Topic 2

Urban Green

The effectiveness of seed sowing *in situ* to create low maintenance ornamental meadows for hostile urban environments

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Zusammenfassung

Die Forschung an der Universität in Sheffield ist sehr erfolgreich in der Entwicklung von Methoden der *in-situ*-Samen Aussaat, um Wiesen und Weiden in urbanen Landschaften zu schaffen. Diese sollen sich zuverlässig etablieren und sich in der Pflege durch einen minimalen Arbeitsaufwand und mit wenig gärtnerischer Ausbildung auszeichnen. Solche Erfahrungen wurden in einer aktuellen Studie gesammelt, in der eine Reihe von Mischungen aus Staudenarten hinsichtlich ihrer spezifischen Anforderungen an eine städtische Umgebung und bezüglich der Möglichkeiten, neue Vegetation auf degradierten, semi-durchlässigen oder undurchlässigen Oberflächen zu etablieren, getestet wurden. Es ist anzunehmen, dass Begrünung durch Saatgut dort widerstandfähiger und erfolgreicher ist als durch Jungpflanzen, wo lediglich kleine Mengen an Kultursubstrate vorzufinden sind.

Schlüsselwörter: Pflanzenartenreichtum, Ressourcenmanagement, Stadterneuerung

Abstract

Research at the University of Sheffield has been highly successful in developing the method of in situ seed sowing for the creation of grassland and meadows in the urban landscape. It has permitted greater confidence that they will establish reliably and can be maintained with a minimum of labour with little horticultural training. This experience was built upon in the current study to test a range of mixtures of herbaceous perennial species, with specific requirements within urban environments, where there is a possibility of establishing new vegetation over degraded, semi-permeable or impermeable surfaces. Establishment from seed is likely to be more durable and successful than from plug plants in these environments, where there is minimal volume of growing media.

Keywords: plant species richness, resource management, urban regeneration

1. Introduction

This paper represents a discussion of the role of a seed established planting scheme within the context of an environmentally poor urban environment, its diversity of plant species, contribution to restoration or recreation of habitats and land usage. It is a departure from both the more traditional views of urban bedding schemes and from conserving areas of urban land, with minimal human intervention or interaction, for spontaneous appearance of valued wildlife species. The current work recognises the need to make use of urban land most efficiently, particularly where there is changing land use, creating an environment for both human and wildlife species. Rather than seeing the preservation of a specific habitat or species as central to maintaining urban biodiversity, this method presents an opportunity to make positive changes in an urban system to increase diversity of selected species, particularly flowering species. There is the possibility also promote the ingress of other valued local or native species.

Summary methodology and results are given to present the study in the context of urban landscape research. More detailed methodology and results will be published and made available in the scientific literature. It is the aim to continue to spread the use of this technique and the consideration of appropriate species usage to practitioners and land managers, and to promote further discussion of species selection and inclusion within the urban environment.

We consider in this study the identification of site appropriate plant communities, which are successful in establishment and continuity. How are species assessed and selected in the urban environment? Should urban areas be used to conserve rare species, or is it more effective to create or enhance communities which are regionally or locally appropriate rather than traditional habitat restoration?

2. Background

Previous work from Anhalt University since 1998 to produce attractive, low maintenance planting schemes for urban areas, named Perennemix, forms a base for this study. It is further developed by applying the same principle of a defined combination of herbaceous perennial species to produce a mixed community of known characteristics, but creating them from seed to minimise establishment costs and permit their use over larger areas. A closer interaction between species can be generated by controlling the sowing density of the species. The mixes may be for specific environmental situations or to satisfy a requirement for native or exotic species, in a similar manner to the Perennemixes.

The method of seed sowing mixes has been used to dramatic effect in U.K., in Sheffield Botanical Gardens, and in RHS Garden Wisley, established in 2008 to 2009, where a diverse vegetation community of mixed origin was achieved over a large area at minimal cost. The future Olympic Park in 2012 in London will demonstrate the method on its largest scale; all these schemes have been created from seed.

A further development of the method is the use of manmade and waste materials as growing media. With increasing regulation in the control and reuse of construction materials in urban and peri-urban environments and with the high value of naturally derived soils, there is a niche for serious consideration of the use that is made of readily available materials of manmade origin as a vegetation growing me-

dium. This leads to a specific application, growing in an artificially created system within a high environmental stress urban environment. The groundwork of selected perennial species growth in construction materials was carried out in monoculture pot studies (HITCHMOUGH et al. 2001, 2003) and in field studies with mixed species (GRAHAM 2008).

3. Overview of method

A field experiment was set up to establish a range of mixtures of perennial species mixtures which would have the characteristics of a defined height, a diverse vertical structure and a long flowering period. Species were selected from steppe or prairie habitats in both central Europe and North America, based on their habitat of origin and their height. The objectives were trialling of North American and European perennial species grown in predefined mixtures. The origin of the species could be defined as generally native or regional or as exotic when considered from a western European perspective.

Eight different seed mixtures were created, which were intended as either low growing, up to 30 cm maximum height, or high growing, up to 100 cm in height.

The species were selected by their tolerance of xeric habitats or xeric–mesic habitats on both continents, giving a wide range of species tolerant of diverse environmental conditions. The plant community groups used for selection were those described as short-grass prairie or goat prairie in North America, or continental steppe or dry grassland in central Europe. The groups of plant species created are not necessarily seen growing together naturally as communities. However they are selected to have a distinctive character, recognisable in the larger region, although not necessarily the local area.

A multilayered vertical structure was achieved by selecting species of varying growth habit and maximum vertical height, particularly in the mixes with 100 cm total vegetation maximum.

The two selected heights of the vegetation mixes would produce neat, low profile schemes, from the shorter plants, and taller beds with greater impact and range in height. Additionally the mixes were intended to flower throughout the summer season, providing both colour and a nectar food source for invertebrates.

The growing conditions imposed were those of restricted environmental resources, limited root volume and organic matter and therefore low water and nutrient availability. The mineral component in addition was nutritionally inert and very freely draining. Due to its origin as quarried material, it was free of weed propagules, a significant advantage in new vegetation establishment. The depth of growing medium was limited to ten centimetres, to test the response of the selected species to drought stress imposed by limited substrate water availability. Access to ground water or the lower soil profile was strictly limited with plastic sheeting, while allowing free drainage of water away from the plant root system, in order to simulate the conditions of growing over hard landscape surfaces. Irrigation and weed species removal was limited to the first season of growth, and not continued in subsequent years.

Assessment of the vegetation was made after establishment during the first growing season and after three years of growth, with the aim of quantifying species survival, their increase or decrease in frequency, and therefore an indication of a growing or declining population. The maximum height of the vegetation in total and the presence or survival of each species, are presented here. The total standing vegetation was also collected, dried and its weight determined to give a value of biomass or carbon accumulation after three years growth.

4. Summary results

Initial results showed a wide range in the rate of germination of seeds from different geographical regions, the rate of establishment and ground coverage. It was speculated that this would have implications for the eventual establishment of the mixed community. Population surveys after one year of growth showed distinct trends in establishment of particular species. After three years, it could be seen that while there was a loss of almost 50% of species from some mixes, others were stable in species frequency.

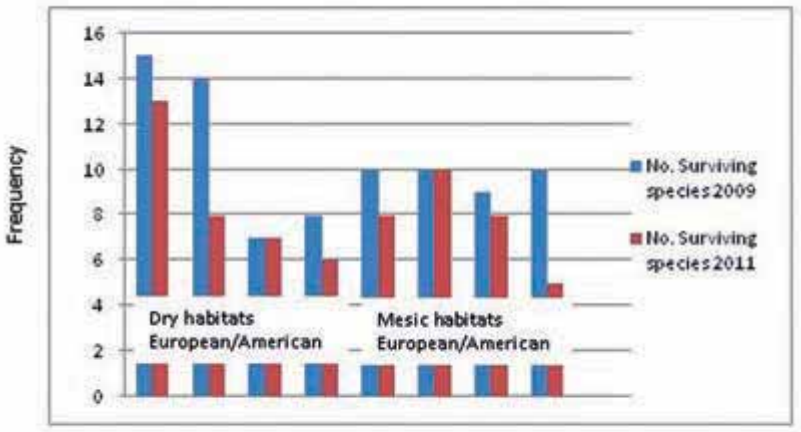

Fig. 1: Change in the number of surviving species of 8 species mixtures over 3 years' growth

Those species with rapid germination were not necessarily successful in dominating the community, but frequently succeeded in establishing large individual plants, which could later become a distinctive feature of the population, even in low numbers. It was noted those which could be useful as alternative ground cover plants for ornamental schemes, to create greater diversity in urban vegetation, with consequent benefits in faunal biodiversity.

With low inputs of water and fertiliser, only a limited number of species reached their full height potential after one year but this was achieved by the third year, with consequences for the overall visual impact of the mixture. Low-growing species were found to be more successful in colonisation in general. It appeared that there was miniaturisation of some species, however with survival of high frequencies of individuals and distinctive vegetative growth form in clumps.

Productivity of the systems as a whole were in general low, no more than 350 g per m^2, expected in a low resource environment. A notable result of a vegetation system suited to very low maintenance was the absence of significant invasive grass colonisation or dominance of the scheme, particularly where there was complete ground coverage by sown species.

The significant findings of the study were

• Consistent establishment of a limited range of mixed species

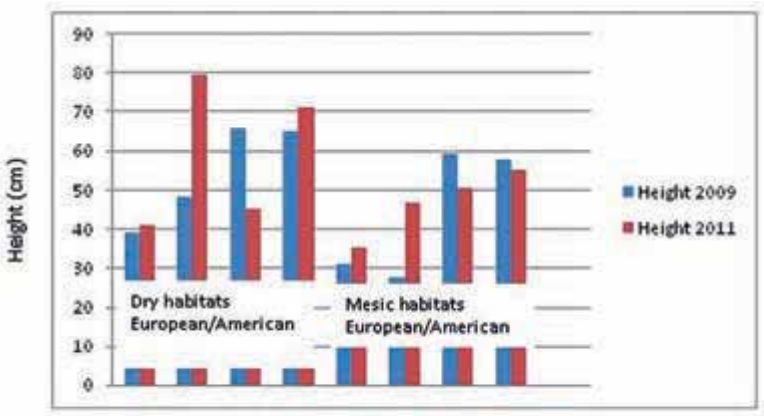

Fig. 2: Increase in height of 8 species mixtures over 3 years' growth

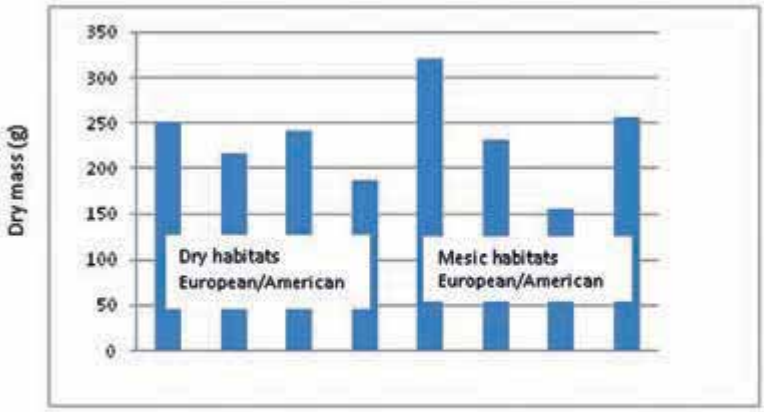

Fig. 3: Maximum biomass achieved in 8 species mixtures after 3 years' growth

• Reliability in horizontal (i.e. ground coverage) and vertical vegetation structure

• Weed control and effects of limited water on competitive species ingress

5. Discussion and application

This study and the background method described may be considered as a departure from more traditional ecological or plant community ideas of habitat recreation or enhancement of diversity. When the application of ecological methods is the focus of modern work particularly in urban areas, we need greater subtlety and complexity in vegetation establishment and management.

The areas of interest within urban areas where this research can be applied include;

• Poor sites – economically, socially and environmentally

• Restricted growing medium

• Restricted drainage and potential for surface water flow

• Novel substrates and reclamation of material

• Economical and large scale ground coverage

• Long term visual improvement and increase in diversity, native or non-native.

This study represents an examination at the small scale of plant individual and community response, which provides the opportunity for larger scale visual changes and provision of feeding and sheltering sites for invertebrates and vertebrates. It examines development in two time scales – vegetation establishment, and so the development of ground cover, which leads to potential for and awareness of, land management. The enhancement of aesthetic value and species diversity results then in long-term improvement of the area.

Cessation of mowing or grazing has steadily lead to a loss of species in meadows and xerophilic grassland and an increase in competitive or alien species, particularly in urban adjacent areas. The current study most closely lends itself to reconsidering meadow or grassland vegetation types within these areas. Management of establishment is used here as a method for directing development of the vegetation. Greater emphasis should be given to low-growing mixtures, focusing on reliability of establishment and visual impact of the mixture as a whole.

Further developments from this trial allow the refinement of perennial mixtures with defined vegetation structure and ground coverage. It will potentially provide empirical evidence of the generation of meadow-like habitats in degraded landscapes. Follow-on benefits from this approach are the provision of habitat sites for local invertebrates. It was not within the remit of the study to quantify this, but invertebrate feeding was observed, in an area of poor provision of flowering plants. With limited evidence of a widely spread requirement for specific host species in invertebrate feeding, this represents an additional food source for the existing and incoming population. Visiting by invertebrates could now be quantified in further studies. Some requirement for specific vegetation structures has been seen, for example among spiders. The experimental work sits most comfortably within this area of research.

Issues of native and alien or invasive species are addressed here by careful consideration of the species included in the mixes, and in developing geographically distinct mixes. Historically invasive species are frequently the result of human activity. A sensitive approach to use of vegetation may improve the quality and so value of land in urban areas. Use of American species in urban landscape has been developed to augment native European species mixes (HITCHMOUGH et al. 2004). In the context of the current study, North American species were found to have more specific uses in potentially controlling growth of weed grass species, and achieving consistent ground cover. There is currently a need to restrict the ingress of alien species by careful selection in new species, and prevention of access to niches or unutilised resources, particularly where they are garden escapes or appear at higher frequencies in populated areas.

There is continuing post industrial structural change in landscape and habitats. With interest in management of water resources comes the development of xerophilic greenspace. Consequently there is an opportunity to make use of the land area to develop appropriate vegetation. Species richness and composition within an urban environment are influenced by their land use and human interaction and management.This study examines areas of minimal management, of low intensity land use or low value. An immediate use of the method is in the development of brownfield sites in derelict areas or those undergoing land use change. Some of these sites are already valued for spontaneous ingress of some species, particularly ruderal plant species or invertebrates. Management of self established vegetation may enhance urban wilderness (MARQUES

2008). Is it more highly valued if it is spontaneous rather than sown? Direction of the development of vegetation, especially in flowering species may increase the rate of re-inclusion of the sites in the urban land use system, or in reassigning them as areas or green space. Use of brownfield sites represents an enhancement in biologically transitional or marginal land within the urban area, in a structured way, rather than a loss or competition for use of more highly valued greenspace. Sites of low ecological and social value; undesirable, abandoned or problem areas, in that they are not readily adapted to traditional restoration, may be brought into use for with limited establishment and management costs. It combines the potential for community involvement and for improvement in plant species diversity.

6. Conclusions

It can be demonstrated that the seed sown method can be used to establish a plant community group of selected species, with benefits for developing more biodiverse systems. While this technique has been used to great effect in more conventional plant growth and ground preparation, this current work supports development of research into particularly urban environments, of low resource input and restricted rooting and water availability. It is proposed that in turn there is a contribution to improved greenspace connectivity and urban habitat heterogeneity. It provides an alternative method for the increase in known or controlled species richness, within the urban area.

A second outcome of the study is the quantification of survival of these species in manmade mixed communities. Although low numbers were recorded, they represented at least a 50 % establishment of the sown species, with minimal maintenance after the first season. In addition, these numbers appeared to develop into a stable population. Their long-term persistence is not however, known. It was observed that the biomass of these plant communities was low. Low productivity was reflected in the low maximum height of vegetation achieved in the first season. However by the end of three years' growth, this had increased to fulfil the typical maximum height expected for the chosen species. It is significant, both in achieving deliberate visual impact and in a distinct vertical vegetation structure.

A benefit of the system created in this study, was seen in the control of weed species ingress on the experimental plots. By establishing a sown sward over the ground surface, and due to limited water availability, there was little opportunity for other vegetation growth, particularly of weed grass species. These can be detrimental to survival of desirable species in a resource competitive environment. Where there was significant weed species ingress, it was observed on plots where ground coverage at establishment was low. Further work on the measurement of invertebrate diversity in similar systems would contribute to evaluation of the plant community established. It would be of interest to further refine the communities and assess a greater number of possible species. If highly valued or rare species can also be successfully introduced in this way, it would be of use in the fulfilment of local Biodiversity Action Plans. Further consideration could be made of the extent to which this could achieve or approach pre-classified vegetation types. The current work focuses on highly robust, persistent species mixes, with their defined visual and structural character.

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