Status of freshwater fish biodiversity in the Yangtze River Basin, China

Jianhua Li

College of Environmental Science and Engineering, Tongji University, Shanghai 200092, China

ABSTRACT

Tere are over 1000 species in Chinese freshwater fish fauna, in which at least 717 species in 33 families inhabit rivers, along with a further 66 species spend part of their lives in rivers. The other species are mainly confined to esturine reaches, but they swim upsteam occasionally. According to the recently gathered information on freshwater fish biodiversity, 361 species are found in the Yangtze River Basin, of which 177 species are endemic to the Yangtze River. Pessimistically, 25 species in the Yangtze River Basin are listed as endangered species in the China Red Data Book for fishes. the Three Gorges Dam (TGD). Regarding to the species richness patterns along the basin altitude gradient of total, non-endemic and endemic fishes were different, which non-endemic richness showed a significant decrease with increasing elevation, whereas endemic richness had a couple of peaks including a major peak at around 500-m and a minor peak at near 1800-m. Meanwhile, species density also presented two peaks at mid elevation zones for endemic and non-endemic fishes, such as 1500-2000m and 3500-4000m for endemic fishes, and 500-1000m and 3500-4000m for non-endemic fishes, respectively. In addition, structure of endemic fish assemblages in the upper Yangtze River was highly correlated with local topographic and geomorphic characteristics.

The combined effects of pollution, habitat degradation and overexploitation have reduced fish stocks dramatically. Hydrological alterations are perhaps the largest threat to fish biodiversity in the Yangtze River Basin, such as dam construction and disconnection between river and its lakes. Conservation measures which were applied currently to protect the fish biodiversity in the basin exert ineffectively, such as nature reserve establishment, artificial propagation and releasing. Therefore, in order to preserve fish biodiversity more effectively in this area, reserve networks, rather than a single national nature reserve, should be established. Moreover, the improvement of artificial releasing and habitat rehabilitation should be considered urgently.

Status of freshwater fish biodiversity in the Yangtze River Basin, China





Jianhua Li

Key Laboratory of Yangtze Aquatic Environment, Ministry of Education, China Tongji University



No. of freshwater fish and basin characteristics of main rivers in China

	No. of	Total length	Basin area	No. of species	Average latitude
Rivers	species	(km)	(10^4km^2)	/basin area	(°)
Pearl River	296	2216	44	6.7	24
Yuanjiang River	83	677	3.8	21.8	24
Jiulongjiang River	102	285	1.4	72.9	24.5
Hanjiang River	123	428	3.4	36.2	24.5
Minjiang River	135	581	6.1	22.1	27
Oujiang River	93	388	1.8	51.7	28
Qiantang River	168	605	5.4	31.1	29
Yangtze River	361	6397	181	2.0	31
Huaihe River	104	1078	26.9	39	33
Yellow River	150	5464	75	2.0	38
Yalvjiang River	80	795	6.4	12.5	41
Liaohe River	89	1394	23	3.9	42
Heilongjiang River	92	4350	88.7	1.0	49

(Wang 1997; Fu et al. 2003)

Freshwater fish in different countries

www.Fish base.org





Total length: 6300 km; Drainage area: 1,800,000 km² Population: 40% of China; Water resources: 36% of China GDP: 40% of China; Food production: 40% of China



In China, the Yangtze (Changjiang) River is often likened to a "Dragon" because of its length and importance.....



长"Chang" – long 江"Jiang" – river



The Distribution of fish species along the Yangtze River

SECTION	Upper Yangtze	Middle Yangtze	Lower Yangtze
Number of fish species	126	140	180
Major fish species	copper fish, common carp, grass carp, Leiocassis longirostris, Procypris rabaudi, Spinibarbus, Varicorhinus simus, Elopichthys bambusa	copper fish, black carp, grass carp, silver carp, bighead carp, common carp, crucian carp, Chinese sturgeon	anchovy, Shad, Eel, common carp, silurid catfish, black carp, grass carp, silver carp, bighead, whitefish
Catch percentage	3% of the total	34% of the total	63% of the total

(Chen et al. 2004)

Freshwater Fish in the Yangtze River

361 species distributed among 12 orders, 29 families and 131 genera.



Present of species number of the most species-rich orders to the total species in the Yangtze River Basin

(Fu et al. 2003)

Freshwater Fish in the Yangtze River



Percent of endemic species number of the most endemic species-rich families to the total endemic species in the Yangtze River Basin (Fu et al. 2003)

4000lakes20,000km²More than 170 fishes,

C&L YANGTZE

production, 44% of Global

>50% of Chinese

freshwater fish

RIVER BASIN

Threats to fish biodiversity in the Yangtze River Basin



Endangered Species Loss



Decrease in the numbers of fishes year by year in the Yangtze river, Especially Rare species,

Over-exploitation

There are over 160 kinds of fishing gears in the Yangtze River (Duan et al. 2002), of which, the most harmful are fyke net of dense mesh, fyke net of ramie cloth, maze, drop net, damming net and trap net (Chen et al. 2004).



Over-exploitation



Water Pollution



Water Quality of the Yangtze River Waters

(MEP, 2007)

Habitat Degradation

160 000 hectares of land were reclaimed from Lake Dongting (Liao et al. 2002), resulting in a loss of fish spawning grounds by 36 percent.



Freshwater fish in the lakes of Yangtze River Basin





- + \sim 50,000 dams since 1950
- total storage capacity of reservoirs \sim 200x10 ⁹ m ³,

or 22% of Yangtze annual runoff

sediment accumulation in reservoir: >850x10 ⁶ t/yr in 2003

Yang et al., 2005

Acipenser sinensis



chinese sturgeon

Production of *Acipenser sinensis* in different reaches (before and after construction of Gezhou Dam)



Flow modification



The Jinsha (upper Yangtze) River in China showing the location of 13 dams planned or under construction above the Three Gorges Dam (TGD) and Gezhouba Dam (see inset).

Flow modification



Species invasion

Category of invasive alien species in China

	Category	Number of species	Percent(%)
	Microorganism	19	6.7
<	Aquatic plant	18	6.4
	Terrestrial plant	170	60
<	Aquatic invertebrate	25	8.8
	Terrestrial invertebrate	33	11.7
<	Amphibian and reptile	3	1.1>>
<	Fish	10	3.5
	Mammal	5	1.8
	Total	283	100

(Xu et al. 2006)

Origin of invasive alien species in China

Category	Region					
	America	Europe	Asia	Africa	Oceania	Unknown
Microorganism	9	4	1	0	0	5
Aquatic plant	16	1	1	1	0	5
Terrestrial plant	106	45	21	18	1	1
Aquatic invertebrate	19	13	1	0	0	0
Terrestrial invertebrate	17	5	6	4	1	4
Amphibian and reptile	3	0	0	0	0	0
Fish	6	0	1	3	0	0
Mammal	2	2	1	0	0	0
Total	178	70	32	26	2	15
				= -	_	
	Intenti	onal	Uninten	tional	Natural	
Category	Intenti introdu	onal ction	Uninten introdu	tional ction	Natural dispersio	n Unkown
Category Microorganism	Intenti introdu 0	onal ction	Uninten introdu 19	tional ction	Natural dispersio	n Unkown 0
Category Microorganism Aquatic plant	Intenti introdu 0 7	onal ction	Uninten introdu 19 11	tional ction	Natural dispersion 0 0	n Unkown 0 0
Category Microorganism Aquatic plant Terrestrial plant	Intenti introdu 0 7 88	onal ction	Uninten introdu 19 11 54	tional ction	Natural dispersio 0 0 8	n Unkown 0 0 23
Category Microorganism Aquatic plant Terrestrial plant Aquatic invertebrate	Intenti introdu 0 7 88 1	onal ction	Uninten introdu 19 11 54 24	tional ction	Natural dispersion 0 0 8 0	n Unkown 0 0 23 0
Category Microorganism Aquatic plant Terrestrial plant Aquatic invertebrate Terrestrial invertebrate	Intenti introdu 0 7 88 1 5	onal ction	Uninten introdue 19 11 54 24 32	tional ction	Natural dispersion 0 0 8 0 0 0	n Unkown 0 0 23 0 0
Category Microorganism Aquatic plant Terrestrial plant Aquatic invertebrate Terrestrial invertebrate Amphibaian and reptile	Intenti introdu 0 7 88 1 5 3	onal ction	Uninten introdue 19 11 54 24 32 0	tional ction	Natural dispersion 0 0 8 0 0 0 0 0	n Unkown 0 0 23 0 0 0 0
Category Microorganism Aquatic plant Terrestrial plant Aquatic invertebrate Terrestrial invertebrate Amphibaian and reptile Fish	Intenti introdu 0 7 88 1 1 5 3 10	onal ction	Uninten introdue 19 11 54 24 32 0 0	tional ction	Natural dispersion 0 0 8 0 0 0 0 0 0 0	n Unkown 0 0 23 0 0 0 0 0 0
Category Microorganism Aquatic plant Terrestrial plant Aquatic invertebrate Terrestrial invertebrate Amphibaian and reptile Fish Mammal	Intenti introdu 0 7 88 1 5 3 10 10 1	onal ction	Uninten introdue 19 11 54 24 32 0 0 3	tional ction	Natural dispersion 0 0 8 0 0 0 0 0 0 0 1	n Unkown 0 0 23 0 0 0 0 0 0 0 0

Conservation of freshwater fish diversity in the Yangtze River



Nature Reserve Establishment

A lot of nature reserves have been established for freshwater fish conservation in the Yangtze River Basin.



Nature Reserve Establishment

11 nature reserves in the Yangtze River Basin have been listed in Ramsar Convention.



Rehabilitation of Habitat for fish

		Minimum protected area estimated (km ²)			
Habitat guild	target	S/A	S/log ₁₀ A	log ₁₀ S/log ₁₀ A	
Total species	173	10,100	28,500	14,400	
River-sea migratory fishes	14	7900	11,800	7500	
River-lake migratory fishes	11	-	-	-	
Lake resident fishes	100	10,400	23,000	13,500	
Riverine fishes	48	11,500	79,800	11,400	

-, not estimated because of poor relationship between the two variables.

Comparison of minimum protected area estimated by different models in the Middle Reach of Yangtze River Basin (Liu & Wang 2010)

Enhancement of Legislation

Closed fishing season in different areas of Yangtze River Basin

Location	Period
Upper reaches of Yangtze River	February 1 st - April 30 th
Middle-lower reaches of Yangtze River	April 1 st - June 30 th
Donting Lake	March 10 th - June 30 th
Poyang Lake	March 20 th - June 20 th
Honghu Lake	April 1 st - June 30 th
Chaohu Lake	Febuary 1 st - Julyl 31 st
Taihu Lake	Febuary 1 st - August 31 st













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



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

Three main factors for fish in river/stream ecosystem



Temperature, pH, BOD, etc.

Physical environment/character

Pool-riffle structure, complexity at river bank, substrate, etc.

Interaction among organisms

Interspecific/ intraspecific interaction, alien fishes, fishing by human, etc.



Tiaoxi River, China



Tiaoxi River, China

Threats for physical environment





ovember 200

River engineering could be the main threat to fish diversity in the upper stream, which is ongoing practice in the upper streams resulting in decrease of fish richness and abundance dramatically





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)

Thank you!

Thanks a lot to Mitsubishi corporation and Global COE program of Kyushu Univ. for their precious supports

The Major Project in National Water Pollution Control and Management Technology (No. 08ZX07101-006-07)