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New Approaches to Ecologically Based, Designed Urban Plant Communities in Britain: Do These Have Any Relevance in the United States?

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Keywords

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James Hitchmough

Abstract

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THE NEED FOR NEW APPROACHES TO DESIGNED URBAN PLANTING

Over the past 15 years a program of research undertaken by the author, his colleague Dr Nigel Dunnett, and numerous postgraduate students has led to the creation of new paradigms as to how public and in some cases private urban spaces (gardens) could be designed and planted. This research was conceived as a response to two long-term problems affecting urban parks and green space in Britain: a significant decline in the funding of maintenance programs and the erosion of horticultural vegetation maintenance and management skills within urban park authorities (Dunnett et al. 2002). These two factors had resulted in an ongoing simplification of urban parks and green spaces into mown grass and trees, as plantings of herbaceous plants and shrubs were "edited out" in both existing landscapes and new developments. The challenge was to develop new types of vegetation that were inexpensive to install and could be maintained within a minimal resources environment, while meeting human aspirations for color and seasonal change, and providing a valuable habitat for native animal biodiversity.

Our research is not derived from, or based upon, any one particular theory or model, but is a pragmatic approach that draws upon a variety of interdisciplinary perspectives, as is discussed in greater detail in Dunnett and Hitchmough (2004). The central thrust in this work has been to take the understanding derived from contemporary ecological science (e.g., Grime 2001; Grime et al. 2007) and restoration ecology (e.g., Luken 1990; Pywell et al. 2003) and apply this to the design of plant communities, and in particular, those composed of herbaceous plants (grasses, forbs, and geophytes) for use in urban landscapes. There is a long European tradition of creating (or more commonly wishing to create) naturalistic or "wild-looking" herbaceous vegetation in designed landscapes (e.g., Robinson 1870; Jager 1877). In practice these plantings were often difficult to sustain given the limited historical understanding of the mechanics of competition between plants and other ecological processes.

In terms of urban ecology perspectives, our research is grounded in recognition of human created urban environments as habitats in the tradition of Gilbert (1989). This view interprets urban ecology in *laissez-faire* terms of understanding the outcome (positive and negative) of interactions between human beings, environments, and natural processes, rather than focusing mainly on surviving remnant native plant communities in urban areas and seeing everything else as a degraded landscape.

In terms of semi-natural plant communities, urban ecosystems often have peculiar, sometimes extreme characteristics. This is particularly true for potential vegetation productivity in the case of landscapes that are the product of past industrial processes and practices. When new environmental design initiatives, such as Sustainable Urban Drainage (SUDS) Schemes (Dunnett and Clayden 2007) and the development of green/brown roofs on large buildings (Dunnett and Kingsbury 2008) are overlaid across existing post-industrial urban landscape, the result is a huge diversity of new planting opportunities, many of which lie outside the canon of traditional designed plantings. Some of these planting environments are extremely unproductive, for example, a 50 mm layer of crushed brick substrate on a roof; others are extremely productive, as in a SUDS scheme on urban soils subject to past and ongoing eutrophification. When confronted by these types of sites, most landscape architects and other urban designers have sought firstly to amend or ameliorate these sites to take them back into the "normative" range associated with a horticultural–agricultural perspective.

Our work has deliberately chosen not to do this, but rather has sought to develop designed vegetation that is capable of responding positively to the specific ecological conditions of the site largely as found. This approach results in unique, site-specific plant communities that

lie outside of conventional phytosociology frameworks, as the combination of site and management generates natural selection pressures on the plant community originally established on the site. The purpose of this paper is to explore whether our approach has any relevance to thought and practice of designing and managing urban landscapes in urban North America.

Native versus non-native plant use in naturalistic planting

Where our work deviates from "ecological practice" norms is that we do not restrict ourselves solely to plants native to the British Isles; indeed often we create plant communities that contain no native species whatsoever and yet still involve the ecological processes that are often seen to be the prerogative of native species. We do not prefer exotics over natives or vice-versa, other than when the ecological and social-cultural context suggests that this is the appropriate thing to do. Native species are, however, widely used in landscape architecture in Britain, and indeed they are the norm within rural and urban fringe landscapes and in major green infrastructure projects irrespective of location, as woodland, scrub, and various meadow communities. When it is sensible to do so, we are as keen to conserve and expand the territory of remnant native vegetation as are ecological practitioners in the United States.

My experiences of the United States as a regular visitor and one time resident, plus host to numerous American visiting scholars and students, is that there is a widely held perspective that non-native species lie outside of ecology, like souls separated from their physical body (the native habitat). While this view is understandable, it is clearly nonsensical; alien species have physiological and ecological niche ranges in the same way that native species do, and like native species, they interact with the biotic world in that they form relationships with other organisms, and provide habitat opportunities for herbivores, predators, decomposers, and indirectly for parasites. From a purely objective perspective, alien species have ecology. In an urban context it is sensible to recognize this, as by doing so it is possible to use them in ways that allow them to fit well enough to maximize benefits for the minimum resource input possible, but not so well that they colonize beyond the planting site.

But why do we use alien species? Why not restrict ourselves entirely to native species? There are a number of issues here. Firstly we respond strongly to context. Where extant semi-natural vegetation is the dominant character around or next to a site, or where there are areas of significant remnant native vegetation, we would tend to use predominantly native species. In contrast, on a green roof in a city center we would potentially use no native species at all as the potentially extreme conditions may lie beyond the physiological and ecological niche ranges of otherwise desirable native species.

A second factor that encourages our use of exotic species is that the native flora of the British Isles is extremely small. Due to post-ice age sea level rises that isolated the United Kingdom from the European mainland, the flora consists of only 1140 truly native species (i.e., species that re-colonized post the last ice age without obvious human agency), plus approximately 300 archaeophytes (introduced pre-AD 1500) and neophytes (post-AD 1500) (Preston et al. 2002). Native plant species richness in the United Kingdom is approximately half that of, for example, Ohio, United States on an equivalent area basis. As only a percentage (experience suggests typically <20%) of this flora is judged sufficiently attractive to be used in designed contexts, in Britain designers soon run out of species that are well enough suited to the conditions as found (i.e., to be used in a sustainable way) and that do things such as flower at the desired time of year. In most of our native forbs, flowering is restricted to late spring-early summer. In rural contexts where human expectation of landscape content is reduced, and vegetation viewed far less closely and intensively as a component of "scenery", having no flowers in late summer is

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not a problem. These are, however, potentially significant issues of choice in some "pressure-cooker" urban contexts, such as public parks that are heavily visited during the summer months. North America has a much richer flora, both in total and regionally, than Britain, and hence it is much easier to achieve visually acceptable results by relying on the native and in some cases regionally native flora. Of course even in America there are situations when the use of non-native, or politically native but geographically "exotic" species, is extremely helpful in urban design.

We are fortunate in Britain, in that we have extremely detailed, long term records at a 10 km grid scale, of naturalization of non-native species (Preston et al. 2002). Since most of the species we use are long and widely cultivated in millions of gardens across the land, generally for periods in excess of 100 years, there are strong cues to species that have high dominance potential or are invasive, and we avoid these. During the 10 years or so it takes to develop a new designed plant community, we continue to assess likely invasive potential. A major factor restricting alien forb invasiveness in Britain is intense slug and snail predation; seedlings of palatable species are quickly eliminated beyond the management regime of the designed planting that allows them to persist. Many widely naturalized herbaceous species are highly unpalatable as seedlings and adults. This is one of the factors we screen for in developing new communities, together with assessments of seed production and dispersal capacity, relative growth rates of seedlings and adults, and capacity to spread by rhizomes and other colonizing structures. In general we operate within the guidelines developed in the United States to identify species with a high risk of becoming invasive (e.g., Widrlechner et al. 2004).

The aesthetic characteristics of naturalistic urban vegetation

The herbaceous vegetation that we design and create (be it native, non-native or a mixture) has a strongly naturalistic appearance. As most species are established by sowing *in situ*, in a visual sense, distribution is strongly random, although of course in many cases there are patterns that the informed viewer can perceive, and these tend to increase through time as natural selection pressures are imposed, and species move around through recruitment and mortality. This is a very different aesthetic to the public herbaceous plantings of in-vogue designers in the United States, such as Oudolf (Oudolf and Kingsbury 2005), and Oehme and Van Sweden (2002), where species are planted in groups or blocks. This form of arrangement makes it clear to viewers that the plantings are intentional and probably cared for; some of the requirements of the "Cues to Care" hypothesis (Nassauer 1995) are therefore satisfied.

In our work this is not the case, and likewise this is also true of the habitat and perhaps most specifically prairie restoration movement in the United States Layperson appreciation of naturalistic herbaceous, and particularly tall herbaceous vegetation in urban contexts is therefore potentially problematic. The creators of a tall-grass prairie in the United States are engaged with its appearance because they see it as ecologically and ethically worthy, but urban vegetation generally has to stand or fall on its immediate visual interpretation by laypeople without deciphering coded messages regarding its goodness. This has been a major challenge for us in the United Kingdom, even though I would suggest that as a culture we are more attuned to accept the disordered appearance of naturalistic vegetation in urban contexts than are Americans. The landscape fabric of British suburbia is far more heterogeneous than its United States equivalent; it is relatively messy, there are many shrubs and tall herbaceous plantings in the 0-2.0 m above ground level zone, many boundary walls, fences and hedges, fewer large trees, and lawn is much less cared for. There are no "weed" ordnances that dictate the composition and height of vegetation as there are in the United States (Rappaport 1993). Despite this British cultural pre-conditioning to accept difference and disorder in the private and public landscapes adjacent to

where they live, in public spaces attempts to gain acceptance of naturalistic herbaceous vegetation have often struggled except where that vegetation has included colorful, visually dramatic species. This latter approach has been developed for native meadows and woodland understory vegetation by urban based, socially focused agencies in Britain such as Landlife/National Wildflower Centre, as part of their "Creative Conservation Agenda" (Luscombe and Scott 2004) but is largely absent from the "rural founded" thinking of many ecological practitioners. The author is currently directing a United Kingdom Economic and Social Research Council funded study into how color and other drivers affect attitudes of the public and grounds maintenance staff towards wildflower meadows in urban parks.

Our experience to date suggests that in order to make naturalistic (irrespective of where the species come from) urban herbaceous vegetation acceptable to laypeople, it must be designed and managed to be visually dramatic at some point in its annual growth cycle. This often means increasing forb density and reducing grass density, and within the forbs increasing the density of the most dramatic, long flowering species. If this means a designed native plant community looks substantially different to the wild occurring stereotype, so be it. Within the United States this approach has been championed within restored prairie plant communities in urban contexts by Neil Diboll of Prairie Nursery, Wisconsin and Carol Franklin of Andropogon Associates (Kingsbury 2004). By doing this, a bridge is provided that some people will be able to cross over to allow them to gradually value the latent ecological worthiness of naturalistic urban vegetation.

Amateur gardening as a shaper of attitudes to nature in a cultural context

Another reason why we use non-native plants extensively is that they are an extremely important part of our urban cultural tradition. Discussions about the (de)merits of non-native cultivated species within conservation biology and even the popular media rarely reflect the fact that many of these species are strongly culturally valued commodities, in the same way as opera, sport, cooking, literature, and art. In Britain these notions of value and meaning are particularly highly developed within the people who own and use the country's 16 million private gardens, and make millions of day visits per year to the huge number of public and institutional gardens (Dunnett et al. 2007). To the British, the American vernacular for the garden ("yard") suggests a disturbingly utilitarian relationship with this space. The rear (and often front) garden in Britain is generally a highly gardened space, a dialogue between the creativeness of (or absence of) householder and nature. Gardening is an extremely important recreational activity within Britain and is often pursued with vigor, passion, and even intellect. Although participation in gardening is also high in the United States as evidenced by National Gardening Association (2004) surveys, I suggest that there is, however, a discernible qualitative difference between the intensity and degree of engagement in gardening between the two countries. This in turn explains why our work in Britain has developed such strong connections with this aspect of popular mass culture.

The capacity to grow a diversity of colorful herbaceous plants in parks and public green space that are highly valued in private gardens has been diminished in the late 20th century by declining green space budgets. Our work has sought to turn this around by using plants valued by the public, but reorganized into naturalistic designed communities that are managed at very low resource levels using the tools of nature conservation management, often cutting and burning. We value the meaning and richness these plants and plantings give to urban life, and we challenge the notion that valuing non-native plants limits the capacity to do the same for native plants and native plant habitats. We would argue that the converse is true; developing an interest in cultivated plants, predisposes people to value vegetation of nature-conservation significance. Michael Pollan's seminal text "Second Nature" (Pollan 1991) suggests that this may also be true in an American context.

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Sustainability and non-native plants

At the Ohio Ecological Landscaping Conference from which this paper is derived, a number of speakers and members of the audience articulated the view that only native plants could be sustainable. Native plants can be very sustainable, but they can also be extremely unsustainable; it is all a question of the context in which they are used. In terms of plant use in landscapes, sustainability is largely determined by the degree of fit of a species to the environment in which it is to be cultivated. In more technical terms, it is whether the environment falls within the niche range for all the key factors that determine the survival of a given species, for both juveniles and adults: soil moisture regime, minimum and maximum air temperature, solar radiation, predation regime, soil potential productivity, competition with neighboring plants and so on. Because urbanization often radically changes these factors one cannot assume that what vegetation once occurred on a site will be well-fitted post-urbanization. Indeed experience from around the world shows that attempts to re-establish the original native flora of a now urban environment often struggle, and require large inputs of resources to facilitate this (Brown and Bugg 2001). Most often this is because eutrophication from urban processes and changed disturbance regimes have made sites far more productive than they originally were, making the original lower productivity plant communities poorly fitted. They frequently need ongoing management to restrict colonization by more productive native or non-native species not part of the original plant community.

On urban sites in Britain we use North American tall grass prairie for a variety of reasons, but one of the most important is that many of the component species are able to compete and persist at productivity levels that would lead to competitive exclusion of much less productive native forbs of species-rich meadow communities.

This idea of an organism placed outside of its original climatic, geological and biotic context by urbanization is a really important one to the sustainability debate. To illustrate this point I will draw on a paper given at the conference on using Northeastern United States species on un-irrigated green roofs in that region. The summer soil moisture regime in 100 mm of crushed brick substrate on a building in New Jersey is not of that place; urbanization has created a highly xeric habitat that has more in common with montane Colorado than New Jersey. Sustainability requires this to be recognized in plant selection; plants need to come from somewhere in the world where these summer soil moisture conditions naturally occur. If native plants evolved to these conditions can be found locally this is good; however if not, sustainable planting may have to utilize species from Grand Mesa in Colorado or the Roggeveld Plateau in South Africa. You could, of course, irrigate to pretend the green roof is not a green roof to allow you to grow the local mesic native species that occurred on this site pre-urbanization, but in most cases this is not a sustainable path and mirrors the cultural construct underpinning the idealized American lawn. The latter involves applying a near universal standard of greenness, freedom from broadleaved forbs, and the absences of pest and disease symptoms, irrespective of precipitation and temperature regime, which is then achieved through the intensive application of energy and other resources. Whatever its merits as a ubiquitous, and highly valued cultural landscape that potentially sequesters carbon (Milesi et al. 2005), overall the idealized lawn is not a model for more sustainable urban landscapes (National Gardening Association 2004; Robbins 2007).

In the case of the conference paper I previously referred to, the Northeastern American species planted on the roof performed very badly or died, as one would have expected given their evolutionary selection for mesic environments. One could have used more xeric genotypes of some of the more widely distributed species used, for example Colorado populations of *Asclepias*

tuberosa, however, this might be seen as inappropriate in terms of current sustainability debates on local populations (Jones 2003). Native plants can, like exotic plants, be either sustainable or non-sustainable, it all depends on context.

Climate change is going to have a major impact on these considerations. In Britain the Climatic Models suggest that Southern England is going to experience a climate similar to present day Southwest France (Met Office 2005). Severe winter frosts are already increasingly infrequent in our major cities. As a result of these climatic changes exotic species that historically were seen as transients in the garden-landscape flora, for example, many South African species, are increasingly perennial and correspondingly more widely planted. Within 50 years many of the semi-natural native plant communities of South England will also be significantly changed, and as an island with no physical connections with the European mainland, many of the currently alien Southern European species that could and should colonize these new habitats will be unable to do so, unless introduced through deliberate human agency or allowed to colonize from cultivated plants in gardens. The United State's contiguous north-south landmass will buffer some of these changes, although habitat fragmentation through agriculture and urbanization will raise similar issues to those discussed above for the United Kingdom. A fluid rather than dogmatic, approach to native and non-native plantings is going to be required together with the publication of new regional floras. Fighting over what is native at the state border will become ever more fatuous.

Designed "cultural" vegetation as a habitat for native animal biodiversity

The fifteen years of our vegetation research has coincided with growing interest in the capacity of designed garden-like vegetation to support the native invertebrate fauna of Britain. This started with the seminal work of Owen (1991) on investigating the flora of a typical suburban garden in the city of Leicester over a 15 year period. This revealed extraordinary invertebrate richness across a wide range of taxa, even though much of the garden vegetation was composed of exotic species and not in the least bit "wild". Owen's work put the potential of garden vegetation for urban invertebrate conservation on the map, and led indirectly to the Biodiversity in Urban Gardens Study (BUGS), coordinated through the University of Sheffield and funded by NERC (BUGS 2007). This is the most extensive study of the plant and invertebrate biodiversity of urban gardens yet undertaken anywhere in the world and to date has resulted in a large number of published papers in international journals (e.g., Loram et al. 2007).

BUGS has confirmed that Owen's findings were not anomalous. The 60 study gardens in Sheffield also show extremely high invertebrate diversity, and this is also seen in other cities in the United Kingdom. Far from being a biological desert simply by virtue of the dominance of non-native plants, urban gardens in Britain are an extremely important nature conservation resource. This is because they are, as a land use type, spatially and temporally complex; indeed far more so than natural habitats. They are also mega-diverse in terms of plant species, many of which are cultivated aliens. Total plant diversity in Sheffield gardens was assessed as 438 species per 0.01 ha (Thompson et al. 2003). To put this into perspective the most diverse parts of the wet tropics support > 200 tree species per 0.1ha and the richest Mediterranean vegetation (Israel) has around 250 species per 0.1 ha (Crawley 1997). There are also very great differences in the plant species present between individual gardens; ongoing human agency (the independent decisions of 16 million gardeners) works to maintain and expand diversity, as this is culturally valued by many gardeners. As more than 70,000 garden plant taxa are currently commercially available in Britain (Lord 2007) and this total is probably growing, it is almost inevitable that garden plant diversity will continue to be extremely high.

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Even if BUGS or Jennifer Owen had never existed it would still have been clear to the author and his co-workers that our vegetation types support a wide diversity of invertebrates, birds, amphibian, and small mammals. We see these every time we take research measurements, or harvest biomass for growth analysis. The larvae of most invertebrates (with the exception of butterflies) are not particularly host-plant specific, and many alien plant species, are in any case related to native species. Even butterflies, the cause *célèbre* of exclusive native plant-native invertebrate relationships, show signs of adaptability to other food plants in urban contexts. In Davis, California, the larvae of nearly all the native butterflies now depend on introduced alien plants (Shapiro 2002).

So there is good evidence to support the notion that hybrid native-exotic vegetation and even entirely exotic vegetation play a positive role in supporting a rich native invertebrate fauna and as a result vertebrates that feed on these species. What about the bigger picture in relation to urban ecology as a whole? In Britain we now recognize that in order to maximize biodiversity value in urban landscapes it is necessary to create vegetation types that mirror the content and structure of either i) gardens, ii) post industrial derelict land, or iii) "ancient" managed native woodlands and grasslands. All of these are complex and dynamic, although for very different reasons, because species complements change rapidly (particularly in the first two) in space and time. Our urban green space staple, the traditional 19th century park of widely spaced large trees and hectares of closely mown grass is much less good as biodiversity habitat for organisms other than those restricted to tree canopy or mown grassland.

There are many parallels between the green space of American and British cities, however, American suburban gardens are very different from British gardens. Indeed many have a similar vegetation structure to urban parks, closely mown grass and tall trees (Hefland et al. 2006). House blocks are large, and the suburbs cover huge tracts of land, as is strikingly obvious when one descends to Chicago's O'Hare airport on a clear day. In Britain, approximately 25% of cities are composed of gardens (Loram et al. 2007); it would seem likely that this figure is higher in the United States (although comparable data have proved difficult to find) and hence the significance of gardens is potentially greater still. Data discussed in Milesi et al. (2005) suggests that garden lawns in the United States account for a total area of at least 60,000 km^2, and possibly considerably more. This suggests that in addition to public green space, increasing the complexity of gardens should be one of the main targets of urban nature conservation. It seems unlikely to the author that this cultural shift can be achieved without a step-wise approach, starting with planting that is more familiar and moving to that which is potentially much wilder looking as changes in visual norms become embedded. The willingness of residents to make changes to their garden landscapes has been discussed in Helfand et al. (2006). Emphasizing highly colorful vegetation types, including non-invasive exotic species where these are culturally valued as much as the most attractive native species, is likely to assist in achieving an increase in plant diversity and spatial complexity.

OUR APPROACH TO CREATING NATURALISTIC HERBACEOUS VEGETATION IN PRACTICE

In contrast to conventional design practice, we normally create our vegetation types by sowing seed *in situ*, where it is to grow, and we have developed, and continue to refine, sophisticated techniques to ensure that what is created closely resembles what was envisaged at the design stage.

Establishing herbaceous vegetation by sowing seed *in-situ* avoids many of the carbon expenditures associated with the growing and transportation of conventional nursery grown

plants. Because we need our vegetation types to meet the expectations of urban green space managers and visitors in terms of appearance and function, we have invested much time in understanding how to engineer vegetation with high forb-species richness, and develop management techniques to retain this, *albeit* in modified form, in the longer term (e.g., Hitchmough et al. 2008). An example of our research to make sowing highly predictable in terms of the number of emerged seedlings of each species sown is shown in Figure 1.

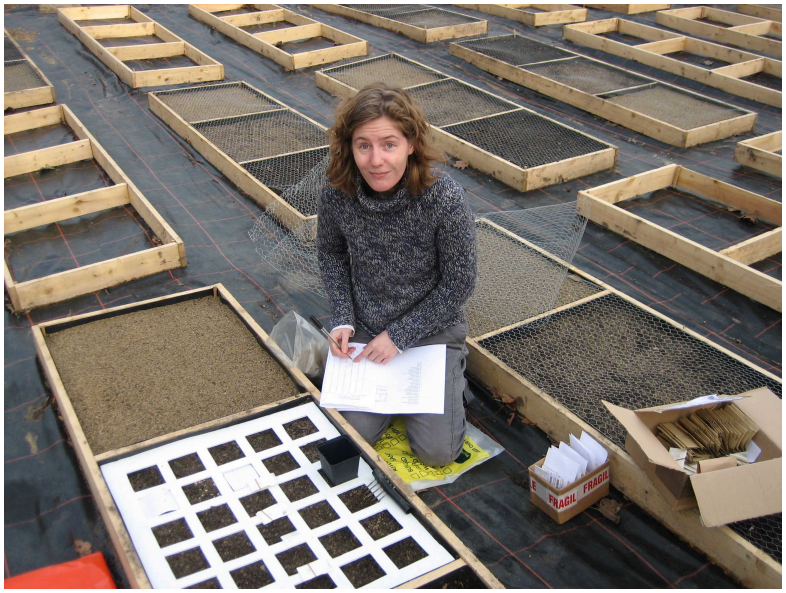

Figure 1. Testing field emergence of species used in our research to ensure the composition of vegetation created in practice closely resembles the design model. EU funded research with Jelitto Seeds, Germany.

After the existing vegetation on a site to be sown has been eliminated, a 50-75 mm deep mulch layer of sand, crushed building rubble, or composted urban green waste is spread over the surface of the soil. The actual material chosen on any given site depends on local availability, and the nature of the plant community being created. These materials typically contain relatively few weed seeds, in contrast to the topsoil lying beneath. Seed mixtures are then sown into the surface of this "sowing mulch" layer, which in turn suppresses most weed seed emergence from the soil below. In the absence of sufficient rainfall, the mulch layer is irrigated twice a week in April, the main germination and emergence window in the United Kingdom. The sown seedlings develop largely in the absence of competition from weedy species (see Figure 2), and weed management costs in the first year are low. In a project in the Sheffield Botanic Gardens, total maintenance costs for the first year to maintain a 800 m^2 sown area in a weed-free state was 14 hours (Hitchmough, unpublished data). Seed costs per m^2 typically vary from £1.00-£3.00 ($1.70 - $5.11 USD). The costs of planting to achieve a similar vegetation type are typically 10 to 15 times higher. A greater understanding of what types of vegetation we make and how, can be gained from our research websites (http://shef.ac.uk/landscape/staff_minisites/james/, http://www.nigeldunnett.co.uk/index.html), a textbook (Dunnett and Hitchmough 2004), plus various published papers (e.g, Hitchmough et al. 2004, Hitchmough and De La Fleur 2006).

Making examples of our vegetation types in public and institutional landscapes in Britain, often on a large scale, has been an important contributor to the evolution of our research agenda. This "road testing" is critical to our understanding of establishment phenomena, large-term

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management in practice, and also how people respond to the appearance of these types of vegetation. Examples of our vegetation can be seen for example, at: The Eden Project, Cornwall (Figure 3); National Botanical Garden of Wales; The Royal Horticultural Society Gardens at Wisley, Surrey (Figure 4); Harlow Carr, Yorkshire (Figure 5); The Sheffield Botanic Gardens; plus a number of urban parks, green spaces, and commercial landscapes across Britain.

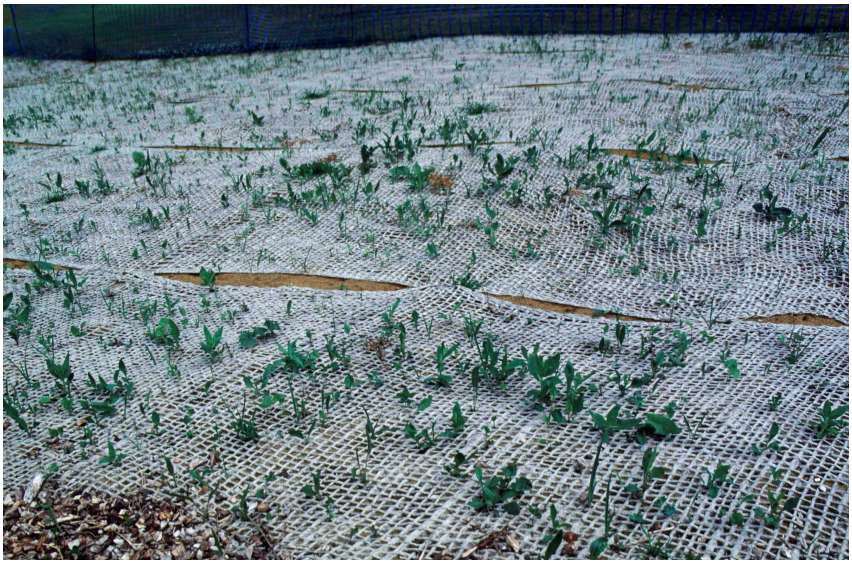

Figure 2. North American prairie vegetation emerging through jute erosion matting out of a sand mulch layer in a public park project in Sheffield, United Kingdom. Note the absence of weed growth.

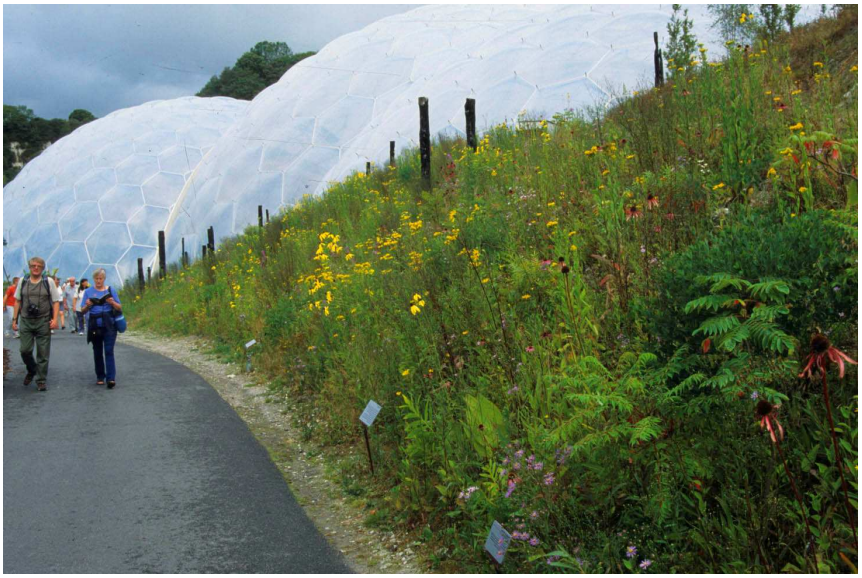

Figure 3. Tall-grass prairie vegetation created by sowing seed *in situ* at the Eden Project, St. Austell, Cornwall in 2000.

Figure 4. Second generation dry steppe-prairie vegetation 6 months after sowing at RHS Wisley, Surrey, United Kingdom. At this point in time the scene is dominated by the shade intolerant lower layer. In the second and subsequent growing seasons the predominantly leafless flowering stems of medium and tall species that are present in the ground layer at low density will emerge to provide a complex vertical structure.

We have also developed the idea of the "managed gap" as a way of addressing concerns about the escape of non-native species. When North American prairie vegetation is used in Britain, for example, most species can only persist and recruit successfully from self-sown seed when sown into an area surfaced with sand or a similar granular mineral (to check slug predation) and burnt in spring to restrict the invasion of C3 grasses. Without these simple, low intensity practices (the managed gap) this community is rapidly replaced by weedy native species (Hitchmough and de La Fleur 2006). There are aspects of the managed gap in nearly all of our designed plant communities, including of course, those composed entirely of native species, many of which also cannot persist unless specific management actions are applied to them in perpetuity.

A central idea in our research has been to create vegetation that is spatially complex in both space and time and contains a high diversity of species. To contribute to this we have explored how to create herbaceous vegetation composed of multiple layers of species "stacked" on top of one another. Typically this entails a low growing, spring flowering shade tolerant understory layer (Figure 6), a mid-canopy late spring to summer flowering layer and a taller mid-summer to autumn flowering layer (Ahmad and Hitchmough 2007). Species selection, sowing and emergence density, are key tools in successfully achieving these goals. We have pursued these complex layered structures to maximize resource utilization within the vegetation to restrict invasion of weedy species from outside, to maximize the duration of flowering, and to maximize opportunities for wildlife, and in particular invertebrates – the bulk of the visual biodiversity.

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Figure 5. Wet meadow vegetation containing native and non-native species, but dominated by Himalayan *Primula* species. Established by sowing in Harlow Carr Garden, Harrogate, United Kingdom.

Figure 6. North American prairie vegetation with an understory of shade tolerant, winter-green, spring flowering European woodland forbs; an example of a simple and robust multi-layer vegetation we have developed to minimize maintenance inputs

We are now developing more sophisticated "second generation" communities in which most of the plant diversity is held within the ground layer, with the plants present in the mid- and tall canopy layers present at much lower densities to prevent the elimination of shade intolerant ground layers species. These plant communities are created by ensuring most of the seed sown is of ground layer species (typically around 70% on a target seedling emergence basis) with

intermediate canopy layers at 20% of target seedling emergence and tall canopy species 10% or less.

CONCLUSION

In this paper I have discussed the reasoning behind our development of naturalistic, but sometimes non-native herbaceous vegetation to explore some of the bigger issues about how ordinary urban citizens might engage with new forms of urban landscapes that are richer in biodiversity, and more sustainable and meaningful to people. Throughout this paper, I have adopted a cautious position on how this work might translate into practice in American cities. One of the reasons for this caution is that to Europeans, America seems more polarized in terms of perspectives on urban ecosystems and, in particular, the role of non-native species in naturalistic vegetation, although this may merely be an artifact of an outsider's view. As evidence of these contrasts I would cite the omnipresent manicured lawn and the willingness to use large quantities of embodied energy and biocides in order to conform to an "ideal lawn construct" seemingly independent of climate and location (Milesi et al. 2005; Robbins 2007). As a counterpoint to this, a nativist movement, with strongly contrasting values is pursued by some of its proponents with an almost religious fervor (Kingsbury 2004), fuelled by a sense of what has been lost. Between these positions there are obviously many people who wish to have a positive relationship with nature but who also wish to engage in aspects of human culture that they value. It is important to the author to develop and mainstream plural landscape dialogues in urban areas, and to be reflective and adaptive, rather than being in thrall to inflexible positioning of whatever sort. I hope some of the ideas in this paper may at least prompt reflection on such approaches for the design and management of urbanized landscapes in the U.S.

LITERATURE CITED

Ahmad, H., and J.D. Hitchmough. 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.

BUGS - Biodiversity of Urban Gardens Study, University of Sheffield. 2007. http://www.bugs.group.shef.ac.uk/index.html. (accessed October 10, 2008).

Brown, C.S. and R.l. Bugg. 2001. Effects of established perennial grasses on introduction of native forbs in California. Restoration Ecology. 9: 38-48.

Crawley, M.J. 1997. Biodiversity, pp. 595-632. In Crawley, M.J. (Ed.). Plant Ecology. Blackwell, Oxford.

Dunnett, N, C. Swanwick, H. Woolley. 2002. Improving Urban Parks, Play Areas and Green Spaces. Office of the Deputy Prime Minister, London. pp.214.

Dunnett, N. and J.D. Hitchmough. 2004. The Dynamic Landscape: Design Ecology and Management of Naturalistic Urban Planting. Taylor and Francis, London, pp. 332.

Dunnett, N.D. and A. Clayden. 2007. Rain Gardens. Managing Water Sustainably in the Garden and Designed Landscape. Timber Press, Portland. pp 188.

Dunnett, N. and N. Kingsbury. 2008. Planting Green Roofs and Living Walls. Timber Press, Portland. pp 328.

Dunnett, N., J.D. Hitchmough, C. Jenkins, M. Tylecote, K. Thompson, R. Matthews-Joyce, and D. Rae. 2007. Growing Nature – The Role of Horticulture in Supporting Biodiversity. Commission Report 244, Scottish Natural Heritage, Clydebank. pp 63.

Gilbert, O.L. 1989. The Ecology of Urban Habitats. Chapman and Hall, London. pp 369.

Grime J.P. 2001. Plant Strategies, Vegetation Processes and Ecosystem Properties. New York, Wiley. pp 417**.**

Grime, J.P, J.G. Hodgson, and R. Hunt. 2007. Comparative Plant Ecology; A Functional Approach to Common British Species. Second Edition. Castlepoint Press, Dalbeattie. pp 748.

Helfand, G.E., J.S. Park, J.I. Nassauer, and S. Kosek. 2006. The economics of native plants in residential landscape designs. Landscape and Urban Planning. 78: 229-240.

Hitchmough, J.D., M. De La Fleur, and C. Findlay. 2004. Establishing North American prairie vegetation in urban parks in northern England: Effect of sowing season, sowing rate and soil type. Landscape and Urban Planning. 66: 75-90.

Hitchmough, J.D. and M. De La Fleur. 2006. Establishing North American prairie vegetation in urban parks in northern England: Effect of management and soil type on long-term community development. Landscape and Urban Planning. 78: 386-397.

Hitchmough, J.D., A. Paraskevopoulou, and N. Dunnett. 2008. Influence of grass suppression and sowing rate on the establishment and persistence of forb dominated urban meadows. Urban Ecosystems.11: 33-44.

Jager, H. 1877. *Lehrbuch der Gartenkunst*. Hugo Voigt, Berlin. pp 687.

Jones, T.A. 2003. The restoration gene pool concept: beyond the native versus non-native debate. Restoration Ecology. 11(3): 281-290.

Kingsbury, N. 2004. Contemporary overview of naturalistic planting design, pp 58-96. In Dunnett, N. and J.D. Hitchmough, (Eds.). The Dynamic Landscape: Design, Ecology and Management of Naturalistic Urban Planting. Taylor and Francis, London.

Loram, A., J. Tratalos, P.H. Warren, and P. Gaston. 2007. Urban domestic gardens. (X): the extent and structure of the resource in five major cities. Landscape Ecology. 22(4): 601-615.

Lord, T. 2007. RHS Plant Finder 2007-2008. Dorling Kindersley, London. pp 970

Luken, J.O. 1990. Directing Ecological Succession. Chapman and Hall, London. pp 251.

Luscombe, G. and R. Scott. 2004. Wildflowers Work; a guide to creating and managing new wildflower landscapes. Third Edition, Landlife, Liverpool. pp 48.

Met Office. 2005. Climate Change and the Greenhouse Effect. A briefing from the Hadley Centre. DEFRA, London. pp 71.

Milesi, C., S.W. Running, C.D. Elvridge, J.B. Dietz, B.T. Tuttle, and R.R. Nemani. 2005. Mapping and modeling the biochemical cycling of turfgrasses in the United States. Journal of Environmental Management. 36(3): 426-438.

Nassauer, J.I. 1995. Messy ecosystems, orderly frames. Landscape Journal. 14(2): 161-170.

National Gardening Association. 2004. Environmental Lawn and Garden Survey. South Burlington, Vermont. pp 46.

Oehme, W. and J. Van Sweden. 2002. Bold Romantic Gardens. Spacemaker, Washington. pp 310.

Oudolf, P. and N. Kingsbury. 2005. Planting Design. Gardens in Time and Space. Timber Press, Portland. pp 175.

Owen, J. 1991. The Ecology of a Garden: The First Fifteen Years. Cambridge University Press. Cambridge. pp 403.

Pollan, M. 1991. Second Nature, A Gardeners Education. Bloomsbury. London. pp 279.

Pywell, R.F., J.M. Bullock, D.B. Roy, L. Warman, K.J. Walker, and P. Rothery. 2003. Plant traits as predictors of performance in ecological restoration. Journal of Applied Ecology. 40(1): 65-77.

Preston, C., D. Pearman, and T. Dines. 2002. New Atlas of the British and Irish Flora. Centre for Ecology and Hydrology and Botanical Society for the British Isles. Oxford University Press. Oxford. pp 910.

Rappaport , B. 1993. The John Marshall Law Review. Volume 26, Summer 1993, Number 4. http://www.epa.gov/greenacres/weedlaws/. (accessed August 25, 2008).

Robbins, P. 2007. Lawn People, How Grasses, Weeds and Chemicals Make Us Who We Are. Temple University Press, Philadelphia. pp 208.

Robinson, W. 1870. TheWild Garden. John Murray, London. pp 304.

Shapiro, A.M. 2002. The Californian urban butterfly population is dependent upon alien plants. Diversity and Distributions. 8: 31-40.

Thompson, K., K.C. Austin, R.M. Smith, P.H. Warren, P.G. Angold, and K.J. Gaston. 2003. Urban domestic gardens (I): putting small-scale plant diversity in context. Journal of Vegetation Science. 14: 71-78.

Widrlechner, M.P., J.R. Thompson, J.K. Iles, and P.M. Dixon. 2004. Models for predicting the risk of naturalization of non-native woody plants in Iowa. Journal of Environmental Horticulture. 22: 23-31.

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