Institution: University of Sheffield

Unit of Assessment: 16 - Architecture, Built Environment and Planning

Title of case study: The development of new, designed sustainable plant communities for use in urban greenspace.

1. Summary of the impact

A research programme in the Department of Landscape, University of Sheffield from 1993 to the present has developed radically new types of designed urban plant communities that support a rich native biodiversity, embody low carbon, and contribute to storm-water infiltration into soils, reducing urban flooding. These communities are simple to maintain, cost-effective, and highly attractive. This combination of factors has led to wide application in practice by government agencies, local authorities, and by the public in private gardens. We were invited to apply our approach in full at the London 2012 Olympic Park, the largest and most high profile Landscape Architecture project in the world in 2012, and this in itself has had great impact on international thought and practice.

2. Underpinning research

From 1993 to the present, Dunnett (Lecturer, now Professor) and Hitchmough (Reader, now Professor) investigated whether it was possible to harness the most desirable traits of semi-natural "wild" vegetation – their species diversity and ability to survive changing environmental conditions without continuous human support – and successfully engineer these into beautiful, artificial designed plant communities that could be easily reproduced in urban settings without the need for labour-intensive management. We were the first researchers in the world to apply rigorous ecological experimentation to the design of urban plant communities and much of our research has been published in *Landscape and Urban Planning*, one of the most highly ranked journals in Urban Studies.

Our work has focused on producing vegetation that is exceptionally attractive to the public, producing colourful flowers from spring to autumn, as a means of gaining public support to allow functions such as biodiversity enhancement and water management to be achieved without alienating the large number of people in urban places who are unreceptive to environmental issues. We investigated a range of plant communities with key aesthetic or functional attributes, and used these as hybrid ecological/design models. We evolved a standardised protocol for the work, generally starting at laboratory or glasshouse scale with individual species, and then moving to multi-species microcosm experiments and finally to field or practice scale experiments. In developing our work we have collaborated with a variety of organisations; however their role was always limited to the provision of technical and other forms of practical support.

Initial research looked at the fundamental issues of whether horticultural species with presumed poor ecological fitness could compete when sown or planted with naturally occurring native species. We ran two experiments over 6 year periods: 1993-1999 (R1) and 2001-2006 (R6) which showed that persistence and fitness were not necessarily defined by nativeness *per se*, but rather by the specific conditions of the site: knowledge that we used to underpin our subsequent philosophical and ecological approach. Both of these studies were run in conjunction with external partners (Scottish Agricultural Colleges for (R1) and ARK DM, a Sheffield based Architectural practice for (R6)), who supported the research by allowing us to use their facilities over long periods of time.

Research from 1999 onwards (R2, R3) has focused on establishing communities from seed sown *in situ*, as a means of using seedling density to manage competition with weeds. This method also allowed us to engineer very large areas of these plant communities with limited budgets. Aspects of this work were supported through technical collaboration with the RHS (Royal Horticultural Society) and later by a Marie Curie TOK grant (2006-9, £256K) with a large international seed company, Jelitto Seeds, Germany. This research also generated methods of effectively controlling

seedling weeds, the soil weed seed bank that would otherwise lead to the elimination of the sown species, plus the number of seedlings/m^2 of each sown species (R5). This latter study was supported by the Malaysian Department of Agriculture via a PhD Scholarship.

Research published in 2006 (R4) confirmed that our designed plant communities could be successfully and sustainably managed by using nature conservation techniques such as cutting or burning, rather than by traditional, expensive and highly labour intensive techniques. These innovations enabled close control of the composition of sown, designed plant communities that was a pre-requisite for large scale application to landscape practice.

3. References to the research

R1. Hitchmough, J.D. (2000) Establishment of cultivated herbaceous perennials in purpose sown native wildflower meadows in south west Scotland. *Landscape and Urban Planning.* 714, 1-15 doi: 10.1016/S0169-2046(00)00092-X

R2. Hitchmough, J.D., Kendle, A.D., and Paraskevopoulou, A. (2001) Seedling emergence, survival and initial growth in low productivity urban "waste" soils; a comparison of British forbs and grasses with continental European forbs. *Urban Ecosystems*, 5, 4, 285-308 (published in December 2003)

R3. Hitchmough, J.D., De La Fleur, M., and Findlay, C. (2004) Establishing North American Prairie vegetation in urban parks in northern England: 1. Effect of sowing season, sowing rate and soil type. *Landscape and Urban Planning,* 66, 2, 75-90. doi: 10.1016/S0169-2046(03)00096-3

R4. Hitchmough, J.D., and De La Fleur, M. (2006) Establishing North American Prairie vegetation in urban parks in northern England: Effect of management practice and initial soil type on long term community development. *Landscape and Urban Planning,* 78, 386-397. 10.1016/j.landurbplan.2005.11.005

R5. Ahmad, H., and Hitchmough, J.D. (2007). Germination and emergence of understorey and tall canopy forbs used in naturalistic sowing mixes. A comparison of performance in vitro v the field. *Seed Science and Technology*, 35,3: 624-637

R6. Dunnett, N., Nagase, A., and Hallam, A. (2008) The dynamics of planted and colonising species on a green roof over six growing seasons 2001–2006: influence of substrate depth. *Urban Ecosystems*. 11,4, 385-398. doi: 10.1007/s11252-007-0042-7

4. Details of the impact

The route to impact

Our impact strategy to change the nature of planting design in urban places included writing articles for professional and public journals/magazines, plus publishing books that translated the research into practice. We also disseminated our work to professional and public audiences through conferences, workshops, websites, blogs, radio and TV, in Britain and internationally.

IMPACTS

Influence on policy, both UK and international

Dunnett actively engaged (2006-11) with Sheffield City Council to initiate the Sheffield Green Roof development programme resulting in the only mandatory green roof policy for a British city. '*The research in the design, maintenance and evaluation of green roofs has given the City confidence to develop clear policies that promote green roofs across the City: the city is fast becoming known as the green roof capital*.' (S1). In addition, the Sheffield Green Roof Development Programme directly inspired the initiation of a full-scale green roof programme by the City of Melbourne, Australia, linked with University of Melbourne, following a keynote presentation by Dunnett at the Australian Green Roofs Conference in 2008: ''*The City of Melbourne's green roof development programme, and associated initiatives … was modelled on Nigel Dunnett's work in Sheffield*". (S2). Since 2008 our research and practice has become referred to internationally as the "Sheffield School."

Contribution to improved social, cultural and environmental sustainability

Dunnett has communicated the principles behind our research to a national and international audience through designing gold-medal-winning gardens at the Chelsea Flower Show. This has had a direct impact on what happens in millions of gardens across the world. Our work was featured as part of a BBC2, three-hour TV programme in February 2012 (S3).

Influence on professional guidelines and best practice training.

Our approach to the design of the Olympic Park was highlighted in a training video specially commissioned by the Landscape Institute (National Professional Body for Landscape Architecture) for its members (S4). This has been viewed extensively by landscape architects in Britain and around the world, to inform and change practice norms. These impacts have been further extended by books we have written derived from our research, which now form a key part of the literature of Landscape Architecture (such as *The Dynamic Landscape: Design, Ecology and Management of Naturalistic Urban Planting,* Taylor and Francis). These have now been translated into four languages including Chinese and more than 15,000 copies have been sold worldwide.

Changes in environmental design standards and professional practice.

Our work has re-invigorated planting design throughout the world: "*Sheffield…. has emerged as the world leader in naturalistic planting, courtesy of …. James Hitchmough and Nigel Dunnett*" (S5). This is evidenced by a raft of invitations to undertake commissions to design examples of this sustainable vegetation in prestigious, heavily visited landscapes (Eden Project Cornwall; Royal Horticultural Society Gardens, Wisley and Hyde Hall; Toyota UK (Derby); London Wetland Centre; Queen's Gallery, Buckingham Palace; Burgess Park, London; Oxford University Botanical Garden; and Cambridge University Botanic Garden). Dunnett's innovative approaches to green roof and rain garden planting have resulted in prestigious and highly public design commissions including the South Bank Centre, London, Google UK's new head office, the head offices of the John Lewis Group (to create Central London's first street-side rain garden), and at Buckingham Palace. In June 2013, Dunnett gave a private tour of the latter garden to Her Majesty The Queen, at her request. In addition to our own work, we have encouraged many others around the world to adopt our approaches (S6, S7).

Changes in traditional attitudes and behaviours towards the designed environment and biodiversity

Our research and practice has had a profound effect on winning support amongst practitioners and the public for the use of ecologically based, but culturally responsive vegetation in designed urban landscapes. In part this is because we have shown through our research how vegetation that is attractive to people can, with only small adjustments, also be highly sustainable and good for biodiversity. The Royal Horticultural Society, traditionally ambivalent or even hostile to ecological approaches has used the Olympic Park wildflower meadows as a springboard for its 2013 public campaign on increasing urban sustainability and diversity. Sue Biggs, RHS Director General, says: "*After enjoying the Olympic Park meadows in 2012 there is a great appetite from the British public to create their own version at home, which is great news for pollinating insects*" (S8). In addition it has commissioned the authors to design over 15ha of horticultural wildflower meadows at one of its UK gardens demonstrating how its attitudes to conservation have been changed. Hitchmough was awarded a Fellowship in May 2013 from the British Naturalists Association for outstanding contribution to natural history. Dunnett's Green roof on Sharrow Junior School (Sheffield) is the only designed green roof in the world that has been awarded formal government Nature Reserve Status.

Help in shaping the 2012 Olympic experience and the UK's global reputation

We were head-hunted by the Olympic Development Authority (ODA) to lead on the planting design of the London 2012 Olympic Park. This involved developing a new planting strategy for the whole

site based on our research, designing and specifying the plant communities and supervising implementation. "*At the brief stage I made it very clear that I wanted James Hitchmough and Nigel Dunnett to be involved. I wanted a 21st century landscape that redefined the public park"* (ODA Project Director for the Olympic Parklands and Public Realm) (S9).

We have continued to provide guidance through the Transformation (2012-14) and this will extend to the long term Legacy (>2014) phase. The park received 5 million visits over the six-week period of the games and Paralympics, and the 20 hectares (equivalent to 40 football pitches) of plant communities that we designed was key to shaping the experiences of these visitors. This email was received from a member of the public and was typical of visitor responses reported in the media: "*Thank you for giving me and thousands and thousands of others the most wonderful gift, the exquisite plantings around the Olympic buildings. They will be my most enduring memory of the London 2012 Olympics.., their impact was so astonishing… the… natural… pervaded with a unique and precious sense of humanity, a perfect metaphor for the Olympic ideal*". The work has received rave reviews internationally ("*the most ambitious public planting ever?")* (S10).

The international impact of our work at the Olympic Park is shown by invites to provide presentations on the approaches used to Landscape architecture practitioner organisations/ university departments in (by the end of 2013); China, the USA, Germany, Australia, Italy, the Czech Republic, Denmark, South Africa, and Sweden. The ground breaking nature of the work has been recognised in many international design websites and journals (*Topos*, *Garten + Landschaft,* the two leading Chinese Landscape Architecture Journals; *Chinese Landscape Architecture, Landscape Architecture Frontiers*), plus awards such as the Dulux Colour Prize in 2013.

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

S1. Lead Officer – Sustainable Cities Programme, Sheffield City Council corroborates the impact of the research in the development of Sheffield Council's mandatory green roof policy

S2. Email received from 'Canopy' Melbourne's Green Roof Forum, 23rd June 2013. Corroborates influence on policy, both UK and internationally

S3. *Bees, Butterflies and Blooms*. Three-hour BBC TV programme (Feb 2012). http://www.bbc.co.uk/programmes/p00p7b36. This shows examples of our work and corroborates its contribution to improved social, cultural and environmental sustainability.

S4. The Landscape Legacy of the Olympics, Part 7, The Olympic Planting Strategy, The Landscape Institute http://www.youtube.com/watch?v=YsuU3APsA5c Corroborates influence on professional guidelines and best practice training

S5. Richardson, T. (2011) Futurescapes, Designers for Tomorrow's Outdoor Spaces. Thames and Hudson, London, p 122-124, p 267-274. Review of our work and ideas and corroborates changes in environmental design standards.

S6. Beck, T. (2012) Intersecting Ecological Theory and Landscape Design. Island Press, New York. Features our work as an example of these new approaches. Corroborates changes in environmental design standards and professional practice

S7. Oudolf, P. and Kingsbury, N. (2013) Planting; A New Perspective. Timber Press, Portland, Oregon. Reviews the significance of our work from an international perspective. Corroborates changes in environmental design standards and professional practice

S8. RHS press release corroborates changed attitudes and behaviours towards the environment (http://tinyurl.com/nbpnugq).

S9. Pallister, J. and Slavid, R. 2012. EastSide Story, Olympic Park, Architects Journal, articles by John Hopkins, pages 50-52, and Dunnett and Hitchmough page 53. Corroborates helping to shape the 2012 Olympic experience and the UK's global reputation

S10. Grounded Design, USA Landscape Architecture blog, July 2nd 2012 corroborates helping to shape the 2012 Olympic experience and the UK's global reputation (http://tinyurl.com/pkegu3o).