

<b>Institution:</b> University of Sheffield		
<b>Unit of Assessment:</b> C-13 Architecture, Built Environment and Planning		
<b>Title of case study:</b> Maximising sustainability, biodiversity, and well-being benefits from designed green infrastructure		
<b>Period when the underpinning research was undertaken:</b> 2000–2018		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b> James Hitchmough	<b>Role(s) (e.g. job title):</b> Professor of Horticultural Ecology	<b>Period(s) employed by submitting HEI:</b> 1995–present
<b>Period when the claimed impact occurred:</b> August 2013–2020		
<b>Is this case study continued from a case study submitted in 2014?</b> N		
<p><b>1. Summary of the impact</b> (indicative maximum 100 words)</p> <p>Hitchmough’s experimental research has pioneered the application of ecological science and environmental psychology to the design and management of urban green infrastructure for more sustainable urban vegetation, biodiversity, and enrichment for people. His collaborations and projects in China have made available hundreds of new species with the resilience to create more sustainable landscapes. These include new woodland demonstration gardens at the 2019 Beijing International Expo and large-scale gardens in central Beijing; plus the framework strategy for the ecological restoration of a 1,275km<sup>2</sup> Chengdu mountain range as the world’s largest urban forest. This work has increased appreciation of the value of biodiversity leading to changes in landscape approaches in China. His work in Australia has led to the development of novel plant communities – “woody meadows” – used by the City of Melbourne as part of their climate change adaptation plan.</p>		
<p><b>2. Underpinning research</b> (indicative maximum 500 words)</p> <p>From 2000, Hitchmough investigated harnessing the most desirable traits of semi-natural “wild” vegetation - high species diversity and ability to survive urban conditions without intensive horticultural management - to test these characteristics in designed plant communities. Hitchmough pioneered the application of rigorous ecological experimentation on these types of urban plant communities. Much of this research has been published in <i>Landscape and Urban Planning</i>.</p> <p>The research aimed to produce attractive plant communities and maximise biodiversity, whilst gaining the popular and political support of urban populations for eco-centric approaches. A range of novel plant communities was conceptualised, and used as ecological models. Standardised protocols were developed, starting at laboratory scale with individual species, moving to multi-species microcosm experiments (R1, R2, R3), then field scale experiments, and finally landscape practice. Environmental psychology research was undertaken in parallel to understand how urban populations viewed this vegetation, from meadows to woodland (R2).</p> <p>The initial research examined establishing herbaceous vegetation from seed sown <i>in situ</i>, facilitating the creation of large areas of complex vegetation with limited budgets (R1, R2, R3). This determined which species that can be successfully and economically established <i>in situ</i>, the seedling density of each species to give the desired designed appearance via random</p>		

broadcast sowing and how competition from weed seedlings could be minimised (R1, R2). Subsequent research investigated planted as well as sown vegetation. The research was supported through collaboration with the RHS (Royal Horticultural Society), grants from the Stanley Smith Trust, and PhD studentships. A Marie Curie TOK grant (2006-2009, £256K) with Jelitto Seeds, Germany, provided data on the emergence characteristics of 1,000 species.

The research established that it was possible to create successful designed plant communities for urban landscape space (R1, R2, R3), and that energy intensive horticultural management involving irrigation and fertilisation was detrimental to community persistence and attractiveness (R1, R2, R3). It also proved that designed naturalistic plant communities could be efficiently and sustainably managed, primarily by using more sustainable nature conservation techniques such as cutting (R2, R3). Attractiveness to the public was shown to be strongly correlated with the percentage of the vegetation surface area that was covered by coloured flowers/autumnal leaves (R5-R6) and these key findings were applicable to both herbaceous and woody vegetation (R4).

Key research findings were applied to landscape practice to test how ecological processes at the research plot-scale worked when transferred to the large-scale sites such as at the 2012 London Olympic Park.

### 3. References to the research (indicative maximum of six references)

- R1.** Hitchmough, J., de la Fleur, M., & Findlay, C. (2004). Establishing North American prairie vegetation in urban parks in northern England. *Landscape and Urban Planning*, 66(2), 75–90. [https://doi.org/10.1016/s0169-2046\(03\)00096-3](https://doi.org/10.1016/s0169-2046(03)00096-3)
- R2.** Hitchmough, J., & Wagner, M. (2013). The dynamics of designed plant communities of rosette forming forbs for use in supra-urban drainage swales. *Landscape and Urban Planning*, 117, 122–134. <https://doi.org/10.1016/j.landurbplan.2013.04.018>
- R3.** Hitchmough, J., Wagner, M., & Ahmad, H. (2017). Extended flowering and high weed resistance within two layer designed perennial “prairie-meadow” vegetation. *Urban Forestry & Urban Greening*, 27, 117–126. <https://doi.org/10.1016/j.ufug.2017.06.022>
- R4.** Jorgensen, A., Hitchmough, J., & Dunnett, N. (2007). Woodland as a setting for housing-appreciation and fear and the contribution to residential satisfaction and place identity in Warrington New Town, UK. *Landscape and Urban Planning*, 79(3–4), 273–287. <https://doi.org/10.1016/j.landurbplan.2006.02.015>
- R5.** Hoyle, H., Hitchmough, J., & Jorgensen, A. (2017). Attractive, climate-adapted and sustainable? Public perception of non-native planting in the designed urban landscape. *Landscape and Urban Planning*, 164, 49–63. <https://doi.org/10.1016/j.landurbplan.2017.03.009>
- R6.** Hoyle, H., Hitchmough, J., & Jorgensen, A. (2017). All about the ‘wow factor’? The relationships between aesthetics, restorative effect and perceived biodiversity in designed urban planting. *Landscape and Urban Planning*, 164, 109–123. <https://doi.org/10.1016/j.landurbplan.2017.03.011>

#### 4. Details of the impact (indicative maximum 750 words)

The 2012 London Olympic Park changed British attitudes toward ecological vegetation in urban areas. Since 2013 Hitchmough has worked to introduce his green infrastructure innovations in China and Australia.

##### China

Utilising the worldwide acclaim from the 2012 Olympic Park work, Hitchmough engaged with key stakeholders in China to promote a shift from traditional, development-led monocultural designs by demonstrating the benefits of biodiverse, ecological design based on his experimental research. Key priorities were to:

- a) Use Chinese plant communities as models for urban landscapes
- b) Encourage the identification, cultivation, and commercialisation of indigenous plant species
- c) Develop understanding of the political, technical, and organisational barriers to implementing an ecological vision in China
- d) Demonstrate the viability of new sustainable planting design in a Chinese context.

This was done through varied collaborations across China, allowing Hitchmough to develop a reputation as an international expert on ecological planting design using native Chinese species.

In 2013, Kaixian city contracted Hitchmough to develop sustainable vegetation designs for their city. Kaixian city developed a new research station to investigate the establishment of 200 herbaceous species using Hitchmough's methodology. Identified species were used to create the first sown perennial meadow vegetation in China [S1]. Hitchmough's planting design was then used in major road interchange planting (3,000m<sup>2</sup>) in the city [S1]. Hitchmough was subsequently invited to advise on the redevelopment of NanShan mountain ridge (approximately 100,000m<sup>2</sup>). The city developed a nursery to grow local native Chinese vegetation to support the project. This nursery was the first in Western China to encourage the use of locally occurring Chinese species. Additionally, from 2014-15 Hitchmough further developed his expertise in native Chinese plant species through collaboration with Shenyang Jianzu University. Over 100 species new to cultivation were identified and seeds collected to create a new planting palette for designers [S2].

These collaborations positioned Hitchmough as a leading expert in ecological design with Chinese plant species, a political pre-requisite to be taken seriously by the Chinese government. This, in turn, facilitated his involvement in large-scale ecological landscape design projects in China.

##### Beijing-Xiong'an

As Visiting Expert to the City of Beijing (2016-), Hitchmough was asked by the Expo Organising Committee to design one of five 1500m<sup>2</sup> permanent "Master Gardens" at the 2019 Beijing International Horticultural Expo. Building on his experimental research, Hitchmough created a sustainable woodland design, mixing native and non-native species. Hitchmough then worked directly with the Green Garden Group (Beijing) to expand their range of species to include those needed for the Expo. This led to the commercial availability of new species that were previously unavailable in China, and which have since been used in further landscape projects [S3].

The expo was visited by an estimated 16 million visitors. Hitchmough's research and the garden were featured on peak Chinese National TV 'CCTV' (1.2bn viewers) [S4], introducing audiences to biodiverse, sustainable urban plantings and greatly increasing receptivity to these new ideas from those who experienced them [S5].

This led to a commission to design the first native Woodland Park in China at Lotus Lake (1ha) in central Beijing. This biodiverse, native woodland has been used as a model for the green infrastructure of the new urban woodland rings of Beijing:

*"James helped us develop a variety of native woodlands, replacing traditional practices with more sustainable design techniques, and successfully applied these concepts to a new urban forest park in Beijing and other projects in the city. We attach great importance to cooperating with him and to help us integrate new ideas into the green space of Beijing" [S6].*

The City of Beijing's woodland task force of national experts worked with Hitchmough to critique existing policy and practice to promote new types of green infrastructure. They commissioned a demonstration woodland to show how to apply these ideas to create complex, multi-species, native woodlands that are highly biodiverse, self-regenerating, and resilient as an alternative to hundreds of km<sup>2</sup> of traditional, short-term, monoculture forests:

*"These areas will involve hundreds of square kilometers of urban forest... These sustainable, low maintenance and naturalized urban forest can benefit the city more than traditional planting style" [S6].*

### Chengdu

In 2018 Hitchmough was invited by the city government of Chengdu (population 16.33 million) to lead a competition entry (with LDA Design and Grimshaw Architecture) to create a vision for the sustainable development of Chengdu's 1,275km<sup>2</sup> degraded Longquanshan mountain range that is being subsumed in the city. Hitchmough's team won with a radical strategy to restore indigenous forest vegetation of the mountain and to create woodland corridors from the mountain range into three nearby cities. This is transforming a vast landscape, reintroducing indigenous species to create a sustainable, ecologically-focused landscape. This new bio-diverse, incremental development landscape "frame" has now become the official policy of the city of Chengdu. A member of Longquanshan Urban Forest Park Management Committee stated:

*"Professor James Hitchmough's team... proposed to restore the local original forest ecosystem by imitating nature... which are beneficial to water, soil conservation, ecological restoration, and the creation of new local economic models... We have begun to integrate these strategies into the overall planning of forest parks... After one year's observation, the model reflects the aesthetic feeling of naturalism, and the maintenance cost is obviously reduced compared with the traditional method" [S7].*

### Australia: Melbourne

In 2013 Hitchmough was invited by the City of Melbourne to develop new types of multi-species drought-tolerant vegetation as part of their climate change adaptation plan. He proposed using taxonomically diverse communities of post fire re-sprouting shrubs ("the woody meadow") to create an entirely new, infinitely sustainable urban vegetation, maintained perpetually floral, and optimal for fauna by triennial canopy removal. In collaboration with the University of Melbourne and \$100K funding from the City, the designed "woody meadow" planting demonstrations were

created in central Melbourne from 2015 [S8]. “*The Woody Meadow project in Melbourne is transforming how we consider our native fauna in the urban setting as something that goes beyond a background green, and instead is highly floral and ever-changing*” [S10].

This work received widespread recognition for the value of the concept, with nine Australian local and state government agencies signing up to participate in the next pilot phase of the project in practice (supported by a \$800k Australian Research Council Grant in 2020). In 2019 Hitchmough was also appointed to design biodiverse, drought tolerant, and human wellbeing-friendly vegetation for the AUD 1.4bn Arts Precinct Project in Central Melbourne - the most ambitious urban green infrastructure project in the history of Australia [S8, S9]. The start of the project has been delayed due to the pandemic; however, Hitchmough is involved in the developed design stage. Hassel Studio architects state “*Without his deep, thoughtful and research based planting proposals, the concept would not have held true through the myriad of political twists and turns and remained intact. Once completed the project will be a once in a generational transformation*” [S10].

#### 5. Sources to corroborate the impact (indicative maximum of 10 references)

- S1. Landscape Journal (2016) Seeds of Change, p.40-42 ([https://issuu.com/landscape-institute/docs/landscape\\_journal\\_2016\\_1\\_spring](https://issuu.com/landscape-institute/docs/landscape_journal_2016_1_spring)) and Kaixian city interchange.
- S2. Testimonial from collaborators at Shenyang Jianzu University on Hitchmough contribution to development of new planting palette for designers.
- S3. Article on growth of Green Garden Group Beijing after International Horticulture Exhibition 2019 ([http://www.xinhuanet.com/english/2019-10/10/c\\_138461482.htm](http://www.xinhuanet.com/english/2019-10/10/c_138461482.htm)).
- S4. News coverage of International Horticulture Exhibition 2019 (<http://tv.cctv.com/2019/04/27/VIDE2Pv4EehSTH75oX2suuGn190427.shtml>) and CGTN ‘Nature’s beauty, bounty at Beijing Horticultural Expo’ (<https://youtu.be/rx6k-62IQMY>) from 8.18.
- S5. 800 visitor survey responses to Expo garden indicating changed attitudes to urban gardens.
- S6. Testimonial from Vice-Director, City of Beijing Greening Bureau (support for how Hitchmough involvement changed their attitudes to woodland infrastructure).
- S7. Longquan Mountain Administration Committee, City of Chengdu confirmation of impact of Hitchmough in this project.
- S8. ABC “Gardening Australia” profile of the woody meadow on National TV, from 00.56 (<https://science.unimelb.edu.au/news/woody-meadow-project-profiled-on-gardening-australia>).
- S9. “Melbourne Age” Newspaper (<https://www.theage.com.au/national/victoria/renowned-design-teams-to-create-public-space-for-1b-melbourne-arts-precinct-20190219-p50yso.html>).
- S10. Testimonial from either Hassell Studio on contribution of Hitchmough to change in attitudes in Australia and their winning the contract for the Melbourne Arts precinct project.