Briefing on Xiaonanhai Dam and Its Impact on the Upper Yangtze Rare and Endemic Fishery

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Contents

INTRODUCTION

- The Yangtze River is the largest river in China and in Asia. It hosts the world's most important freshwater aquatic life gene pool, as well as the aquatic ecosystem linked to it. The Yangtze River is key to maintaining the planet's biodiversity and ecosystem, and to meeting demands for sustainable development of human society.

- The building of the Gezhouba Dam and the Three Gorges Project in the last century has greatly changed fish habitats and spawning conditions in the Yangtze River, leaving many species critically endangered. In order to protect the rare and endemic fish species of the Upper Yangtze, a provincial nature reserve was created in 1997 along the Hejiang to Leibo course of the Upper Yangtze mainstream in Sichuan. The nature reserve was elevated to national status in 2000.

- However, following the encroachment by two large-scale hydropower plants – Xiangjiaba and Xiluodu – of its boundaries, the nature reserve was forcibly 'modified' in 2005 so that it now only covered the course between Yibin and the tail end of the Three Gorges Reservoir in Chongqing. This is the last remaining natural section in the Upper Yangtze mainstream. It is the only stretch in this part of the river that could still provide a habitat for a diverse fish stock. It also represents the last refuge that the rare and endemic fish species of the Upper Yangtze have for their survival and reproduction. At the time, the State Environmental Protection Administration clearly stated that, "It should be made clear both in revised plans and during construction that no new hydropower project is to be developed in the modified nature reserve."

- Despite the MEP statement, those with vested interests proposed the continued development of large-scale hydropower projects, such as the Xiaonanhai hydroelectric plant, within the modified nature reserve. In order to eliminate 'obstacles'to the installation of the Xiaonanhai plant, the Upper Yangtze Rare and Endemic Fish National Nature Reserve was made to face yet another 'modification'. This plan was approved by the National Nature Reserve Review Committee in November 2010, and was announced in the Ministry of Environmental Protection's public circular no.1 in 2011.

- In the 'modification' plan for the reserve, the area proposed for the mega-dam at the Xiaonanhai hydroelectric plant and an adjacent 22.5km river section become 'non-reserve waters' after they are removed from the protection zone. At the same time, an originally protected 73.3km natural course above the Xiaonanhai mega-dam is turned into a reservoir area, which means a loss of at least 95.8km – or a 27% truncation – to the 353.16km Yangtze mainstream section in the reserve. The Xiaonanhai project will sever the last ecological passage for migration and reproduction for the rare and endemic fish species of the Upper Yangtze. The effective collapse of the nature reserve has fatal consequences to the aquatic ecosystem of the Upper Yangtze.

- The Upper Yangtze Rare and Endemic Fish National Nature Reserve was once again 'modified' so that the Xiaonanhai project can proceed. The move violated the People's Republic of China's 'Environmental Protection Law', 'Wildlife Protection Law', 'Regulations

on Nature Reserves', and 'Regulations regarding the Amendment of Range and Function, and Renaming of National Nature Reserves'. This amounted to a serious challenge to the country's laws and regulations.

- The fact that the Xiaonanhai hydroelectric plant is in a valley basin is going to lead to massive flood losses. Justifications such as the need to develop new energy solutions, to prevent mud and silt sedimentation, and to improve navigation channels, as well as the need for energy conservation and emissions reduction, are hard to support since the project struggles to meet the technical and economic standards expected of them. The massive environmental, social and economic costs involved in the project far outweigh the short-term gains from the tens of billions worth of investments, and the revenues and taxation that they will generate.

- The plight facing the fish population of the Yangtze is a final warning of the environmental degradation that the river has slid into. This threat is even more desperate than the serious difficulties that giant pandas and Tibetan antelopes had previously faced. The progressive extinction of aquatic life in the Yangtze will trigger a domino effect, bringing grave repercussions to mankind.

- We call for a public hearing and an administrative review of the planned modifications to the nature reserve. We call for the scrapping of the Xiaonanhai hydroelectric plant building plan on the Yangtze mainstream. We call upon all individuals who are concerned about the global environment and the sustainable development of human society to rally for the preservation the Yangtze ecosystem, and the aquatic life inextricably linked to it!

Open Letter on the protection of Upper Yangtze rare and endemic fish species and their ecology

The Honorable Wen Jiabao, Premier of the State Council
The Honorable Zhang Ping, Chairman of the National Development and Reform Commission
The Honorable Zhou Shengxian, Minister of Environmental Protection
The Honorable Han Changbin, Minister of Agriculture
The Honorable Chen Lei, Minister of Water Resources
The Honorable Cai Qihua, Chairman of the Yangtze Water Resources Commission
The Honorable Bo Xilai, Secretary of the Chongqing Municipal Party Committee
The Honorable Cao Guangjing, Chairman of the China Three Gorges Corporation

In order to eliminate 'obstacles' to the installation of the Xiaonanhai hydroelectric plant on the Yangtze mainstream in Chongqing, 'modifications' were once again imposed on the Upper Yangtze Rare and Endemic Fish National Nature Reserve. Those with vested interests in the project had been very determined in their quest for new achievements in hydropower development. In November 2010, they secured approval for new 'modifications' to the freshwater protection zone by the National Nature Reserve Review Committee. The endorsement was subsequently announced in the Ministry of Environmental Protection's public circular no.1 in 2011.

Once again, the country's laws and regulations in relation to nature reserves and environmental protection are under severe threat. Rare and endemic fish species of the Upper Yangtze and the defence of their habitat are in dire straits. We call for a public hearing and an administrative review of the planned modifications to the nature reserve. We call for the scrapping of the Xiaonanhai hydroelectric plant building plan on the Yangtze mainstream. We call upon all individuals who are concerned about the global environment and the sustainable development of human society to rally for the preservation the Yangtze ecosystem, and the aquatic life inextricably linked to it!

The Yangtze River is the largest river in China and in Asia. It is the third largest river in the world after the Nile and the Amazon. Known as the 'mother river' of China, it spans 1.8 million square kilometers and covers nearly one-fifth of the nation's area. The mighty river hosts the world's most important freshwater aquatic life gene pool, as well as the aquatic ecosystem linked to it. It is key to maintaining the planet's biodiversity and ecosystem, and to meeting demands for sustainable development of human society. Research by Chinese experts say there are approximately 370 fish species in the Yangtze, with about 260 of them found in the upper reaches of the river. Most of these species have evolved in the conditions offered by the natural water ecology of the Yangtze, and are endemic to China.

The building of the Gezhouba Dam and the Three Gorges Project in the last century cut the migratory channels previously used by many fish species of the Yangtze River. A large number of spawning grounds were inundated, and the habitat for the river's fish population is very different now. According to research by the Institute of Hydrobiology at the Chinese Academy of Sciences, the Three Gorges Project alone has reduced by about a quarter the habitat of approximately 40% of Upper Yangtze endemic fish species. As water flow in the reservoirs markedly slows, mud and silt sedimentation has increased, and major changes have occurred to the river bed structure, river depth, water temperature, and the composition of fish food organisms. Certain fish species that previously called that section of the river home could no longer cope with the drastically altered conditions.

However, when it became impossible for them not to move, they were confronted with a greatly compressed living space, which in turn contributed to the decline of the fish population as a whole.

According to Jia Jingde, a researcher with the Chinese Academy of Fishery Sciences, a compelling amount of studies conducted overseas asserts that dams are the main reason why one-fifth of the world's 9,000 freshwater fish species have been destroyed or become threatened – if not endangered – in the past century. Since the Gezhouba Dam and the Three Gorges Dam were installed, the resources available to migratory and semi-migratory fish species have suffered. In particular, the anadromous Chinese sturgeon, a precious species native to China, has been driven to near extinction. According to Conservation International, a species is considered endangered if it decreases by 20% over a 10-year period. However, the Chinese sturgeon in the Yangtze is now falling by 50% in a single decade; it has become a critically endangered species. The release of a million young Chinese Sturgeon to the Yangtze in recent years has produced no noticeable effect on the population of the species. In fact, their numbers have continued to decline rapidly. **Even if the number of artificially introduced fish goes up even further, it cannot replace the natural reproduction of fish in the river.** As methods to salvage endangered species, artificial breeding and artificial introduction of fish to rivers can only produce very limited results. At present, the sex gland in artificially reared first-generation Chinese Sturgeon has yet to show signs of maturity. The exercise to salvage the endangered species cannot be considered a success unless and until there is artificial hatching of second-generation Chinese Sturgeon. It will therefore be very difficult to reverse the damage caused by dam construction on the Yangtze mainstream to fish resources.

According to Ma Yi, Deputy Director of the Yangtze Fishery Management Commission, fish fry generated by the much-loved 'Four Great Domestic Fish' of the Yangtze (grass carp, black carp, silver carp and bighead carp) has decreased sharply because of the reservoirs created by the Three Gorges Dam. Monitoring results have shown that the average volume of fish fry produced between 2004 and 2006 has crashed by 90% compared with the levels recorded in 2003 when the reservoirs were still un-filled. These statistics suggest that all species in the Yangtze aquatic life chain are in comprehensive decline, and they clearly show that the ecology of the entire Yangtze River has suffered massive damage, while future trends do not allay fears of further deterioration. Ma Yi also asserted that any gains that came from the various Yangtze hydro projects were countered by the massive negative consequences left in their wake. From the serious encroachment of aquatic life habitat and the breaking of migratory channels to the inundation/damage of spawning grounds and the hastened decline of aquatic life resources; from the decline in species quality and abnormal genetic mutations to the drastic fall in the total volume of resources available, these damages amount to devastation – and they are irreversible. The biodiversity of the Yangtze is gradually disappearing.

In order to protect the biological resources and habitat of the rare and endemic fish species in the Upper Yangtze, and to mitigate the impact from the Three Gorges Project, a provincial nature reserve was created in 1997 along the Hejiang to Leibo course of the Upper Yangtze mainstream. The nature reserve was elevated to national status in 2000. However, with the activation of the cascade hydropower facilities along the Jinsha River mainstream, and the encroachment by two large-scale hydropower plants in the river's lower reaches - Xiangjiaba and Xiluodu – of the nature reserve's core and buffer zones, the protected area was forced to move downriver to a shrunken area that stretches from the tail end of the Three Gorges Reservoir in Chongqing to the section immediately below the Xiangjiaba Dam in Yibin. At the same time, the Chishui River, as well as the Yibin to Yuebo section in the Min River mainstream, were added to the redrawn nature reserve boundaries. The new hold-out is renamed the Upper Yangtze Rare and Endemic Fish National Nature Reserve. At the time, the State Environmental Protection Administration clearly stated that, **"The modification plan should**

proceed according to the State Council approval opinion. It should be made clear both in revised plans and during construction that no new hydropower project is to be developed in the modified nature reserve."

According to a study by the Institute of Hydrobiology at the Chinese Academy of Sciences, so far there are 189 known fish species in the Upper Yangtze Rare and Endemic Fish National Nature Reserve. Among them, three each were placed in the PRC's List of Wildlife under Special State Protection, and the 1996 Red List of the International Union for Conservation of Nature and Natural Resource (ICUN). Meanwhile, two species appeared in Appendix II of the 1997 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), nine were in the 1998 Red Data Book of endangered animals in China, and 15 were in the List of Aquatic Wildlife under Local Protection in the Four Provinces (Municipality) of Yunnan, Guizhou, Sichuan and Chongqing.

Jie Yan, Secretary-General of the International Society of Zoological Sciences and China Project Manager at the Wildlife Conservation Society, pointed out that "The Xiaonanhai area is home to the richest collection of endemic fish species in China, and it is also the area with the highest number of threatened species in the country."

The area from the tail end of the Three Gorges Reservoir in Chongqing to Yibin where the nature reserve sits is the last remaining natural section in the Upper Yangtze mainstream. It is also the only stretch in this part of the river that could still provide a habitat for a diverse fish stock. Moreover, as the Yibin – Tiger Leaping Gorge natural section in the Jinsha River turns into a network of cascade reservoirs, and as cascade hydropower exploitation begins to unfold across all branches of the Upper Yangtze, the nature reserve represents the last refuge that the rare and endemic fish species of the Upper Yangtze have for their survival and reproduction.

However, the future of this one and only national nature reserve on the Yangtze mainstream is now hanging by a thread. Those with vested interests are sticking to their plans to build three hydroelectric plants at Xiaonanhai, Zhuyangxi and Shipeng which are all within the protection zone. This will turn the entire Upper Yangtze mainstream into an inter-locking series of cascade reservoirs. In order to eliminate 'obstacles' to the prioritised Xiaonanhai plant in Chongqing, a 're-modification' plan was proposed for the Upper Yangtze Rare and Endemic Fish National Nature Reserve. In this plan, the area proposed for the Xiaonanhai mega-dam and an adjacent 22.5km section between Songgaixi and Masangxi Bridge become 'non-reserve waters' after they are removed from the nature reserve. At the same time, the originally protected 73.3km Shimenzhen – Di Wei Bridge course upriver from the mega-dam is downgraded from a buffer zone to a test zone. Further, once the Xiaonanhai plant is completed, the Shimenzhen – Di Wei Bridge natural river course will cease to be a test zone. Instead, it will turn into a reservoir zone, which will effectively spell the end of the nature reserve's protection function. This will mean a loss of at least 95.8km – or a 27% truncation – to the 353.16km Yangtze mainstream section in the reserve.

Professor Cao Wenxuan, an academician at the Institute of Hydrobiology at the Chinese Academy of Sciences and a leading Chinese fish expert, has previously stressed in a report that "the lower section of the Upper Yangtze Rare and Endemic Fish National Nature Reserve, namely, the Xiaonanhai section, is a vital channel for the functional life-cycle of rare and endemic fish species in the nature reserve, as well as the commercially important 'Four Great Domestic Fish' species. We call this vital channel an 'ecological corridor'." It is "most crucial to the survival of the rare and endemic fish species in the Upper Yangtze nature reserve, and to the development of fishery in the Three Gorges Reservoir. Therefore, it must be kept free, and no hydro projects should be built there. The important

role played by this ecological corridor cannot be replaced by fish ladders or any other similar designs."

Further, Professor Cao and other experts said that eggs from Yangtze fish species are mainly of the 'drifting' or 'floating' variety, and their growth requires the right combination of temperature, current speed and flow trajectory. For fish eggs laid in the Upper Yangtze nature reserve, they need to drift over a minimum range of 200 – 500km to complete hatching and to get sufficient space to grow. These fish eggs/fish fry are first carried through the Xiaonanhai section into the Three Gorges Reservoir. When they develop into juveniles, they have to travel through the Xiaonanhai section again in order to return to the lotic environment of the nature reserve. The reservoir environment does not allow Yangtze fish species to breed, or their spawn to mature into adult fish. The Xiaonanhai mega-dam is set to become a vast barrier that will break a vital route for migratory fish species to swim either upriver or downriver.

Qin Weihua, an expert with the MEP's Nanjing Institute of Environmental Sciences and his colleagues have pointed out that "**the aggregate impact of the Xiaonanhai plant and other cascade hydropower plants will seriously alter the water environment of the river's ecosystem, spelling disaster for the rare and endemic fish species that they will displace.** The Xiaonanhai project will directly affect an approximately 72.5km-long section in the Upper Yangtze Rare and Endemic Fish National Nature Reserve. This section is the most important spawning ground for, and it boasts the highest concentration of, the diverse endemic fish species living in the lower portion of the nature reserve. Also, of all endemic fish spawning grounds in the nature reserve, it is the closest to the Three Gorges Reservoir zone. Once the Xiaonanhai project is completed, its reservoir will inundate seven pre-existing rare and endemic fish species spawning grounds. Among them, the intersection between the Qi River and the Yangtze mainstream is a key spawning ground for the Chinese sucker which is found in the lower portion of the nature reserve. Inundation caused by the Xiaonanhai Reservoir will completely kill the function of these seven spawning grounds. The backwater zone and the immediate area surrounding the dam in the Xiaonanhai project are not only bad to the spawning grounds of certain rare and endemic fish species, but they will also block fish migration and interactions along the two sides of the mega-dam. The lentic conditions of the flooded area will mean a compressed living environment – and a progressively disintegrating habitat – for fish that prefers flowing water. Migratory fish species will be greatly hit, and their extinction is now a distinct possibility.

In February 2009, the Ministry of Agriculture (MoA) organized a conference after the Chongqing Municipal Government submitted "A Special Research Report on the Impact of Yangtze Xiaonanhai Hydropower Project on the Upper Yangtze Rare and Endemic Fish National Nature Reserve and Strategies for Impact Reduction" (hereafter referred to as "Special report"). During the discussion, an expert panel pointed out that the Upper Yangtze Rare and Endemic Fish National Nature Reserve is a remedial measure designed to mitigate the impact of the Three Gorges and Jinsha River cascade hydropower developments on fish resources. They also said it performs an important and irreplaceable role in protecting Yangtze fish species resources and fishery in the river.

The "Special Report" suggested the building of artificial fish passages as a remedial measure to create living room for fish. However, Professor Cao Wenxuan does not believe the idea to be an effective way to protect Yangtze fish species. This is because fish species endemic to the Upper Yangtze are mostly used to high-speed moving water, and are therefore unsuited to the lentic reservoirs created by mega-dams. In particular, cascade hydropower exploitation will all but destroy the remaining sites of high-speed moving water. The plight facing these species cannot be solved by merely building fish passages.

Regarding remedial measures that have been mooted to address the impact from the dams, such as those targeting fishing boats, the building of fish passages, and increased fish releases, Wu Qingjiang, Head of the Academic Committee at the MoA's Key Laboratory of Freshwater Aquaculture and Biotechnology and a researcher at the Institute of Hydrobiology at the Chinese Academy of Sciences, had this to say: "We are not even clear on fish passage facilities, it is irresponsible to issue a blank cheque …… the prerequisite to artificial introduction of fish to the river is a guarantee that there is sufficient genetic diversity."

Experts at the discussion also argued that: "**The Upper Yangtze is in tatters. The river's natural resources are doomed. Given that there are so few natural rivers left, is it reasonable to be building mega-dams that do not in any case meet the technical and economic standards expected of them?** Local governments may be passionate about development, but are we going to sacrifice the environment for the Xiaonanhai project? Or perhaps it is fair to say the project is not quite ready yet? **Many things are irreplaceable. There are substitutes for electricity and GDP but there is no substitute for the environment.**

The Chongqing Municipal Government had previously asked a leader at the Yangtze Water Resources Commission leader to take over Professor Cao Wenxuan's work. In response, the professor asked point-blank: "Is the Commission serious about restoring the health of the Yangtze, or are they just putting on a show?"

Article 17 of the Environmental Protection Law of the People's Republic of China states that: "**The people's governments at various levels shall take measures to protect regions representing various types of natural ecological systems, regions with a natural distribution of rare and endangered wild animals and plants**, regions where major sources of water are conserved, geological structures of major scientific and cultural value, famous regions where karst caves and fossil deposits are distributed, traces of glaciers, volcanoes and hot springs, traces of human history, and ancient and precious trees. **Damage to the above is strictly forbidden**." The Upper Yangtze Rare and Endemic Fish National Nature Reserve is one such region with a natural distribution of rare and endangered wild animals and plants. Central government approval of it as an official nature reserve is also given on the basis of scientific research.

Article 8 of the Law of the People's Republic of China on the Protection of Wildlife states that: **"The state shall protect wildlife and the environment for its survival, and shall prohibit the illegal hunting, catching or destruction of wildlife by any unit or individual."**

Article 32 of the Regulations of the People's Republic of China on Nature Reserves states that: **"No production installations shall be built in the core area and buffer zone of nature reserves. In the experimental zone, no production installations that cause environmental pollution or damage to natural resources or landscapes shall be built;"**

Under the pretext that the Xiaonanhai mega-dam would cause damage to the structure and the function of the reserve, the proposed site of the dam and the adjoining river section were taken out of the protection zone and turned into 'non-reserve waters'. This seriously undermines the nature reserve, disregards the authority of the country's laws and regulations, and imperils the interests of the environment, all in the name – and cynical pursuit – of hydropower development.

Since it is forbidden to build any production facilities in either the core zone or the buffer zone, the Xiaonanhai reservoir area, originally a buffer zone, was revised as an experimental zone. In reality, however, turning the protected experimental zone, which is itself dependent upon natural river

conditions, into a reservoir area still amounts to serious damage to the protected subject in question, and to conservation targets.

It is obvious that the latest modification of the Upper Yangtze Rare and Endemic Fish National Nature Reserve is not aimed at improving or strengthening the structure, or the function of the hold-out. In fact, it is to allow for the implementation of the Xiaonanhai project. In doing so, it disregards the country's laws and regulations for nature reserves and environmental protection, and further compresses and encroaches upon an already besieged protected area. With new hydropower plants at Zhuyangxi and Shipeng to follow, the eventual fall of the nature reserve is a foregone conclusion.

This catalogue of destructive developments violates the People's Republic of China's "Environmental Protection Law", "Wildlife Protection Law", and the "Regulations on Nature Reserves". At the same time, they contravene the "Regulations regarding the Amendment of Range and Function, and Renaming of National Nature Reserves" which stipulate that 'areal modifications of national nature reserves, and revisions of function zones, should ensure that key objects of protection are effectively safeguarded, and that no damage shall be caused to the ecosystem, the integrity of the ecological process, and biodiversity.'

The Xiaonanhai project comes at the massive cost of undermining the country's laws and regulations, as well as destroying the last refuge for Upper Yangtze rare and endemic fish species. Many other negative consequences are set to follow. At the same time, a host of questions persists over the projected targets for the plant and the actual benefits that it will bring.

The Xiaonanhai plant is sited along the river section between Yibin and Chongqing. The Yangtze River snakes through this part of the Sichuan basin. With a wide river bed and a low drop height, this valley is not conducive to hydropower exploitation. Unlike the hydropower plants along the Three Gorges and the Jin River mainstream, where dams can easily go up 100 or 200 m, and in some cases, over 300 m, the proposed height of the Xiaonanhai dam is only around 50 m. Despite the relatively low height of this mega-dam, the mild undulations of the basin can still bring great flood losses. Reports suggest that floods generated by the Xiaonanhai plant will inundate the four Chongqing Municipality districts of Dadukou, Jiulongbo, Banan and Jiangjin, as well as 70,000 *mu* (46.67 sq km) of arable land. Further, it will affect important infrastructure projects such as the Baishatuo Railway Bridge over the Yangtze, the Luohuang Power Plant and 106 provincial highways. In Jiangjin District alone, 13 towns with a combined population of over 400,000 across a 41 sq km area will be flooded. The investment behind each unit of installed capacity at the Xiaonanhai plant is a substantial 13,553 RMB/kWh whereas the corresponding figures for the hydropower plants at the Three Gorges (4,950 RMB/kWh), Xiluodu (3,538 RMB/kWh) and Xiangjiaba (5,749 RMB/kWh) are all under 6,000 RMB/kWh.

The area that is going to be wiped out by the Xiaonanhai plant is also the most productive human settlement and concentration of arable land along the banks of the Yangtze River. Zhongbadao, the site of the Xiaonanhai mega-dam, is a case in point. Blessed with fertile soil and an agreeable climate, it is a major vegetables supplier in the Chongqing Municipality, delivering 400,000 – 500,000 kilos of produce daily, and over 20 million kilos every year. For many, the exceptional geography that Zhongbadao enjoys makes it the most prized land in Banan District. A local farmer said: "In 2009, the average annual net income for the village is 10,400 RMB, and many on the island are earning more than 130,000 RMB, or even as much as 200,000 – 300,000 RMB per year. You can get really wealthy just by growing vegetables." A high population density and a lack of arable land have been long-standing problems for Chongqing Municipality. As more farmlands are lost and farmers displaced,

migrants in the Three Gorges Reservoir will have to struggle even harder in their search for income and stability.

The area that is going to come under water because of the Xiaonanhai plant is also a MoA-designated "Special Fruits Growth Zone". It produces popular local fruits such as the *jinchen* orange, lychees and longan thanks to the unique mix of climate and soil in this part of the Yangtze River. However, the hydropower plants at Xiaonanhai, Zhuyangxi and Shipeng are set to bring incalculable damage to the zone. There had already been similar precedents before the Three Gorges Reservoir flooded traditional farming bases that had the best soil, climate and irrigation conditions, and which boasted well-known local products such as Peiling preserved vegetables.

One reason behind the construction of the Xiaonanhai plant is to solve the electricity shortage in Chongqing. However, Wang Lida, chief of the Yangtze River Water Resources Protection Bureau, argued that the reason "does not hold water". In fact, electricity generation developments have been growing at an unprecedented pace and scale in China in recent years. According to public data from the National Development and Reform Commission, newly installed generating capacity in 2010 reached 91.27 kWh, or nearly 10% of the aggregate installed generating capacity of 96 million kWh nationwide for that year. This represents a near-equilibrium of supply and demand, with the balance tipped slightly in favor of the former. However, in the current context of macroeconomic regulation and control, energy conservation and emissions reduction, and lowering of energy consumption per GDP, unabated high-speed growth of installed capacity has probably led to an over-supply of electricity. At the same time, it is common sense that for an area to solve its own energy needs, it does not have to completely rely on building its own locally controlled energy enterprises. The size of the numerous large-scale dams and mega-dams under construction in the Upper Yangtze region near Chongqing is truly staggering. On the Lower Jinsha River mainstream, 10 hydropower plants with a combined installed capacity of 54.05 million kWh are being built, they are: Liyuan, Ahai, Jinanqiao, Longkaikou, Ludila, Guanyinyan, Wudongde, Baihetan, Xiluodu and Xiangjiaba. In particular, mega-dams like those at Xiluodu (installed capacity: 12.60 million kWh) and Baihetan (installed capacity: 13.05 million kWh) can rival the sheer scale of the Three Gorges Project. Meanwhile, 13 plants with a combined installed capacity of 16.32 million kWh are being built over the Dadu River mainstream: Shaungjiangkou, Houziyan, Changheba, Huangjinping, Luding, Dajiangshan, Longtoushi, Pubugou, Shenxigou, Zhentouba, Shaping, Shawan and Angu. On the Yalongjiang mainstream, five plants with a combined installed capacity of 14.10 million kWh are under construction: Lianghekou, Jinping I, Jinping II, Guandi and Tongzilin. On the Wu River mainstream, seven plants with a combined installed capacity of 8.31 million kWh are being built: Yinzidu, Goupitan, Silin, Shatuo, Pengshui, Yinpan and Baima. In particular, the plants at Pengshui, Yinpan and Baima, which have a combined installed capacity of 2.65 million kWh, are sited within Chongqing Municipality. These hydropower plants will gradually come into service over the next 10 years, and most of the electricity produced is set to go to markets outside Chongqing Municipality, or to the eastern parts of the country. The irony is Chongqing Municipality can easily meet its rising energy demand by tapping into these new electricity sources, which, in any case, dwarf the 1.75 million kWh installed capacity of the Xiaonanhai plant.

Moreover, it should be understood that under a GDP-led, non-scientific development model that is purely driven by the pursuit of ever higher economic growth rates, a trend of surplus energy supply has emerged. This scenario in turn fuels the continued expansion of energy-intensive, highly-polluting industries so that they can absorb the surplus electricity produced. However, this will eventually lead to a vicious cycle characterized by deteriorating industry structures and environmental degradation. For example, the high-speed development of large-scale chemical industry parks at Luzhou,

Changshou, Peiling and Wanzhou, have led to concerns about the aquatic well-being of the Upper Yangtze. Previously, the introduction of the global chemical giant BASF's MDI project to the Three Gorges Reservoir area had provoked widespread concern about the risks that it would pose to the aquatic well-being of the zone.

Silt reduction at the tail end of the Three Gorges Reservoir is another goal that has been used to justify the building of the Xiaonanhai plant. However, as hydropower cascade exploitation takes place across the Upper Yangtze, the constellation of reservoirs that this will create will already be trapping large volumes of silt and mud. The amount of silt prevention that the Xiaonanhai plant can perform will thus be limited. Further, given the basic geographical and geological rules that govern the Yangtze's movement, even if cascade reservoirs become the norm in the Upper Yangtze, it still will not substantially reduce silting in the Three Gorges Reservoir. At the same time, while silt reduction in the Three Gorges Reservoir has been widely used to justify the building of the various large-scale hydropower projects on the Upper Yangtze, little has been said about the silting that will inevitably hit these same projects. This absurd situation only serves to expose the fallacies and delusions behind the claim that silting can be solved by the Three Gorges Project and the various other large-scale hydropower projects along the Yangtze.

'Hydropower is clean energy. Hydropower plants can help reduce carbon emissions,' is yet another purported reason to justify the building of the Xiaonanhai plant. However, there are two major flaws with this claim:

1. Environmental protection is an integrated concept, it is not only about tackling carbon emissions. Despite the fact that most hydropower projects bring lower carbon emissions than power plants running on fossil fuels, large-scale hydropower projects will still damage aquatic ecosystems, trigger or exacerbate geological crises in reservoir zones, slow river flow which will lead to smaller aquatic environments, and pollute reservoirs. Given these environmental concerns, hydropower can no longer claim to be a form of clean energy. This critique is backed up by a considerable amount of scientific research which is available in the World Commission on Dams report "Dams and Development: A New Framework for Decision-Making" (2000). Carbon emissions reduction must not be pursued at the expense of greater environmental damage.

2. More hydropower exploitation and less fossil fuel electricity do not automatically mean reduced carbon emissions – there does not exist any given, logical link. A hydropower development fever has gripped Western China in the past 10 years. Cascade hydropower systems have sprouted across vast river regions, and total hydropower installed capacity has dramatically increased. However, investments in fossil fuel electricity plants have also grown considerably. Ditto for their installed capacity and amount of coal exhausted to generate electricity. Even though hydropower and fossil fuel electricity now respectively make up a bigger and a smaller share of overall energy supply, the amount of fossil fuel electricity produced, and the attendant carbon emissions, have not decreased. In fact, they are continuing to grow. According to the National Bureau of Statistics, the average year-on-year growth of fossil fuel electricity generated between 2005 and 2009 is 11.02%. Moreover, despite the fact that hydropower now makes up a bigger portion of overall energy use in some provinces, and despite the higher installed capacity available, hydropower shortages and load following requirements during the dry season have resulted in new fossil fuel electricity generation developments as back-up solutions. It is therefore groundless to say the hydropower can replace coal-generated electricity, or that it can reduce carbon emissions. In reality, energy conservation and carbon emissions reduction in Chinese coal power plants have been achieved by decommissioning smaller stations, and by installing new clean, high-efficiency generating units and co-generating units.

All hydropower, fossil fuel electricity, and any other form of energy infrastructure projects should take place within a model of sustainable development, and go through scientific planning, scientific

discussions, as well as scientific management. Otherwise, damage can be done to the environment and to the sustainable development of human society. Those who use the claims that 'hydropower is clean energy', and that 'hydropower plants could reduce carbon emissions' to justify the ill-planned and irrational building of power stations, are either driven by scientific ignorance, or wanton self-interest.

An improved navigation channel between Chongqing and Yibin is another target for the Xiaonanhai Project. The proposed annual cargo transportation volume for the three-step staircase lock to be built at the Xiaonanhai plant is reportedly an ambitious 30 million tonnes. However, judging by the actual usage rates at many existing waterway projects, this target will be hard to achieve. While the one-way cargo transportation load designed for the Three Gorges Dam lock is 50 million tonnes per year, only 34 – 36 million of cargos have passed through the lock (in one direction) since it came into service. According to the Ministry of Transport's Yangtze River Administration, even with the right ship size and ship load, the one-way cargo transportation load cannot go beyond a maximum of 36 million tonnes per year. Another instructive case study is provided by the cascade of 17 navigation and hydropower project proposed for the Chongqing to Guangyuan section of the Jialing River mainstream. Twelve of the projects are already completed. However, during the annual low-water season, the effects of reduced water flow, plus the effects from water diversion for hydropower generation at the transportation hubs, have led to extremely low water levels or a near split in the section downriver from the dams. Further, with mud and silt sedimentation being a serious problem, the navigability of some river channels has actually worsened after the transportation hubs came into service. A related point here is that the navigability of the channels hinges upon normal reservoir storage levels. However, in the present circumstances, the reservoirs are satisfactorily filled for no more than four months in a year. As all transport hubs compete to store up water when water flow is already limited, water storage targets will be hard to achieve. Given this multitude of problems, the supposed benefits from improving navigation channels are seriously in doubt.

Admittedly, as one of Chongqing's biggest individual investment projects under the 11th Five-Year Plan, the 37 billion RMB worth of investments involved in the Xiaonanhai Project will greatly boost GDP growth, as well as taxation and other revenues for the municipality government. However, it is important to put these raw economic imperatives into perspective and pay serious attention to a host of practical and principled considerations. Should we be destroying the Upper Yangtze rare and endemic fish species habitat? Should we be destroying the national nature reserve? Should we be undermining the dignity of the country's laws and the authority of our government? Are we being accountable to the most fundamental and long-term interests of the public? What about sustainable development of our society?

When deliberating on major infrastructure project decisions, the government should prioritize the overall interests of the society. It should exercise justice, promote harmony, and carry out its responsibilities in accordance with the law. It should not succumb to its own or industries' short-term interests, or fuel non-scientific, non-rational 'development', and environmental degradation. Businesses should also obey the country's laws and regulations, as well as assume social and environmental responsibilities when selecting major infrastructure projects. They should not be protecting their own interests at the expense of the public good.

Some have flippantly dismissed the need to protect rare and endemic fish species in the Yangtze. For them, the issue is reduced to: "Why are we worrying about a few fish? It's just a few fish, we can do with eating a little less fish." At a time when there is universal consensus on the importance of ecological protection and sustainable development, and as China's national policy-making embraces these imperatives, it is truly shocking to witness this kind of mentality and ignorance. Can we tolerate

rampant deforestation that destroys the habitat of giant pandas and their fellow animals? Can we tolerate the avaricious, mindless killing of Tibetan antelopes? If the answer is 'No', then why are we turning a blind eye to the wanton destruction of Yangtze aquatic species and their ecosystem?

The Yangtze fish habitat is part of a delicate ecosystem that drives the survival and growth of all kinds of animals including mankind. Its decline and deterioration thus makes it all the more important to ask the question: how will mankind fare under this same unprecedented predicament facing Yangtze fish species?

Once the Yangtze River no longer allows for the survival of the multitude of wild fish species that used to teem its waters, it will be a major sign that the river is increasingly unsuited to human survival. The plight facing the fish population of the Yangtze is a final warning of the environmental degradation that the river has slid into. This threat is even more desperate than the serious difficulties that giant pandas and Tibetan antelopes had previously faced. The progressive extinction of aquatic life in the Yangtze will trigger a domino effect, bringing grave repercussions to mankind.

Regardless of the final outcome of the re-modification plan for the Upper Yangtze Rare and Endemic Fish National Nature Reserve, and regardless of the final decision on the building of the Xiaonanhai plant, these major projects will be synonymous with the worst excesses of this era, and the mark they will leave in history is going to be very difficult to erase. In a land that has suffered more than its fair share of tragedies, we hope these projects will not end up as a source of permanent grief and regret for future generations yet unborn.

As the protection of Yangtze rare and endemic fish species and the river's ecology enters its final hour, we hope that our respected leaders will use their wisdom, vision, courage and responsibility, and make decisions that would stand the trial of history – and their conscience. May we rejoice for the Yangtze! May we rejoice for China! May we rejoice for our planet!

Fan Xiao (Chinese Citizen, Geologist and Environmental Scholar, Professor and Senior Engineer)

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Appendix 1: Illustration of the Upper Yangtze Rare and Endemic Fish National Nature Reserve 'modification' plans

Map 1: The encroachment of two large-scale hydropower plants at Xiangjiaba and Xiluodu (yellow oval signs) upon the Upper Yangtze Rare and Endemic Fish National Nature Reserve (Yangtze mainstream section in red). The construction of the two plants began a few years after approval for given to build the nature reserve in 2000.

Map 2: The redrawn boundaries of the Yangtze Rare and Endemic Fish National Nature Reserve in 2005. The hold-out was moved downriver to a section between Chongqing and the area immediately below the Xiangjiaba Dam. At the same time, the Chishui River, as well as the Yibin to Yuebo section on the Min River mainstream (cascade hydropower plants have been proposed for this section), were added to the downsized reserve.

Map 3: Area loss caused by the new modification plan to the Yangtze mainstream section in the nature reserve. The dark bold lines show the location of the proposed hydropower dams at Xiaonanhai, Zhuyangxi and Shipeng, in relation to the reserve.

Appendix 2: Major rare and endemic fish species, as well as endangered fish species, in the Yangtze Rare and Endemic Fish National Nature Reserve

A Chinese paddlefish sculpture sits proud over a Yangtze Rare and Endemic Fish National Nature Reserve monument, Yibin, Sichuan Province.

Chinese paddlefish

Treatment was given to a Chinese paddlefish found in the Yangtze, Yibin, Sichuan Province, 2003.

Chinese paddlefish, *psephurus gladius* (Martens): National Grade 1 protected wildlife in China. An endemic species in China, it is the biggest freshwater fish in the world. It is generally two to three meters long and weighs between 200 and 300 kilograms. The biggest of them can grow up to 7.5 meters and weigh 1000 kilograms.

In China, it is also known by a range of colloquial names: *xiangyu*, *xiangbiyu*, *qinyu*, *chaojianyu*, *jianyu*, *zhuxunhuang*, *pipayu* and *gumingwei*.

It is listed as critically endangered (CR) in the 1996 Red List of the International Union for Conservation of Nature and Natural Resource (ICUN), and classified as a protected species in Appendix II of the 1998 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It is the most endangered paddlefish species on earth.

Chinese paddlefish is a key commercial fish species endemic to China. It is one of two extant paddlefish species (the other being the American paddlefish in the Mississippi River). It is of great scientific value to research on the origins, evolution and geographical distribution of fish species.

Dabry's sturgeon

Treatment was given to a Dabry's sturgeon found in the Yangtze, Yibin, Sichuan Province.

Dabry's sturgeon, *Acipenser dabryanus* (Dumeril): National Grade 1 protected wildlife in China. A major commercial fish species from the Upper Yangtze, it is also rare and endemic to the river. It has a typical body length of 0.8 – 1 meter, and weighs between 5 – 10 kilograms.

In China, it is colloquially known as *changjiangxun* or *shalazi*.

It is listed as critically endangered (CR) in the 1996 Red List of the International Union for Conservation of Nature and Natural Resource (ICUN), and classified as a protected species in Appendix II of the 1998 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Chinese sucker

A 1.35 meter-long, 35kg Chinese sucker was found in the Jialing River, a tributary of the Upper Yangtze, 9 May 2007.

A 1.3 meter-long, 29 kg Chinese sucker mistakenly caught from the Yangtze - Jialing River intersection at Jiangbeizui in Chongqing. It was returned to the river on 9 December 2008.

Chinese sucker, *myxocyprinus asiaticus* (Bleeker): National Grade II protected wildlife in China. A rare and endemic species in the Yangtze, it is approximately 1 meter long and weighs between 4 to 10 kilograms. The biggest of them can grow up to 30 kilograms.

In China, it is also known by a range of colloquial names: *huangpai*, *shupai*, *xuepai*, *huoshaobian*, *hongyu*, *muyepan*, *yanqueyu* and *zibianyu*.

Chinese sucker is not only important for scientific research but it has always been a prized commercial fish thanks to its large size, fast growth rate and handsome scales.

Largemouth bronze gudgeon

A largemouth bronze gudgeon caught from the Yongshan section of the Yangtze in Yunnan.

Largemouth bronze gudgeon, *Coreius guichenoti* (Sauyage et Dabry): an endemic, major commercial species in the Upper Yangtze.

In China, it is also known by a range of colloquial names: *fangtoushuimizi*, *shuimizi*, *feituo*, *jinqiu*, *yuankou*, and *mahua*.

Elongate loach

Elongate loach, *leptobotia elongate*: the biggest loach species, it weighs between 1 – 1.5 kilograms, and can grow up to around 3 kilograms.

A major commercial fish species from the Upper Yangtze, it is also endemic to the river. It has been listed as a vulnerable species in China.

In China, it is also colloquially known as: *huayu*, *huabanqiu*, *hualiqiu*, *huaqiu*, *hongshaqiuzuan*, and *boqiu*.

Rock carp

Rock carp, *procypris rabaudi*: a major commercial fish species from the Upper Yangtze, it is also endemic to China. It has been listed as a vulnerable species in the country.

In China, it is also colloquially known as: *shuizi*, *heliyu*, *yanli*, *moli*, *guitouyu*.