





1. 建成后的汉丰湖芙蓉坝湖湾湿地生态系统 (2015年9月)

1. The completed wetland ecosystem of Furongba Bay in Hanfeng Lake [photographed in September, 2015]

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应对环境变化的多功能湿地设计

——三峡库区汉丰湖芙蓉坝湖湾湿地生态系统建设

MULTI-FUNCTIONAL WETLAND DESIGN ADAPTIVE TO ENVIRONMENTAL CHANGES — WETLAND ECOSYSTEM CONSTRUCTION OF FURONGBA BAY IN HANFENG LAKE OF THE THREE GORGES RESERVOIR AREA

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1 项目背景

2010年, 三峡工程在完成175m实验性蓄水后, 施行“蓄清排浑”的运行方式, 由此在145~175m高程的库区两岸形成了冬季淹没、夏季出露的水库消落带。其中, 位于重庆市开州区的消落带面积大、类型多, 生态环境问题复杂。为最大程度地减少消落带所带来的不利影响, 开州区在新城下游4.5km处修建水位调节坝, 将水位消涨幅度由30m降至4.72m, 形成独具特色的城市内湖——汉丰湖(图2), 同时形成典型的双重水位, 即当冬季三峡水库高水位运行时, 汉丰湖水位维持在175m; 当夏季三峡水库水位消落到145m时, 汉丰湖水位保持在170.28m(图3)。

为应对季节性水位波动带来的环境影响, 有效保护三峡水库水环境安全, 在促进消落带生态恢复的同时提升开州区人居环境质量, 项目以汉丰湖芙蓉坝湖湾为对象, 进行多功能湿地设计与建设, 探讨如何将生态智慧及生态系统整体设计手法运用于具有季节性水位变化的湖湾湿地生态系统中。

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摘要

汉丰湖是一处因三峡水库蓄水造成的季节性水位消涨而形成的城市内湖, 面临着水环境污染、水生生物物种消失或濒危、土地利用格局改变等问题。本文以汉丰湖芙蓉坝湖湾湿地生态系统建设为例, 探讨如何借鉴中国传统农耕时代与治水、利水、善水相关的生态智慧, 运用动态景观设计、多功能景观设计、环湖圈层设计和协同进化及互利共生等理念, 打造能够适应环境变化的多功能消落带湿地。

关键词

多功能湿地; 生态系统; 传统生态智慧; 汉丰湖; 消落带; 三峡库区

ABSTRACT

Hanfeng Lake, an inland lake formed by the seasonal water fluctuations due to the water storage and sluice in the Three Gorges Reservoir, was faced with ecological challenges such as water pollution, aquatic biodiversity loss, and changes in land use pattern. This article takes the wetland ecosystem construction in Furongba Bay, Hanfeng Lake as an example to explore approaches to designing multi-functional wetlands which could adapt to hydro-fluctuation and other environmental changes, by drawing from the ecological wisdoms of water regulation, conservancy, and utilization developed in the agrarian age of China to support a dynamic, multi-layered landscape of mutualism and co-evolution.

KEY WORDS

Multi-Functional Wetland; Ecosystem; Traditional Ecological Wisdom; Hanfeng Lake; Hydro-Fluctuation Zone; The Three Gorges Reservoir Area

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项目地址:

重庆市开州区

项目面积:2.58hm²**项目委托:**

汉丰湖国家级湿地公园管理局

景观设计:

重庆大学建筑城规学院、重庆大学山地城镇建设与新技术教育部重点实验室

项目负责人:

袁兴中

项目团队:

袁嘉、王晓锋、熊森、刘杨靖

设计时间:

2011年至今

LOCATION:

Kaizhou District, Chongqing

AREA (SIZE):2.58 hm²**CLIENT:**

Administrative Office of Hanfeng Lake National Wetland Park

LANDSCAPE ARCHITECTURE:

Faculty of Architecture and Urban Planning and Key Laboratory of New Technology for Construction of Cities in Mountain Area, Chongqing University

CHIEF DESIGNER:

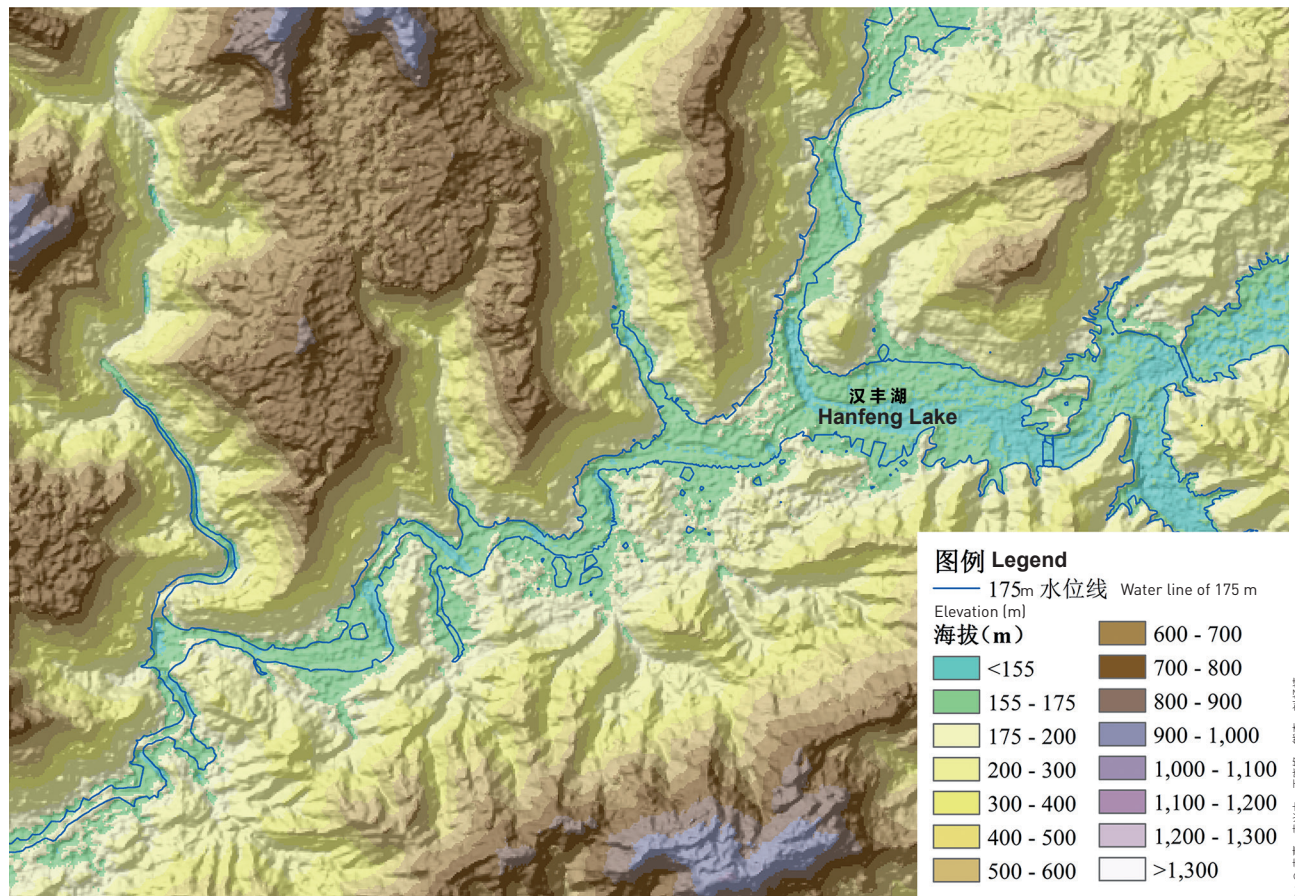
Xingzhong Yuan

PROJECT TEAM:

Jia Yuan, Xiaofeng Wang, Sen Xiong, Yangjing Liu

DESIGN PERIOD:

2011 to present



2. 汉丰湖高程及水位图

3. 三峡水库及汉丰湖年度水位变化示意图

2. Elevations and water levels of the Hanfeng Lake

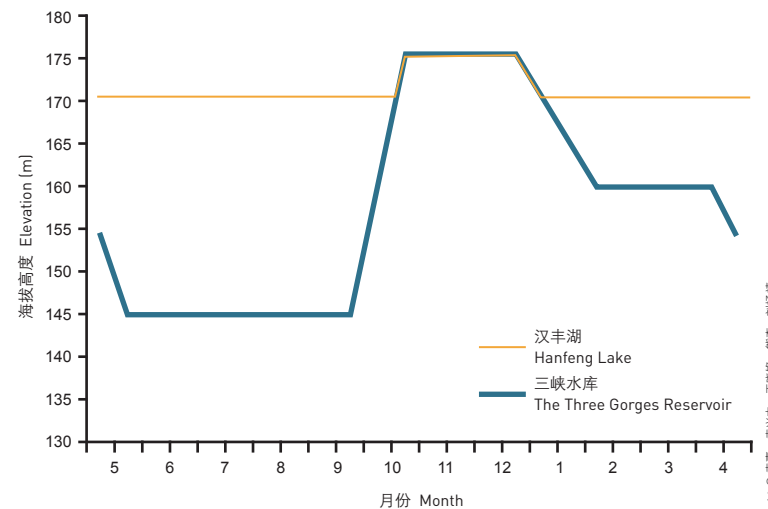
3. Diagram of the annual water level changes of the Three Gorges Reservoir and the Hanfeng Lake

2 场地概述及问题

项目核心区域芙蓉坝湖湾位于汉丰湖南岸（图4），在三峡工程蓄水前，芙蓉坝下部高程较低处为典型的河漫滩区，河底以细沙和卵石为主；因长期挖沙采石，场地内采石坑和砂石堆交混分布；其上部高程较高区域是受洪泛影响的河岸过渡高地，可供当地居民进行季节性耕种（图5）。在2010年三峡工程完成175m蓄水后，每年10月中旬至次年1月中旬，芙蓉坝175m水位以下的区域会被淹没，夏季出露后的芙蓉坝自然生长着以狗牙根（*Cynodon dactylon*）为优势种的耐

水淹草本植物群落。

汉丰湖是三峡水库蓄水后形成的库中库，其水文变化特征受湖体上游和三峡库区的双重影响。汉丰湖面临的主要问题包括：1）位于汉丰湖湖滨的开州城区有35万人口，建成区面积约40km²，是一座典型的水敏性城市，来自陆域集水区的地表径流携带面源污染物，经消落带这一水陆界面入湖，对水环境安全造成威胁；2）冬季深水淹没、夏季高温季节出露带来巨大生态威胁——由于湖泊型水体与河流型水体的生态系统存在差异，原有河流型水生生物因不适应生存条件的改变而濒危甚至消失；生活在原有河岸



环境中的物种难以适应汉丰湖消落带的新环境；3) 土地利用格局的改变使得水敏性区域的水环境胁迫难以预测和治理；4) 长期的季节性水位变化对库岸稳固性产生不利影响。

3 设计理念

设计借鉴了中国农耕时代传统的水利工程，以及生态系统中与治水、利水、善水理念相关的生态智慧。都江堰、灵渠等水利工程利用自然之力，维持河道稳定与河流生态系统结构完整性，为后世留下了巧妙利用自然的自我设计（图6）、动态适应等生态智慧遗产；蕴含于陂塘、桑基鱼塘等塘系统，以及稻鱼共生系统中的自然梯度适应、互利共生和协同进化等生态学机制，是自然的生命智慧与生态智慧的有机结合。针对汉丰湖季节性水位变化的特点，项目旨在设计和建造能够应对环境变化的多功能湿地，将上述生态智慧融于以下设计理念之中：

1) 动态景观设计理念：根据季节性水位变化及其引发的环境变化的特征，动态设计景观生态结构和植物物种组成；

2) 多功能景观设计理念：以水体净化、生物多样性保育、湖岸稳固、审美启智等生态服务功能的优化为目标，设计多功能湖湾湿地生态系统，满足水陆交错滨水空间的多样化需求；

3) 环湖圈层设计理念：按照海拔高程梯度和湖泊圈层生态序列，根据不同高程水位变化特点和植物生长特性，以及不同的功能需求，设计湖湾湿地生态圈层，形成自然蜿蜒多变、多景观层次、多生态序列的消落带湿地景观；

4) 互利共生和协同进化理念：形成由多物种组成的、互利共生和协同进化的湿地生态系统。

4 设计策略

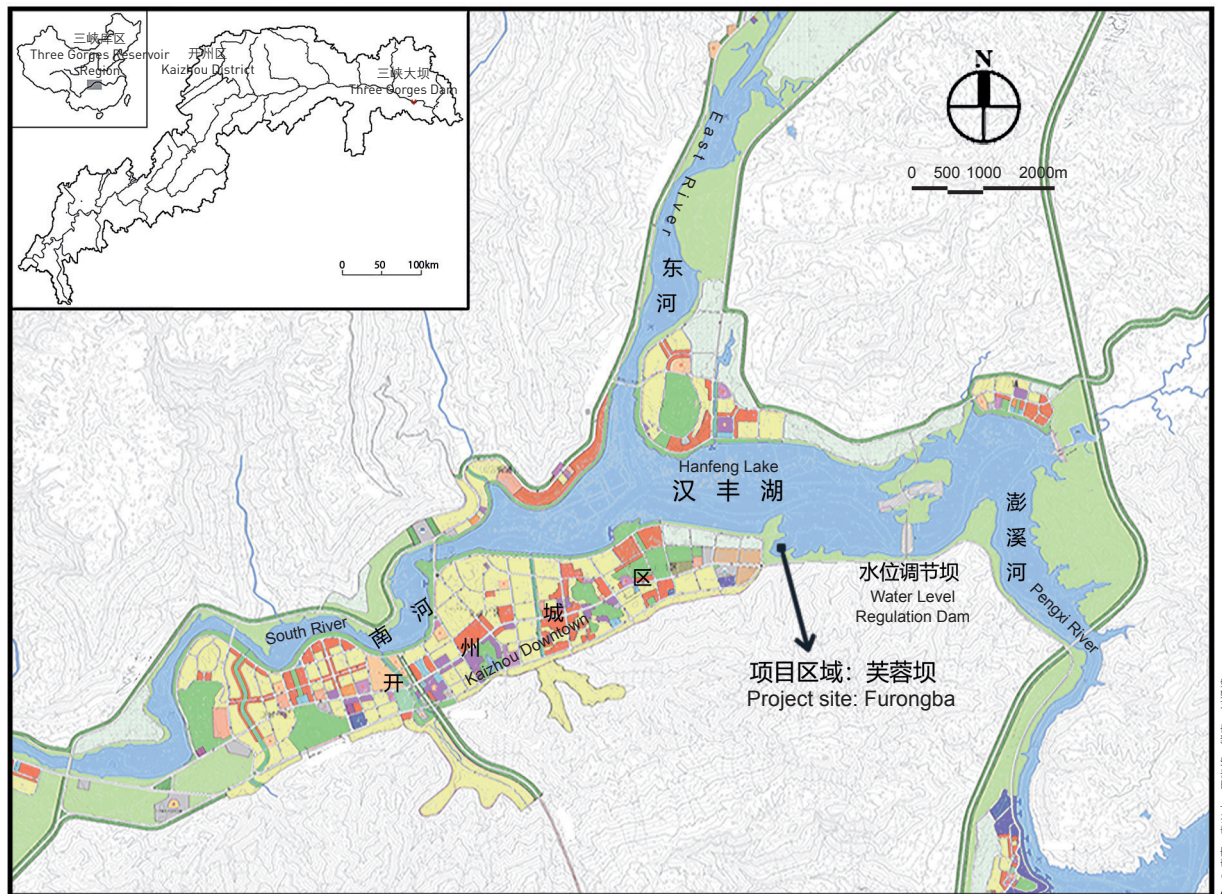
4.1 多功能湿地生态系统

基于以上设计理念，项目团队在芙蓉坝海拔高程160~180m的区域，设计和建造了

具有圈层结构的由林泽-基塘复合系统、环湖多塘小微湿地和野花草甸构成的芙蓉坝湖湾多功能湿地生态系统（简称芙蓉坝湿地，图1, 7）。

4.1.1 林泽-基塘复合系统

缘起于战国时代的陂塘，其生态智慧在于利用自然地形条件，筑陂为堤，蓄水为塘，并利用自然水文变化特点，实现蓄水及水利灌溉。桑基鱼塘则是珠江三角洲地区有着400多年历史的传统农业文化遗产，桑、蚕、塘、鱼4个基本成分共存于一个系统中，互利共生与协同进化是其生态智慧的核心。



4. 汉丰湖芙蓉坝湖湾地理位置图

5. 湿地生态系统建设前的汉丰湖芙蓉坝湖湾（2010年8月水位消退出露期）

4. Site location of Furongba Bay in Hanfeng Lake

5. Furongba Bay in Hanfeng Lake with exposed landscapes due to the drop of water level in August, 2010 before the project started.



风水塘是广东东江流域客家民居的水环境净化系统，它们与村落相伴生，与河流水系相连通，是客家文化与水环境保护完美结合的生态智慧。

借鉴上述生态智慧，团队在海拔高程160~175m的消落带区域构建了多功能林泽-基塘复合系统——在芙蓉坝原位挖泥成塘、堆泥成基。塘的深浅、大小、形状不一：塘深度从50cm至2m不等；塘基宽度为120~180cm，塘基高出水面30~50cm；塘底部以黏土防渗，上覆壤土。塘底进行微地形设计，起伏的微地形增加了水塘中栖息地多样性。在塘与塘之间设置潜流式水流通道，以保证基塘系统内部、各塘之间，以及塘与湖水间的水文连通性。环绕塘基栽种耐水淹木本植物，形成网状林泽（图8~13）。塘基上的木本植物与塘中的水生植物形成一个由多物种组成的互利共生和协同进化体系。

4.1.2 环湖多塘小微湿地

中国传统乡村中的“塘、田、堰、井”等小微湿地在空间上呈离散状分布，但通过沟、渠、溪、河的连接，最终形成了功能上紧密联系的小微湿地群。小微湿地具有重要的生态功能，例如，塘、堰可用于蓄水和调

水，沟、渠可用于排洪排涝，构成了相互连通，可提供水源涵养、雨洪管理、污水净化和生物栖息地等生态服务的小微系统。

以此为灵感，团队在芙蓉坝175~178m高程处，即175m高程以上至人行步道之间的区域，营建环湖多塘小微湿地群（图14，15），包括雨水花园、青蛙塘、蜻蜓塘和生态洼地。每个小微湿地面积约10~80m²，镶嵌分布在草坡上，可免受汉丰湖的水淹威胁。滨水的地理特征使得该区域在水体净化及为青蛙、蜻蜓等生物提供栖息地方面发挥着重要作用。

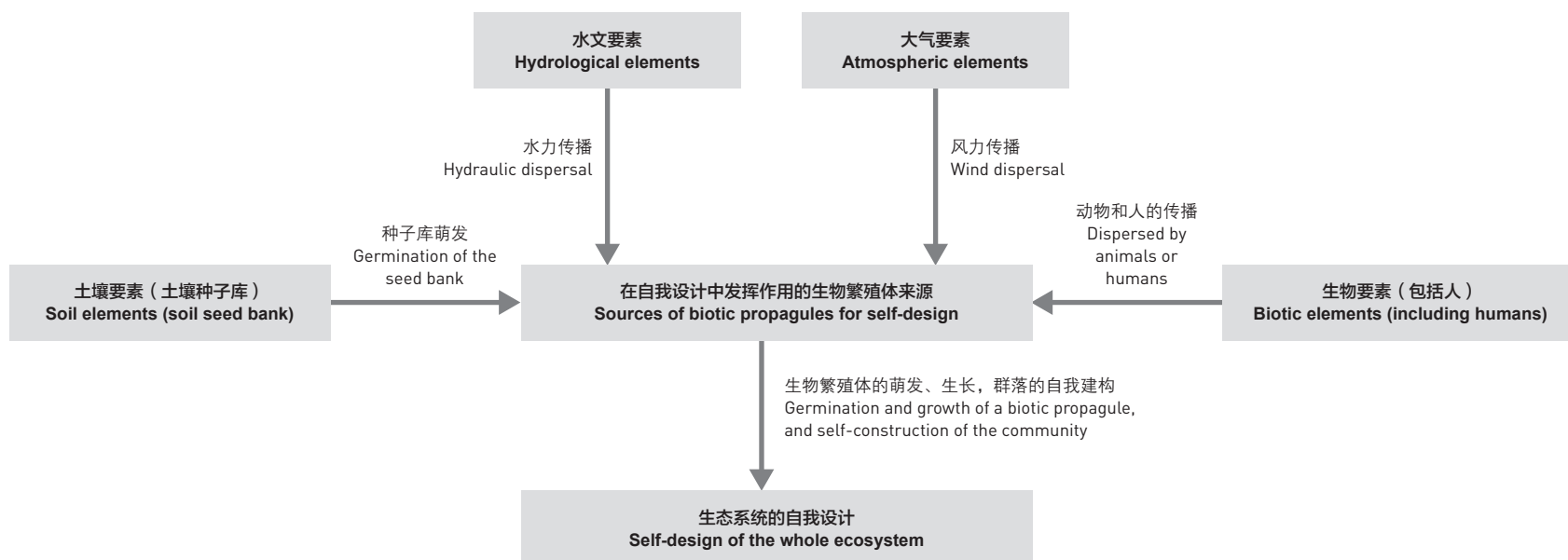
4.1.3 野花草甸带

新自然主义植物景观设计强调“师法自然”，以自然植物群落结构作为植物景观的基本图式；强调群落生物多样性的建立与表达，尽可能多地选用既能适应场地条件，又可与系统中各生物和非生物要素协同共生的植物种类；合理混植草本物种，建立丰富多样的群落和协同共生的结构，提供应对环境变化的系统韧性；加强生态功能设计，以提供更高的系统稳定性和抗逆性，以及较低廉的建植和维护成本。

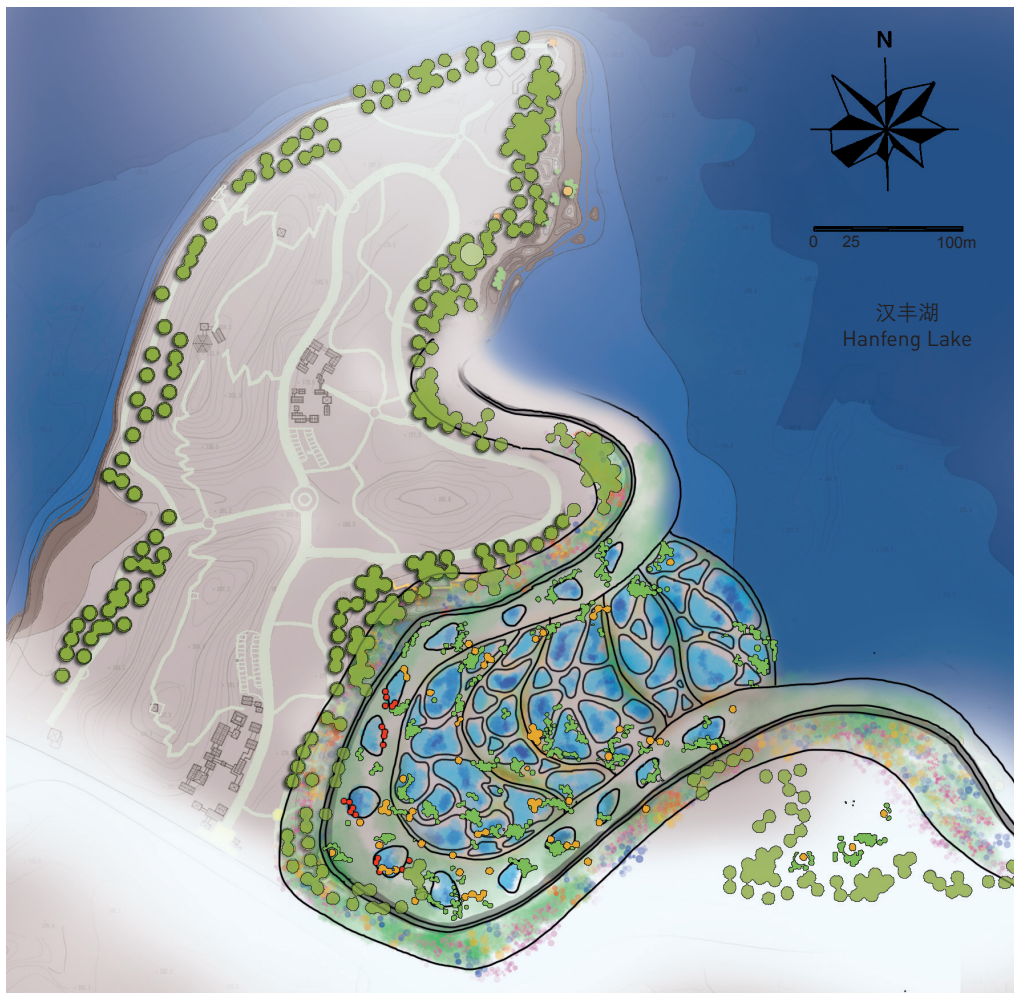
借鉴新自然主义植物景观技术方法和智

6. 生态系统自我设计过程示意图
7. 芙蓉坝湿地规划设计总平面图

6. Schematic diagram of the self-design process of the ecosystem
7. Site plan of the Furongba wetland



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慧，团队在芙蓉坝178~180m高程的护坡区域，建立了混植野花草甸（图16）。这种在地技术能有效引导自然做工，降低人工成本，减少成苗生产的温、光、水资源损耗，以及运输过程中产生的碳排放。沿护坡种植的4m宽的野花草甸带起到了重要的生态缓冲作用，有效阻隔了人为干扰。多季相景观则促进了微气候调节、土壤渗透率改善、水土固持、野生生物栖息地维护等生态服务。

4.2 植物筛选及配植

为促进芙蓉坝湿地的生态功能，项目配植了4类植物：

基塘植物：在林泽-基塘复合系统的基塘内种植的植物需适应于水位变化、耐

冬季深水淹没，同时具备环境净化功能和观赏价值，主要包括普通莲藕（*Nelumbo nucifera*）、“太空飞天”荷花（为消落带定向培育，图17）、水生美人蕉（*Canna glauca*）、鸢尾（*Iris tectorum*）等水生植物。水生植物种植密度为10~15株/m²。

塘基林泽植物：在林泽-基塘复合系统的塘基两侧种植以中山杉（*Taxodium mucronatum*）、池杉（*Taxodium ascendens*）、落羽杉（*Taxodium distichum*）为主的耐水淹乔木（图18，19），尤其是在基塘系统上部175~177m高程环带状种植中山杉和落羽杉，以形成良好的林网系统。

环湖多塘小微湿地植物：湿地中的植物搭配以水生和耐湿植物为主，包括水生美人

蕉、鸢尾、石菖蒲（*Acorus tatarinowii*）等挺水植物，以及苻菜（*Nymphoides peltata*）、萍蓬草（*Nuphar pumilum*）等浮叶根生植物。

野花草甸带植物：以鼠尾草（*Salvia japonica*）、金鸡菊（*Coreopsis basalis*）、桔梗（*Platycodon grandiflorus*）、松果菊（*Echinacea purpurea*）等植物为主，混播形成野花草甸。

5 建成后评价

芙蓉坝湿地的设计基于水敏性规划中的整体生态系统理念进行，在设计和建造过程中，为自然演替留出了足够的空间，让自



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然的自我设计功能得以充分发挥, 形成了一个多功能的生态系统, 充分体现了生态智慧的魅力。自建成以来, 系统已发挥了湖岸稳固、生物多样性保育、水体净化、审美启智等生态服务功能, 具体包括:

1) 经受了季节性水位变化的考验。自2011年基塘系统建造以来, 芙蓉坝经历了7年冬季深水淹没, 迄今为止, 基塘系统形态及结构稳定;

2) 植物生长良好, 生物多样性提升效果显著。在经历了多年季节性水位变化和冬季水淹后, 湿地内的各类植物生长状况良好, 群落结构稳定, 生物多样性显著提升。截至目前, 芙蓉坝湿地所在区域高等维管植物达

79种; 基塘、林泽、野花草甸等栖息地的形成, 为涉禽、游禽、鸣禽等不同生态位的鸟类营造了栖息、觅食乃至繁殖的环境, 提高了整个场地内的鸟类多样性;

3) 水体净化能力有效发挥。芙蓉坝湿地发挥了重要的城市面源污染净化作用。2015年6~9月, 重庆市万州区环境监测站对芙蓉坝湿地进行了水质取样和分析。结果表明, 湿地生态系统对总氮(TN)和总磷(TP)的削减率分别达54%和52%;

4) 景观品质优良、稳定。芙蓉坝湿地景观效果优美, 生态序列良好, 成为了汉丰湖国家湿地公园内颇受城市居民喜爱的休闲观赏区。**LAF**

8. 芙蓉坝湿地出露景观 (2015年7月)
9. 芙蓉坝湿地淹没景观 (2015年10月)
10. 由林泽-基塘复合系统、环湖多塘小微湿地构成的出露期的芙蓉坝湿地景观。
11. 出露期的芙蓉坝湿地景观。环湖多塘小微湿地中的植物正处于开花期, 中部塘基上的耐水淹乔木出露后已开始萌发生长。

8. The exposed landscape of Furongba wetland in July, 2015.
9. The submerged landscape of Furongba wetland in October, 2015.
10. The exposed landscape of Furongba wetland consisting of a complex of swamp forest and dike pond system and several lakeside small wetlands.
11. The exposed landscape of Furongba wetland, where plants were blossoming in the lakeside small wetlands and trees on the dikes resistant to water logging were growing.



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1 Background

After the Three Gorges Reservoir reached its design-maximum water level of 175 m in 2010, it continued to store clear water and discharge muddy water, forming hydro-fluctuation zones along the reservoir banks of 145 ~ 175 m in elevation, which are flooded in winter and exposed in summer. The Kaizhou District of Chongqing is located in one of these zones, facing complicated eco-environmental challenges. To mitigate the environmental impacts on the urban construction of Kaizhou New Town, a water-level regulating dam was built 4.5 km away from the lower

reach of the town, cutting down the fluctuating range from 30 m to 4.72 m. Hanfeng Lake (Fig. 2), as an inner lake of Kaizhou District, was therefore formed with a highest water level of 175 m in winter and a lowest water level of 170.28 m in summer, along with the seasonal water level fluctuation in the Three Gorges Reservoir (Fig. 3).

In order to respond to the resulting environmental changes, protect the water quality of the Three Gorges Reservoir, and promote ecological restoration of the hydro-fluctuation zone while improving the living conditions for citizens in the Kaizhou District,



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this project takes Furongba Bay of Hanfeng Lake as an example to demonstrate multi-functional wetland design and construction. It also explores how to apply the ecological wisdom and the integrated design approaches into the wetland ecosystem construction with specific consideration on seasonal water level fluctuations.

2 Site Overview and Problems

Furongba Bay, core site of the project, is located in the south of Hanfeng Lake (Fig. 4). Before the Three Gorges Reservoir began to fill water, the lower part of Furongba Bay was a typical floodplain with fine sand and gravels



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at bottom, where gravel pits and heaps were found due to longtime quarrying. While the higher part was a tidal upland which was often flooded and provided land for local residents to farm seasonally (Fig. 5). After the Three Gorges Reservoir finished filling water in 2010, the areas below the water level of 175 m in Furongba Bay would be flooded from mid-October to mid-January in the following year. While in summer, as the water level drops, Furongba Bay would expose and was full of naturally growing Bermuda grass (*Cynodon dactylon*), an herbaceous plant of good water resistance.

As a reservoir formed due to water storage in the Three Gorges Reservoir, the hydrological condition of Hanfeng Lake was largely impacted by both the upper reaches and the Three Gorges Reservoir. Major threats to Hanfeng Lake are as follows: 1) The Kaizhou District, with a population of 350,000 and a built-up area of about 40 km², sits on a typical water sensitive area near the Hanfeng Lake. The runoff from the catchment area in the upland carrying non-point source pollutants flowed into Hanfeng Lake, threatening the water environment of the hydro-fluctuation zone. 2) Seasonal water-level fluctuations largely threatened the biodiversity in Hanfeng Lake — many existing riparian species became endangered or disappeared due to huge changes in living habitats and ecosystems brought about by water level fluctuation. 3) Changes in the land use pattern made it hard to foresee and deal with water environmental problems in the water sensitive area. 4) The continuous seasonal water-level changes caused harm to the stability of the reservoir banks.

3 Design Concepts

The design of this project is inspired by the ecological wisdom related to water regulation, conservancy, and utilization practices in the agrarian age of China. For instance, the Dujiangyan Irrigation System and the Lingqu



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12. 出露期的芙蓉坝湿地鸟瞰图, 这是一个呈圈层状分布的多功能湿地生态系统。
13. 正在逐渐出露的林泽-基塘复合系统。此时的塘基尚未完全出露, 塘基上的中山杉经历了3年冬季水淹, 出露后生长良好。基塘中的荷花在经历了7年的冬季水淹后, 生长状况良好。

14. 建设中的环湖多塘小微湿地 (2015年5月)
15. 建成后的环湖多塘小微湿地 (2015年7月)

12. Aerial view of the exposed Furongba wetland, a multi-functional wetland system in a multi-layered form.
13. The emerging landscape of the complex of swamp forest and dike pond system — on the dikes which had not been fully exposed, the Zhongshan cedars were growing well after 3 years of

- water logging in winter; the well-grown lotuses in the dike pond had also survived after 7 years of water logging in winter.
14. The lakeside small wetlands in construction (photographed in May, 2015)
15. The completed lakeside small wetlands (photographed in July, 2015)

Canal make full use of the natural resources and services to maintain the stability of the watercourse and the overall performance of the river ecosystem, representing the nature-inspired ecological wisdom such as self-design (Fig. 6) and dynamic adaptation. The ecological mechanisms of natural gradient adaptation, mutualism, and co-evolution reflected by the strip pond, mulberry-fish ponds, and rice-fish symbiotic systems are good examples of traditional practice combining biotic wisdom with the ecological wisdom. To deal with the environmental problems caused by seasonal water-level fluctuation of Hanfeng Lake, the project aims at designing and constructing a multi-functional wetland by applying these ecological wisdoms into the flowing design concepts:

1) Creating a dynamic landscape: The ecological structure of the landscape and the plant communities should be dynamically designed to adapt to seasonal water-level fluctuations and the consequent environmental changes.

2) Creating a multi-functional landscape: A multi-functional wetland ecosystem is to be designed to meet the diverse needs so as to improve water quality, conserve biodiversity, stabilize lake banks, and provide aesthetic services.

3) Creating a multi-layered lakeside ecosystem: According to different elevational gradients, aquatic conditions, and vegetation habits, a multi-layered lakeside ecosystem is to be designed. This resilient wetland contains various biotic layers and supports ecological successions in the lakeside.

4) Establishing an ecosystem of mutualism and co-evolution: The wetland ecosystem should be designed and constructed as a system of co-evolution and mutualism, composed of a rich biodiversity.

4 Design Strategies

4.1 A Multi-Functional Wetland Ecosystem

The project team designed and constructed

a multi-layered and multi-functional wetland in the Furongba Bay (short for Furongba wetland) in elevation between 160 m to 180 m that is composed of an integrated system of swamp forest and dike pond, small wetlands on the lakeside, and wildflower meadows (Fig. 1, 7).

4.1.1 An Integrated System of Swamp Forest and Dike Pond

The strip ponds originating in the Warring States Period are formed along local topographic conditions and store water for irrigation purposes. The mulberry-fish ponds are traditional agricultural culture heritages in the Pearl River Delta with a history of over 400 years. Mulberry trees, silkworms, ponds, and fish harmoniously survive in the same system, representing a wisdom of co-evolution and mutualism. While the geomantic ponds, popular in the Hakka villages in the Dongjiang River Basin in Guangdong, are featured with their functions of water purification and conservation, and local culture characteristics.

Inspired by these ponds' form and function, the project team built a multi-functional



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- 16. 芙蓉坝湿地中的野花草甸带
 - 17. 芙蓉坝湿地中的基塘植物——“太空飞天”荷花
-
- 16. The wildflower meadow in Furongba wetland
 - 17. Space-breeding lotuses growing in the dike ponds in Furongba wetland

landscape consisting of swamp forest and dike pond system in elevation from 160 m to 175 m of the hydro-fluctuation zone, by digging ponds of varied sizes, shapes, and depths (from 50 cm to 2 m) at the Furongba Bay and building dikes with the lake sludge. The widths of dikes range from 120 cm to 180 cm and are 30 ~ 50 cm above the water. To prevent water leakage, the bottom of ponds was covered with clay and further capped with loam. The micro-topography of the pond bottom allows for a variety of aquatic habitats. The sub-surface channels between ponds ensure the connectivity among the dike ponds and between the ponds and the lake (Fig. 8 ~ 13). In addition, the design introduces water-tolerant plants around the dike to form a swamp forest, constituting a symbiotic relationship with other aquatic plants in the ponds.

4.1.2 The Lakeside Small Wetlands

Although spatially disconnected, the small wetlands in traditional Chinese villages, including ponds, croplands, weirs,

and wells, are closely connected with each other as a wetland network through ditches, canals, creeks, and rivers. These small wetlands are interconnected and provide critical ecological functions by acting as micro-systems centering on water conservation, rainwater management, water purification, and biotic habitat provision. For instance, ponds and weirs can store water and regulate water resources, while ditches and canals can drain and discharge flood.

Inspired by such ecological wisdom, the project team constructed a group of lakeside small wetlands from 175 m to 178 m in elevation, linking with the pedestrian path (Fig. 14, 15). These wetlands, including raingardens, frog ponds, dragonfly ponds, and swales ranging from 10 m² to 80 m² in size, are distributed on the grass slope to prevent floods. The key waterfront location makes these small wetlands crucial in improving water quality and providing diverse habitats for amphibians and insects such as frogs and dragonflies.



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5 Performance and Evaluation

Furongba wetland is an integrated ecosystem designed along the water sensitivity principles, which allows for the self-design function of the nature. Meanwhile, a great deal of ecological wisdoms are reflected in the multi-functional ecological system. Since its completion, it is demonstrated that the ecological services of the site has greatly promoted ecosystem in stabilizing the lake banks, conserving biodiversity, purifying water body, and providing aesthetic services, specifically including:

1) The wetland stands the test of seasonal water-level fluctuations. Since 2011 when the ecosystem was established, the Furongba Bay has withstood 7 floods in winter and the form and structure of the pond network remain well.

2) Plants of various types grow well in the wetland, with the biodiversity improved significantly. For now, there are 79 advanced vascular plants found in the project area. Dike ponds, swamp forest, and wildflower meadows provide various habitats for different habit needs.

3) The wetland ecosystem greatly helps reduce the non-point source pollution. From June to September, 2015, the Environmental Monitoring Center of Wanzhou District, Chongqing sampled and analyzed the water quality of Furongba wetland, and the results proved a reduction of TN and TP by 54% and 52% respectively.

4) The landscape quality and ecological succession of the wetland ecosystem are sound, providing an attractive leisure space for citizens to visit the National Wetland Park of Hanfeng Lake. **LAF**

