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生态植物群落在城市基础设施中的作用和意义

——中国苗圃与种子产业的新机遇

The Role of Ecologically Based Vegetation in Urban Infrastructure

— A New Opportunity for the Nursery and Seed Industry in China

摘要 ……

本文对在城市发展中逐步增强绿色基础设施建设的政策导向和不断发展的种植设计方法之间的关系进行了探究，强调种植设计的新趋势是建立一个受大众喜爱的、具有强烈吸引力的植被景观模式，并同时实现景观的生态功能。而这其中的挑战在于如何在这些不同的角色中保持平衡——过去，这些角色通常被看成是相互独立的。在中国的城市中，应用多功能植被景观进行绿色基础设施建设的主要瓶颈之一是苗圃基础建设发展缓慢、体制不健全。苗圃是景观设计中提供本土植物或非本土植物的重要环节。其供应形式可以是以单位数量出售种子，也可以是以常规的盆栽形式出售幼苗。实际上，中国拥有相当大规模的苗圃产业，但大多仅仅专注于培育那些随处可见、种类有限的景观植物，而非充分把握中国本土物种的多样性；或是关注于具有特殊生态功能的植物，例如那些可应用于雨水花园能承受干湿条件转换的植物。因此，必须尽快展开相应且必要的研究工作。首先，需要发展一个可供应大量高质量野花种子的种子产业，为苗圃产业提供种子资源，也可满足在基础设施建设或其他项目中直接撒播的需求。其次，需要展开区域化研究，识别并采集野生环境中具有景观应用潜力的种子进行培育，掌握种子萌发和生长的过程。最后鼓励大量的种子公司实现商业化，为景观实践提供所需的种子资源。

关键词 ……

绿色基础设施；生态性景观；政策；草本植物；种子产业

Abstract ...

This paper explores the relationship between policies of increasing green infrastructure in cities and the development of planting designs that will allow new vegetation to be interesting and attractive, while fulfilling ecological requirements. The challenge is to maintain a balance between beauty and function, which in the past, have sometimes been seen as mutually exclusive. One key problem in applying vegetative infrastructure to Chinese cities is that the nursery infrastructure, needed to supply cities with both native and non-native plants, is poorly developed. There is a significant nursery industry in China, but it is focused on growing a relatively limited palette of “everywhere” plants, rather than reflecting the regional diversity of native Chinese plants or plants that have specific ecological function, such as floodable or drought tolerate vegetation. Hence, there is a pressing need to initiate research to develop a wildflower seed industry, to develop a large volume of good quality to supply the nursery industry and sell for direct planting. Increasing the seed industry will require a regionalized research effort to identify and collect founder seed in wild habitats that have a high potential for urban use, understand seed germination and emergence, and will involve companies in commercial production to make it available to the wider market of landscape professional.

Key words ...

Green infrastructure; Ecological Landscape; Policy; Herbaceous Plants; Seed Industry

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当前，世界各地的诸多大中型城市均在不断探索能够最大限度满足人们需求、实现生物多样性且保证资源消耗最小化的规划策略。对城市环境营造产生深远影响的决策者和城市规划师们，正逐渐意识到景观设计应该成为城市基础设施建设中不可或缺的组成部分，甚至可被视为基础设施的核心。越来越多的专家认为，要创造一个更为可持续的城市环境，应该大力发展城市景观而非建筑设计。这将要求景观设计师来控制和规划所有建筑的分布，而不是由建筑师创造城市空间，将景观设计师置于仅存的碎片空间中做有限的发挥。气候变化、极端天气事件频发、碳/氮排放和堆积、资源的大量消耗与不断短缺……面对城市发展的主要问题，景观设计应该成为一个能够发挥功能的工具，而不是被简单地看作城市中的装饰元素。同时，我们不仅需要意识到景观设计在成功提升城市品质方面的重要性，还需要在自然和景观的固有文化之间找到一个平衡点。当我们追求更为自然的景观设计时，常常选择

Cities across the globe are currently exploring the strategies by which they can make urbanization successful for people and biodiversity, while minimizing resource consumption. Policy makers and urban planners, who have long helped shape urban environments, are now recognizing that landscape should also be regarded as part of the urban infrastructure, perhaps even the core element. Increasing numbers of professionals believe that to create more sustainable cities, urban development should be based on the landscape, rather than the architecture. Rather than cities where buildings create the urban fabric and landscape is an afterthought, this approach to urban development would start with landscape architecture, with buildings to follow. Faced with urban environmental challenges, such as climate change, carbon and nitrogen accumulation, resource consumption and shortages, landscape needs to increasingly function as a tool rather than an ornamental element. At the same time, it is important to recognize that for landscape architecture to be successful in improving the quality of cities, it is also necessary to address cultural and aesthetic assumptions of the role of nature in Chinese cities. When you are going to have larger natural areas of planting in cities, the more questions will need to be asked about what make this nature attractive or unattractive to ordinary Chinese citizens.

In order to effectively promote the Ecological Process[1] advocated by the central government, landscape and ecology need to become better integrated. Policy statements are easy to write, implementing them is much more difficult. In China, issues of physical health, such as respiratory illness from air pollution, dominate the political agenda. In the post-industrial west, by contrast, increasing attention is paid to urban vegetation’s role in improving mental health and general of well-being. One characteristic of urban Chinese living is limited public interest in building materials, such as masonry or brickwork. These materials, no matter how beautifully designed and crafted, have extremely limited aesthetic richness. Unlike plants, they do not change their shapes and forms over time, change colors, or emit fragrance.

1. 现代公园设计中，具有长期观赏性的大尺度本土观赏草植被景观。
1. Large scale, large native grassy tussock vegetation forming long attractive vegetation in a contemporary public park.

在城市中采用大面积的种植形式，但景观设计师们需要反复斟酌：这些自然式的种植对于中国的普通公众是否具有吸引力？

为了有效地实现综合治理，高质量完成中央政府所倡导的生态文明建设[1]，景观设计、城市规划、生态修复就必须共同发展并且更有效地融合。政策声明可以快速制定，但实施起来却相对困难。在中国，居民的身体健康问题（例如与空气污染相关的呼吸系统疾病等）是长期存在的社会问题之一，并且已经成为一个重要的政治议题。在后工业时代的西方国家中，决策者越来越重视城市植被在提升居民心理和生理健康水平及全民幸福水平中起到的独特作用。城市生活的特征之一是那些组成城市的砖石建筑，但它们很少拥有内在的魅力。混凝土和砖石，无论经过多么精美的设计、采用多么高超的制作工艺，都只能起到有限的装饰作用。和植物不同，随着时间的推移，它们不再改变形态和色彩，也不会散发出宜人的香气。值得强调的是，植物在城市和郊野环境中的调和作用，对人类的幸福是极其重要的。相关研究表明，当人们看见开花的植物抑或泛红的秋叶时，大脑中随即产生的荷尔蒙会使许多人产生积极的情感。

拥有自主土地使用权的私家花园在西方国家随处可见。许多人精心营建并悉心呵护他们的花园，私家花园也因此成为他们远离城市压力、舒缓心情、消除疲倦的重要场所。由于中国缺乏私家花园，就要求公共绿地拥有更为丰富的植物种类和种植形式，从而营造出更为强烈的自然感。中国网络社交平台（如博客、微博）显示：越来越多的城市中产阶级中的年轻成员们，不再仅仅通过聚餐、社交活动、购物等常见方式来寻求放松，而是倾向于前往郊野远足、登山或其他户外运动，去到那些人烟稀少、拥有纯粹自然美景的国家森林公园、自然保护区，来亲近大自然，体验别样的精彩。鉴于这种社会心理的变化和需求，除了标准审美意义上的在城市草坪上配植大树的绿地模式之外，中国的景观设计师们可以尝试将这些生活习惯的改变和城市景观需求的未来趋势融合到城市绿地的设计中去。

当然，在发展生态城市的同时也存在诸多矛盾。例如，规划师们关注城市棕地的改造。这些棕地通常存在污染严重、土质贫瘠、建筑废料堆积等问题，从而影响了当地政府对这些土地的再利用。但在生态学范畴内，这些地块与私家花园一样，也常常是城市中生物种类极其丰富的区域。近年来，一系列典型的后工业用地改造和重新利用、棕地改造并被重塑为城市公园的大型项目相继涌现。在改造的同时，设计师们也高度重视保留原始棕地的生态和视觉特征。著名的美国芝加哥千禧广场、美国纽约高线公园、英国伦敦2012奥林匹克公园都是世界范围内非常成功的棕地改造设计案例。

在城市雨洪管理方面，城市植被的功能体现得最为明显。事实上，城市雨洪问题的最佳解决方案并非仅仅基于庞大的地下蓄水系统，而应该与那些能减缓地表径流、起到临时蓄水作用的漫滩或其他蓄水系统相结合。这种方法在很大程度上依赖于以植物群落为基础的系统，包括屋顶绿化、雨水花园、河道及其他形式的排水廊道，以及自然形态的湿地系统和河漫滩地。政策常常是鼓励可持续性设计的有效途径。在许多发达国家，屋顶绿化是受政府鼓励的，甚至被强制要求应用于所有新建建筑的顶部。例如，德国自20世纪60年代开始推广屋顶绿化技术，并于1982年立法将屋顶绿化确立为规划政策。在日本东京，政策规定任何1 000m^{2}以上（公共设施250m^{2}以上）的新建或翻修的建筑都必须完成总占地面积20%的屋顶绿化指标。然而，在中国城市的大部分区域，将景观设计中不同的种植形式（除了熟知的湿地系统以外）与雨洪管理结合应用的技术还有待于深入研究和大力发展。

“生物多样性”在中国（尤其是城市环境中）目前还仅仅是一个口号，并非学术研究和设计实践真正关注的要点。而在英国，每一个建设项目的实施都要求制定一个能保证实现生物多样性保护

2. 伦敦的一个著名商业园区中，整齐的草坪边缘设计有效过渡了本土草花群落和常规修剪的草坪（保证消防车顺利通行）。
2. Sharp mown edges showing transition between native meadow and mown lawn (reinforced for fire vehicle access) in a prestige business park.

The seasonal rhythms of plants are very important to human well-being. When we see flowers in bloom or red autumn tree leaves, there is evidence that these interactions result in the release of hormones in the brain which increase positive feelings.

In the west, where access to private gardens is widespread, gardens often become a place to refresh and recover from the stress of city living. The absence of access to private vegetative spaces in China increases the importance of building public spaces that are richly planted, and requires that these spaces be linked to larger concepts of nature. This theory is confirmed by Chinese blogs, which suggest that young members of the urban middle class are increasingly seeking respite from the eating, networking, and shopping rituals that have dominated urban free time in favor of walking in the mountains, or other activities where being outdoors and natural values prevail. It would seem sensible to begin incorporating these desires into urban landscape design, in addition to the standard aesthetic of mown grass and lollipop trees in civic greenspaces.

There are of course many contradictions in trying to develop an ecological city. Planners, for example, are often focused on redeveloping urban brownfields, although these spaces are often the most ecologically rich areas of cities. Recent examples of reusing post-industrial sites, while retaining or enhancing the residual ecological and visual qualities of the original brownfield sites, include Chicago’s Millennium Park, New York’s High Line, and the London 2012 Olympic Park.

In many urban areas, planting storm-water management systems have received the most attention for the use of plants as infrastructure. One of the best solutions for storm-water management is not reliance on underground storage systems, but a more integrated system of slowing down surface run off and holding water temporarily in landscape-based flood basins and other storage systems. This approach relies heavily on plant-based infrastructure systems, from green roofs and rain gardens, to the re-profiling of rivers and drainage corridors back to the form of wetlands and natural floodplains. Legal policies have proved to be effective tools for encouraging sustainable design. In many developed countries, it is encouraged or even mandatory to apply greenroofs to new building developments. In Germany, for example, greenroof technology has been promoted since the 1960s, with legislation to make greenroofs a planning requirement since 1982. In Tokyo, Japan, newly built or reconstructed buildings occupying more than 1,000m^2 (public facilities over 250m^2) have to fulfill their obligations of 20% greenroof coverage. However, as of yet, integrated techniques for water management through landscape and planting design, beyond familiar wetland communities, has yet to become well developed in most of urban China. Rather than placing a real focus on implementation and research, biodiversity exists largely in name only for most of urban China. In Britain, for example, every project that requires planning permission has to meet biodiversity retention and enhancement targets, based on the national and local biodiversity action plans (BAPs), for development to be permitted.

In China, Turenscape has broken out of the traditional pattern of perennial plants in urban landscapes. Instead, their designs use agricultural grasses along side ornamental grasses and annuals in public parks, a practice that has been seen as highly innovative both in China and in the West. The Turenscape design for Shenyang Architectural University involved integrating the role of the community into the design process, emphasizing time and cycles of growth and harvesting, as integrated processes integral to the landscape. Students are involved in the harvest of rice, suggesting a way for designers to not only design a campus but also an infrastructure for socially responsive design. This model also suggests a methodology for overcoming concerns of post-occupancy and long-term maintenance. While it is clear that the Turenscape approach is elegant in terms of economic cost and valuable in terms of re-connecting people to historic landscape management practices, rather than just seeing landscape as another product to be consumed, it also raises the possibility of developing landscapes that re-connect urban dwellers with multiple notions of nature in the city. To do this effectively, as in the Turenscape examples, the scale

和强化目标的计划书，才能获得规划许可。这些目标均基于英国国家和各地区的生物多样性行动计划（BAPs）。

由俞孔坚带领的土人设计团队成功打破了中国城市景观设计中传统的种植形式，在城市公园中大量且大胆地使用了农作物、园艺观赏草和一些一二年生草本植物。尤其是农作物在景观中的使用，被国内外景观界视为高度的创新。在沈阳建筑大学的景观设计中，设计师通过用心的设计，鼓励人的参与，强调时间、生长循环、收获等一系列活动都属于景观设计的组成部分。学生们参与水稻的收获过程，这表明设计师不仅仅是在设计一个校园，更是在创造一种新型的社会基础设施。这个模式充分考虑到设计后期的效果和长期的管理维护。由此可见，土人设计的设计模式不仅充分考虑了经济成本，也有益于促进校园环境中人与人之间的交流，而非将景观设计视作一种消费品。同时，土人设计的设计理念提出了通过多种设计途径，建立一种使景观可以与城市居民互为联系的可能性。但倘若要令景观设计有效地发挥此作用，和土人设计的诸多设计一样，就需要运用大尺度的种植设计，后期的管理维护措施要求简单、易操作，且绝大多数情况下要保证成本低廉。

这就需要我们转变自身的视角，不能再将植被景观视为装饰性的图形和仅仅是在景观设计末期添加的细部修饰，而应该将植被景观视为景观设计本身，植被景观设计从方案设计初始就应影响总体设计，并与硬质景观设计相结合。西欧的景观实践表明：这种转变是具有挑战性的，特别是对那些与种植设计的关系最为密切的相关学科而言。由于个体植株不易被近距离地观赏和照料，因此在大尺度上进行的种植设计也常常被园艺学家等专家视为削弱了传统意义上景观植物的观赏价值。

如果想要使大尺度的种植设计对公众具有价值和意义，它就必须被设计得更加美观、更具吸引力。然而影响景观吸引力的因素有很多，越来越多的研究表明其中最关键的因素是“色彩”，尤其是除了基本绿色以外的其他颜色。在英国，政府和景观行业高度重视“绿色基础设施”，而其通常被理解为那些沿栖息地修复区设计的线性景观。这个概念常常被不加斟酌地等同于植被，并被片面地理解为绿色才是我们所需要的。倘若我们居住在一个没有绿色的城市里，那么仅有的、被添加进去的绿色很可能对人们具有重大意义。但当我们拥有了绿色后，我们就渴望更多能刺激并满足我们心理需求的、更为丰富的其他色彩。例如，心理学家亚伯

3. 适合应用于城市雨水花园的中国东北部自然植被。
3. Naturally occurring vegetation in Northeastern China suitable for urban rain gardens.

of planting has to be large, and the management of the vegetation simple and inexpensive.

Increasing implementation of this approach will require a switch from viewing vegetation as a decorative motif imposed upon the landscape, to viewing the vegetation as the landscape itself. Experience in Western Europe suggests that this transition is challenging, particularly for the disciplines most closely associated with garden design. Replanting on a large scale is often seen by horticulturists as devaluating the qualities of plants traditionally perceived through the viewing and appreciation of the individual specimen.

If the use of vegetation on a large scale is to be meaningful, it must maximize its aesthetic appeal to ordinary people. Among many factors that influence how attractive vegetation is perceived to be, growing research shows that color, especially other than green, is a key factor in increasing aesthetic appeal. In Britain, for example, there is a great emphasis on green infrastructure, which is normally interpreted as native woodland, designed along habitat restoration lines. Indeed, this term is often used simply to mean vegetation, but it also suggests that only greenness is required. While it is may be true that for cities with no green whatsoever, the addition of any green would be hugely valuable. Once green vegetation has been established, however, additional color stimulus is needed. For example, in the model of the psychologist Abraham Maslow there is a hierarchy of need, where color, other than green required[2]. At some point, to truly engage people in landscape, diverse colors, for an extended period of time, on a large scale are needed.

The authors' observations at the 2012 London Olympics confirmed these ideas. The huge areas of intensely colorful meadows, both native and non-native speices, were powerful for many visitors. Some visitors were visibly moved to tears by what they saw as the indescribable beauty of the designed landscape. Others wrote emails to the designers saying how the color in the landscape had had a seminal effect on them.

Color can be incorporated into landscape design through many types of plants, such as trees, shrubs, and bulbs. Annual bedding, in most cases, is most effective when perennial herbaceous plants are used. In China, historically, plants are used in monocultural blocks of species. On a large scale this approach is not particularly effective, either in terms of cost of establishment, long-term management, or providing long-term seasonality in each square meter. James Hitchmough's research over the past 20 years has sought to develop designed communities of herbaceous plants, in which plants are mixed together at random. Plants are selected so that in each square meter there are at least six, and in some cases up to twenty different species. Species flower at different times of the year, typically commencing in spring. Most of the herbaceous plants that flower in spring are small and low growing, and as such they form a ground layer in the plantings. These plants are mixed with other species that flower in late spring, early summer, late summer, and occasionally autumn. Species that flower late in the season are typically taller than the species that flowered earlier, meaning later blooming species flower above the earlier species.

Many of the same species are present in each square meter of the planting. Therefore, when a certain species flowers, the whole surface area of the planting (this might be up to 1,000 m^2) turns the color of the blooming flower. The colors of the planting continue to change as the next species blooms. These mixed plantings make it possible to extend the flowering seasons from the same square meter plot of ground. However, to make this work, it is necessary to have an ecological understanding of the species. For example, some flower species are very fast growing, while others are very slow. The fast species will eliminate the slower growing species, leading to a decline in the visual drama or duration of the flowering display. These types of temporal spatial organizing and layered flower displays are normal in mountainous Chinese wildflower meadows.

In designed landscapes, where the choice of vegetation is more limited than in nature, it is possible to increase the longevity of flowering vegetation and make it much more visually dramatic. Speaking to this level of plant spatial organization may seem very removed from notions of large-scale green

面，人们内心对色彩很可能也存在不同层次的心理需求，在绿色作为基本色彩因素已满足人们的心理需求之后，其他色彩将逐渐成为新的刺激因素[2]。在某种程度上，如果景观设计师想要引起公众的兴趣、鼓励人们真正参与到景观设计中，就必须从一个大尺度上去提供能满足人们心理需求且具有丰富色彩的景观，并尽量保证这种色彩的景观持续性。

作者对于伦敦2012奥林匹克公园中游客行为的观察和研究证实了上述理论：英国有史以来面积最大且色彩强烈的本土和非本土生态草花群落设计，对绝大多数来自世界各地的游客来说是极具吸引力的。部分游客在看到那些他们从未见过且难以形容的美丽的景观设计时，甚至为之动容落泪。还有一些游客陆续给生态草花群落景观的设计师们发来电子邮件，表达了这种开创性的景观种植形式给他们带来的前所未有的视觉享受。

在景观设计中，我们可以通过不同类型的植物 —— 可以是乔木、灌木、球根花卉、一二年生草花等 —— 来展现丰富的色彩。但在绝大多数的情况下，宿根花卉（多年生花草）的使用可以使景观植物的色彩表达更为高效。在中国的景观设计中，这些宿根花卉常被用作传统花境的主要设计材料，单一物种在花境群落中各自呈块状种植。但倘若将其应用在大尺度的景观设计中，这种传统的种植模式在群落建立和长期可持续的管理维护方面均有一定局限性，不能有效地控制成本，也不能保证每平方米的范围内都能实现长期的观赏性。本文作者詹姆

用草本植物（尤其是宿根花卉）进行随机组合来建立生态群落。通过对植物材料的精心选择，以保证每平方米至少有6个不同的物种；在某些花期较长的混合群落中，每平方米内可多达20个不同的物种。这些不同的草本植物通常从春季开始，陆续在全年的不同季节绽放。春季开花的草本植物大多体量较小、生长低矮，因此在混合群落中可以成为很好的地被层。希契莫夫教授将它们与晚春、初夏、盛夏，甚至是秋季开花的其他物种相混合，因为这些物种往往植株较高，能够争取到足够的阳光进行生长。

由于同一物种在整个草本群落中分布较为均匀，所以当其中一种植物开花时，整个草本群落（假设总面积为1 000m^2）将会全部呈现一种颜色。当下一种植物到达盛花期的时候，整个群落又会变成另外一种颜色。这种混合型植物群落使得整个种植区域各处均可保持相当长的花期。为实现这一设计理念，需要了解并掌握植物材料的生态特性。例如，将生长迅速的物种和生长极为缓慢的物种混合，在种间竞争中，速生物种会很快抑制慢生物种，使其在群落中的数量大量减少甚至消失，或者大大影响其生长速率，使其花期延后。上述这种空间组织形式和花期展示周期正是中国高山野花草甸的自然形态。

在人工设计的景观中普遍应用的植物种类，相对自然界中的丰富物种来说还极其有限。但我们可以尝试从自然界中引入花期长且极具视觉冲击力的植物来丰富设计。当我们谈论生态草本群落的植物空间组织时，似乎与大尺度的绿色基础设施相距甚远，但作为一名设计师，在概念层面将这一思想融合进不同尺度的景观设计中去是相当重要的。

在英国谢菲尔德大学，希契莫夫及其研究团队已经将这一设计理念广泛应用于实践之中，通过本土物种和外来物种的应用，建立了各种不同的植物群落。设计师可视地理位置、居民需求、长期管理维护资源的具体情况，对生态草本群落的结构和物种类型做出相应调整。例如，英国本土野花草甸的草花基本在每年的八月初就会结束花期，整个秋季没有任何的吸引力。通过研究并应用大量来自于北美高原草甸的草花植物 —— 这些草本植物大多能在夏末和整个秋天开花 —— 填补了本土草花的空白花期。到目前为止，我们已经成功建立了英国本土生态草本群落、来自北美高原的干草甸群落和湿草甸群落、来自北美山区的干草甸生态群落、来自欧洲中部及南部的干草甸生态群落、南非地中海气候球根花卉生态群落、南非高原山区草甸生态群落等，并将来自中国云南、四川等地的湿草甸植物成功应用于可持续的城市雨水花园设计中。

除了利用以宿根花卉为主的草本植物建立具有复杂空间的生态草本群落之外，希契莫夫的另一个重要研究突破是通过在场地上直接“撒播种子”的方式建立植物群落，革新了传统的种植方式。撒播建立生态草本群落的技术拥有绝对的优势，但也存在一些不足。优势是它能大大降低成本（用于撒播的种子成本通常不到2英镑/m^2，而购买适宜种植的大小相同植株的花费往往超过25英镑/m^2）、减少人力投入和运输成本等。不足之处是其在植被形态分布上不如传统种植规整。但撒播可以在单位面积上建立相当高密度的植物群落，有助于实现物种多样

infrastructure, but it is essential as a designer to be able to integrate concepts at different scales.

At the University of Sheffield, we have applied these ideas to a wide variety of plant communities, both native and non-native, depending on the location, the needs of local people, and the resources available for long-term management. We have worked a great deal with North American Prairie species, because many of these flower in late summer and autumn, while much of Chinese native meadow flora has typically finished flowering by early August and is unattractive in autumn. To date, we have also worked on wet meadow vegetation from Yunnan and Sichuan for use in sustainable urban drainage swales; dry, wet and mesic North American Prairie; dry North American Mountain Steppe vegetation; and Central European, Southern European Steppe vegetation, Mediterranean South African geophyte rich steppe, and high altitude South African mountain grassland.

The other major innovation Hitchmough has made is to move away from planting as the primary means of establishing designed vegetation to sowing seed in-situ. This has both disadvantages and advantages. On one hand, one loses some control over composition, but on the other hand, greatly reduces cost (< £ 2.00/m^2 as opposed to > £ 25.00/m^2 for plant material) and the amount of energy (carbon) embodied in the process. Sowing also allows very high densities of plants to be established per square meter, leading to high species diversity and long flowering seasons. This method also produces robust vegetation that is also very resistant to invasive weeds. This is only possible, however, when close attention is paid to the soils used (preferably infertile rather than fertile) and initial weed control. If the site is not initially weed free, then the sowings efforts will be fruitless, as the new plants will be outcompeted by weeds in the first year and fail.

At the Olympic Park, over twenty hectares of the

4. 伦敦2012奥林匹克公园中，可持续城市生态排水洼地（斜坡底部）结合自然式坡地植被的生态景观设计，在实现景观功能的同时兼顾美学效果（由詹姆斯·希契莫夫、奈杰尔·邓尼特和LDA设计公司设计）。
4. Sustainable urban drainage swale at the base of a slope planted with naturalistic vegetation, combining function and beauty, in London Olympic Park, designed by James Hitchmough, Nigel Dunnett and LDA Design.

性、延长观赏季，而且可以呈现出非常强健的植物群落以抵御周边杂草的入侵。然而群落的建立只有在调整土壤介质（最好是相对贫瘠的土壤而非较为肥沃的土壤）和控制初期杂草的前提下才能成功。如果撒播前的场地未进行杂草控制，那么在第一年，幼苗就容易被杂草消灭，最终导致撒播失败。

伦敦2012奥林匹克公园超过20hm^{2}的生态草花群落就是应用这项技术建立并获得巨大成功的案例。但倘若要在中国广泛应用这一技术来建立生态草本群落，仍然存在一系列有待解决的问题。其中首要的问题是：在很多情况下，中国的景观设计文化总是习惯性地不喜欢或是不接纳外来物种，因此拒绝从国外的种子产业引入新的物种。部分的原因在于许多早期的中国景观设计师曾留学于美国，并深受美国景观设计中反外来物种思潮的影响。一方面是担忧外来物种具有成为入侵物种的风险，但更主要的是对任何外来事物惯有的恐惧心理。面对这一现象，较为明智的做法是采取更加细致入微的方法。具有较低繁殖潜能（自播繁衍能力低）的外来物种很可能特别适合在开花效果需求较高的城市中心区的景观中应用。其中，北美物种通常非常符合这一要求，因为它们在夏末和秋季开花，而这一时段很可能仅有为数不多的中国本土草花能满足需求。相反，本土物种（在合适的环境中使用时）通常会自播繁衍，因此本土物种在面积非常大的绿色基础设施建设中具有特别的价值和意义。但中国的问题是：到目前为止，还没有发展并成功建立自己的本土野花种子产业；而在西欧和北美，庞大而完善的种子产业已有近30年的发展历史。在欧洲，设计师可以很方便地购买到50kg已经清理好的各类本土物种的种子，只需要按照一定比例将不同物种的种子混合，就可以很容易地在新建的高速公路路堤上进行撒播。

第二个问题是：在中国，急功近利的思想影响着景观设计行业，导致设计和建设的周期短，甲方追求立竿见影的效果。无论是甲方还是设计团队都非常重视设计，但对施工技术和后期管理维护的措施却不够重视，施工和维护常被置于设计过程之外。正因为这些片面的认识，中国不少已建成的景观项目面临着一遍又一遍的改造更新。但倘若在设计初始便能充分周全地考虑，在设计的同时兼顾长期的管理维护，许多不必要的改造和更新是完全可以避免的。事实上，学界所提倡的可持续景观发展模式正在实际项目的操作过程中被误解并逐渐消

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landscape was sown in this way and it was regarded as extremely successful. However, there are a number of issues that need to be addressed before such approaches could be successful in China. One of the first issues is that in many cases Chinese landscape architecture culture is hostile to the use of non-Chinese plant species, and therefore has chosen not to use species from the international seed industry. In part, this is due to many of the first generation of Chinese landscape architects being educated in the United States, which is also culturally hostile to the idea of using non-native species. In large part, this rejection of non-native species is partly because of the very cultural fear of biological invasion. It is much more sensible to maintain a more nuanced approach to these issues. Exotic species of low reproductive potential may be particularly suitable for use in city center locations, where intense flowering effects are desired. North American species are, for example, often very useful in these environments because they flower in late summer and autumn, a time when few native species might be flowering. Conversely, because native species, when used in appropriate environments, are typically able to reproduce through self-seeding, they are valuable at the very largest scale of green infrastructure. However, China lacks a native wildflower seed industry, as has happened in the past 30 years in Western Europe and North America. In Europe, you can readily buy 50 kilos of seed of multiple species , making the implementation of sown meadows of native species on new motorway embankments, for example, easily undertaken.

The second problem for Chinese incorporation of green infrastructure is the Chinese approach to developing new landscapes, which are based on the desire to see a built landscape as a finished product. Design is valued, but the establishment of longer-term management is often very, very poor, and not an important part of the design process. Landscapes result in being re-planted over and over, a process that could be avoided by more thoughtful long-term initial design. In essence, an entire part of sustainable landscape development is missing – maintenance informed design. While clients in nearly every part of the world wants to see attractive results as soon as possible, in China, this is taken to an extreme level. Everything must happen instantly. One of the reasons why many urban landscapes in Chinese cities look the same is because of this instant mentality, often driven not for the benefit of the citizens as a whole, but to benefit the careers of those who commission design work. Vegetation is not the same as a new carpet or a car. Adopting a more ecological approach requires being prepared to allow vegetation to develop and mature over time. Obsession with the short term is a disastrous strategy.

In many countries, wildflowers are in decline because of loss of habitat from intensification. In Britain, this was recognized in the 1970s and research was commissioned by the government to determine whether it was possible to recreate the agriculturally based hay meadows that had largely been destroyed by agricultural intensification in the 20th Century. Led by Dr. Terry Wells of the Institute of Terrestrial Ecology, this research showed that it was possible. Following the study, a number of individuals, often with botanical training, began to collect wildflower seeds and grow them for seed production. This led to the establishment of companies such as Emorsgate Seeds[3], and caused companies traditionally more involved in turf grass seeds to branch into wildflower seeds. This growth allowed practitioners to buy seed in bulk, which led to increased demand as the industry got larger and more sophisticated. The EU has, for example, invested £ 913,450 in the National Wildflower Center in Merseyside to establish 30 hectares of wildflowers for seed production along road verges and redundant farmland. The project aims to address the endangered UK wildflower species, while also addressing impacts of climate change in urban and rural environment, and providing employment in deprived urban areas. Seeds are harvested each year and sold online, helping to preserve endangered UK wildflowers by encouraging their wider use, from garden to meadow and even green roof gardens. Wildflower sowing has been highly promoted in public spaces, and this creative conservation project has resulted in positive changes for local environment by creating valuable habitats within the cities for birds, butterflies, bees and other insects. Similar processes have happened in Germany

5. 中国云南本土报春花属植物在英国具有长期观赏效果的多年生草本群落景观实验中的应用（拍摄于3月）。
6. 一个月后（4月），同一个报春花群落中，在原有的植株间隙里出现了另外一种不同的报春花。
7. 同一个报春花群落在5月的景观效果。
8. 同一个报春花群落在7月末的景观效果。

5. Chinese primula species from Yunnan used to create long flowering experimental perennial meadows in Britain; March.
6. The same primula meadow one month later (April) with a different species emerging from the spaces between the previous flowering species.
7. Same primula meadow one month later (May).
8. The same meadow in late July.

失，管理维护本该渗透并贯穿于整个设计过程。几乎世界各地的甲方都希望尽快看到显著的效果，而这一现象在中国表现得更为极端。造成中国城市景观千篇一律的众多原因之一就是：甲方片面地追求业绩，而忽视景观的实际功能和可持续性。植被不同于一张新的地毯或是一辆新车。生态景观设计需要给予植被一定的时间去发展演变，而不是一开始就能呈现出最佳的观赏效果。立竿见影的妄想常常会成为灾难性的开始。

因为农耕的加剧，很多国家的野生花卉正随着自然生境的逐渐消失而大量减少。在英国，人们在20世纪70年代就意识到了这个问题，原有的干草甸在20世纪因大规模的农耕而遭到严重的破坏，因此政府委托专家研究重塑这种以农业为基础的干草甸的可行性。这个项目由英国陆地生态研究所的特 ¤ ╪˜ ين˜ ، Ц ז î مط ج ש₩ת Ν 以实现的。于是，一些人（通常是接受过植物学培训的专业人士）开始采集野花种子，培育植株，并将其逐步产业化。一系列诸如Emorsgate种子公司[3]的野花种子公司随后成立，最终传统的草坪种子公司也开始大量地供应野花种子。大量种子公司的存在为设计师们创造了批量购买种子的可能性；设计师的需求逐渐提升，种子产业变得越来越壮大，且愈加完善。欧盟也投资90多万英镑，在英国默西赛德郡的道路边缘和闲置农田上建立了约30hm^{2}的英国国家野花中心，用于种子培育。这个项目意在关注那些濒临灭绝的英国本土野花物种，同时综合考虑气候变化对城市和郊野环境的影响，并为城市贫困地区提供了大量的就业岗位。每年，大量的种子由雇工收获、清理，并在网上出售。大力鼓励人们在私家花园、野花草甸景观设计，甚至屋顶绿化中广泛使用这些种子的举措，有助于更好更充分地保护濒临灭绝的英国本土野花。在公共绿地中，当地政府已大力推广并使用野花种子撒播建立生态草本群落的技术，这个创造性的保护项目为鸟类、蝴蝶、蜜蜂和其他昆虫在城市中创造了可贵的栖息地，并最终彻底改变了整个城市的环境。德国、美国等发达国家也经历过类似的景观转变。在美国，种子贸易以美国中西部的高原植物种子和本土山区植物种子为主要产品[4][5]。

过去的几年里，中国也出现了一些生产和出售种子的苗圃，产品包括一些一二年生植物、多年生植物、灌木和乔木的种子。他们主要培育常见物种（大多是传统的一二年生花坛植物），同时也直接从国外种子公司购买非本土物种的种子，并在中国出售。目前，在广东、江苏、四川等省份的景观项目中，陆续出现了在基地直接撒播建立的草本群落。但大多数这类草本群落主要由非本土的一二年生植物组成，只能提供很短的展示周期，而且需要逐年补播。北京林业大学等科研院校近年来就多年生草本植物的景观应用开展了一些研究工作，但仍处于初级阶段。[6][7]多年生草本植物的种子市场拥有巨大的空间和发展潜力，但至今仍未得到有效的开发。想要突破这个瓶颈，就需要投入足够的科研资金到具有吸引力和生态价值的本土草本物种的选择、生产和生态学特性的研究中去，以供未来的生态景观使用。这使得我们可以掌握相关信息，并获得将野花种子产业化的第一批种子。这样的研究实验最好能在中国的不同区域展开，因为只有少量的物种自然分布于整个中国大陆，而大部分存在明显的区域分布特点。中国的东北部和云南、四川的景观设计就需要应用不同的草花物种。同样的选育工作也适用于其他类型的植物，如乔木和灌木。

实际上，中国拥有大量的园艺和景观基础设施，例如，在中国分布有成百上千的苗圃，但中国本土植物种类的多样性尚未得到很好的研究和应用。院校和研究机构大多专注于常规园艺观赏植物的育种工作。他们虽然也时常组织国际性的会议，和外国专家交流研究和实践经验，但对于种植设计在城市景观中的新功能的关注度仍然非常有限。一些新颖的研究资源也同样引人注目。例如，中国最大的住宅开发企业万科集团，长期致力于引领行业节能减排，持续推进绿色建筑和住宅产业化，并成立了万科集团建研中心，在过去的6年里逐渐开展住宅种植的研究。万科集团建研中心景观研究所正尝试着将国外生态景观方面的高新技术引入万科在中国的实践项目中，并建立了相应的博士后研究点。这类组织很可能会在发掘新的景观植物和发展新型种植模式方面发挥重要作用，尤其是在中国不同的气候地区发掘具有潜在景观应用价值的物种方面。

作者通过互联网进行的调查研究显示：中国有越来越多自发性的组织机构专业人员正在积极了解物种及其生长的自然景观环境，并参与本土野生植物的调查。例如，影像生物多样性调查所 [8]就是由一群具有生态学、地理学、生物学等背景的专业人员组成的，他们调查中国各地的野外生境，并在微博上分享他们的知识和经历。他们在生态领域充分发挥自身的优势，并尝试与其他科研机构和设计公司合

and the United States. The U.S. seed market has mainly been used for prairie plants in the mid-West but also some native species in the Rocky Mountain region[4][5].

In China over the past few years, a small number of nurseries have emerged to produce seeds for annuals, perennials, shrubs, and trees. They cultivate common species, mainly bedding species, and have introduced non-native species by purchasing seeds abroad. Some herbaceous planting communities have been created by seed sowing in situ in built projects in cities such as Guangdong, Jiangsu and Sichuan. Most meadow type plantings are mainly based on non-native annuals, which provide only a short display period and need to be sown every year. The use of perennial planting represents only the beginning of the potential market, with increasing research possibilities occurring at the Beijing Forestry University.[6][7] The seed market for perennials has a large, but undeveloped potential. To break open this log jam, there needs to be more funded scientific research into the selection of beautiful and ecologically valuable native herbaceous plants, followed by additional research into their ecology and seed production. This body of knowledge would provide the understanding and initial seeds needed to set up a wildflower seed industry. This initial research would operate regionally in China, as few plant species grow across the entire country. For example, the species needed to harvest seeds from in northeast China differ from those in Yunnan and Sichuan. The same research would also be required for other plant groups, such as trees and shrubs.

There is significant horticultural, landscape infrastructure, and thousands of nurseries in China, but they do not represent the diversity of Chinese native flora. Similarly, at a university and research level, much of the focus is on propagation of common ornamental plants. These groups do organize an international conference to exchange research and practical experience, however, their focus on new functional roles for planting in urban landscapes appears to be limited. Some novel sources of research are also evident. China Vanke Co., Ltd., the largest real estate developer in Shenzhen, for example, is dedicated to leading the industry in energy conservation and emission reduction, as well as promoting green buildings and housing industrialization. Over the past six years, since building a research center, Vanke has gradually developed its research on planting. The landscape research section is trying to integrate technologies of landscape ecology into local practice and establish a postdoctoral research station. These sorts of real estate organizations could potentially play an important role in developing new forms of plants and planting, especially in terms of identifying plants valuable for landscape use in different climate zones across China.

There is also increasing voluntary interest in native plants and the landscapes in which they grow. For example, the Image Biodiversity Expedition Institute[8] is a group of people with backgrounds in ecology, geography, and biology who gather to survey wild habitat across China, and share their knowledge and experience to others through micro-bloging. This group is giving full play to their knowledge of ecology, and try to fulfill their social responsibility by cooperating with other research and design companies.

There is a great need to advance the use of planting design in landscape projects in China, where vegetation is seen as part of multi-functional green infrastructure rather than purely cosmetic planting. At the same time,

9. 要想了解不同植物萌发和植株建立的过程，需要开展相应的实验研究。
9. Experimental work is necessary to understand the germination and emergence responses of different species of plants.


9

作，履行社会责任。

最后，我们要再次强调：在中国的景观项目中积极推进种植设计的使用是非常必要的，应将这些植被看成是多功能绿色基础设施建设的一部分，而不仅仅是装饰性的点缀元素。同时，与城市基础设施保持联系也很重要，尤其是在人居环境中，必须同时保证所设计的植被景观是赏心悦目的。然而在设计周期很紧迫时，西方的设计师们有时也会忘记在设计中应力求生态。作者认为本土和非本土植物都应该在城市绿色基础设施中发挥作用，然而，在中国这样拥有丰富的本土物种资源的国家，本土物种很可能起到主要作用。当前，在设计中大量应用本土物种 —— 尤其是那些曾经在本地分布，而后因城市化而消失的物种 —— 这一种植理念正受到市场采购模式、景观发展趋势和苗圃理想物种供需不足等方面的多重限制，迫切需要其他科研机构和院校对具有景观应用潜力的中国野生花卉进行调查研究，尤其是那些能在景观中发挥特殊作用的物种。例如，在可持续城市景观排水系统的干湿循环中表现出色，同时形态美观的植物。无论是出售种子还是植株，这项意义重大的工作必将为苗圃产业的发展带来新机遇，并将引领中国景观及其他相关行业走向更为专业化的光明未来。**LAF**

it is also important not to lose sight of the idea that green infrastructure, especially when it is close to where people live and work, also needs to be beautiful, an idea that has sometimes been forgotten in a rush to be as ecological as possible. Additionally, both native and non-native species have roles to play in urban green infrastructure, although in China, native species are likely to play the leading role. At present, the use of an extensive range of native species, especially those that are distributed and used locally, is limited by both the modus operandi of procuring and developing ornamental landscapes and by the unavailability of appropriate species in the nursery industry. There is an increasing need for researchers and universities to begin to screen Chinese flora for species of value to landscape architecture, in particular, for species where function, such as plants capable of performing well wet-dry cycles, is combined with strong aesthetic characteristics. Increased research and development of the seed industry will lead to new opportunities for nurseries and increase the professionalism of Chinese landscape architecture and associated industries. **LAF**

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观点与评论
View and Criticism

当代语境中的景观正趋于成为一种集交通、生态、经济、社会与文化功能的复合载体，扮演着城市基础设施的角色。在这一期中我们试图讨论城市基础设施与景观之间的关系。

城市基础设施通常以庞大的尺度建造于土地之上，对于生活在其中的人们来说，其本身就是一种无处不在的景观。如何将文化和艺术融入到这样的工程中，使之成为“优美的工程作品”，这是我们思考的第一个层面，可以将其称为“基础设施的景观化”。第二个层面则是“基础设施性的景观”，在这个层面中，景观并非依附于基础设施之上，为基础设施增加一层“绿色”的外衣，而是能够直接为城市居民提供基础设施服务，例如生态滞留池可以成为一种缓解城市雨洪问题的“排水管道”。我们思考的第三个层面是，景观作为承载着多种生物及非生物过程的载体，如何将这些动态的过程与原本静态的、孤立的基础设施结合起来，使之具有弹性、创新性和灵活性，以应对日益复杂的城市环境。

Landscape, in contemporary context, is becoming a hybrid entity with transport, ecological, economic, social and cultural functions, and playing a role as urban infrastructure. In this issue, we intend to examine the relation between urban infrastructure and landscape.

Urban infrastructure is often seen as a ubiquitous, huge-scaled landscape in our built environment. The first level we are considering about is how to fuse cultural and artistic values into urban infrastructure to create an “engineering work of beauty”, which could be regarded as “landscaped infrastructure”. On the second level, “landscape functioning as infrastructure”, suggests that landscape will serve the citizens directly — for example, a detention pond performs as “drainage pipes” to mitigate the impact of stormwater in a city — rather than being a green repackaging cover to the urban infrastructure. The third level is that landscape, as a carrier and the matrix for both living and non-living processes, integrates these dynamic processes into the existing static, isolated infrastructure and responses to the increasingly complicated urban environment with resilient and ingenious capabilities.