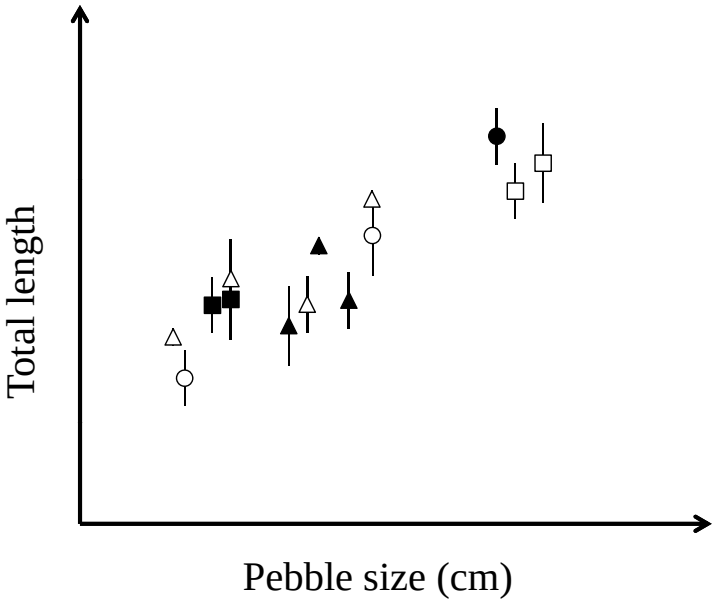
Ⅰ组为S7缓流栖息地
Ⅱ组为S6急流栖息地
Ⅲ组为S6缓流栖息地

组内相似度：
急流>缓流

Microhabitat preference and populati on structure of *Leptobotia tchangi*

The length-frequency distribution calculated using FiSAT software showed the loach pop--ulation structure could be classified into four age groups suggesting that the life span of the loach should be 3- 4 years.





The density of this kissing loach was signi ficantly and positively correlated with wate r velocity, while the body size was signific antly and positively correlated with river b ed pebble size.

4. Conclusion

Conclusion

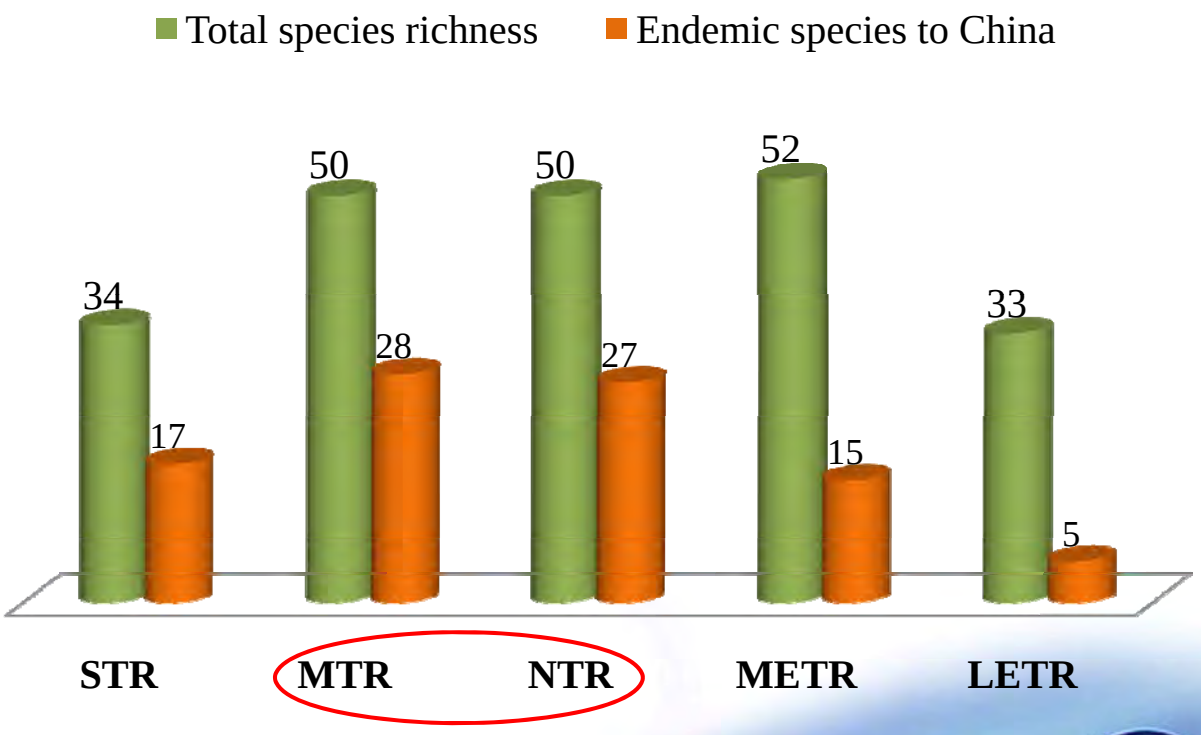
- River engineering could be the main threat to fish diversity in the upper stream, as well as water pollution and overfishing.
- The habitat instream of North Tiaoxi River can be divided into 4 categories, 10 types, the environmental elements of each habitat are significantly different.
- The otherness of fish Community diversity is obvious between different habitat types. Different hydrological conditions of rapid-flow habitats, slow-flow habitats and still-water habitats affect the distribution of fish communities. Fish species diversity is high in floodplain habitat, and fish population is given priority to young fish.

Conclusion

Serious water pollution in small & medium-scale rivers in plain area causes a huge stress to fish and other aquatic life's existence. But some of the rivers is still in its natural or semi-natural state, if we only consider the single mode of water quality improvement when implementing water environment comprehensive treatment, the physical integrity and biological integrity of river habitat will be destroyed, then only to achieve the effect of shibeigongban（事倍功半）.

Most of the upper-middle reaches of small and medium-sized rivers belong to a type of mountain-rivers, water quality status and physical habitat are still in good condition. To reserve aquatic biodiversity, we should make comprehensive protection plan as soon as possible, avoid damage to the physical habitat caused by unreasonable treatment, and especially to give priority to protect the "Hot Spots" which have good fish biodiversity.

Conservation suggestions



(NTR: North Tiaoxi River; MTR: Middle Tiaoxi River; STR: South Tiaoxi River; METR: Middle reach of East Tiaoxi River; LETR: Lower reach of East Tiaoxi River)

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Thank you