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Towards an integrated understanding of green space in the European built environment

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Abstract

In recent years social, economic and environmental considerations have led to a reevaluation of the factors that contribute to sustainable urban environments. Increasingly, urban green space is seen as an integral part of cities providing a range of services to both the people and the wildlife living in urban areas. With this recognition and resulting from the simultaneous provision of different services, there is a real need to identify a research framework in

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which to develop multidisciplinary and interdisciplinary research on urban green space. In order to address these needs, an iterative process based on the delphi technique was developed, which comprised email-mediated discussions and a two-day symposium involving experts from various disciplines. The two outputs of this iterative process were (i) an integrated framework for multidisciplinary and interdisciplinary research and (ii) a catalogue of key research questions in urban green space research. The integrated framework presented here includes relevant research areas (i.e. ecosystem services, drivers of change, pressures on urban green space, human processes and goals of provision of urban green space) and emergent research themes in urban green space studies (i.e. physicality, experience, valuation, management and governance). Collectively these two outputs have the potential to establish an international research agenda for urban green space, which can contribute to the better understanding of people's relationship with cities.

Keywords: Delphi technique; Research agenda; Urban ecology

Introduction

There are a number of significant factors that are converging and forcing a re-examination of the way cities are planned, designed and lived in. The Global Environment Outlook (UNEP, 2007) identified five drivers for human development: demographics; economic processes (consumption, production, markets and trade); scientific and technological innovation; distribution pattern processes (inter- and intra-generational); and cultural, social, political and institutional processes (including human behaviours and the production and service sectors). These drivers, and others that may emerge, will have substantial consequences for urban development, and hence green space within urban areas, yet there is great uncertainty about the ways in which urban areas will be affected. What is lacking is a framework for multi-, inter- and transdisciplinary research that would form an evidence base to support these changes and actions. The distinctions between these three approaches and their difference from a traditional, single disciplinary approach require some consideration. A multidisciplinary approach is one in which individuals or groups working in different disciplines address the same issue, whereas an interdisciplinary approach is one where an individual or a group work at the boundaries of traditional disciplines and often in gaps that emerge between disciplines, and lastly a transdisciplinary approach is one where an individual or group uses knowledge from a number of disciplines to see new connections and gain new insights.

The terms green space and open space are often used interchangeably (Swanwick et al., 2003). In order to address the confusion that may occur, they defined the key terms more clearly. Swanwick et al. (2003) suggested that urban areas are made up of the built environment and the external environment between buildings. The external environment, in their model, is composed of two distinct spaces: 'grey space' and 'green space'. Grey space is land that consists of predominantly sealed, impermeable, 'hard' surfaces such as concrete or tarmac. Green space land, whether publicly or privately owned, consists of predominantly unsealed, permeable, 'soft' surfaces such as soil, grass, shrubs, trees and water. In this paper the authors follow this definition of green space whilst at the same time recognising that the juxtaposition of green and grey spaces is essential in towns and cities.

Across Europe, development trajectories of towns and cities vary (Kasanko et al., 2006). Where the populations are falling, there are opportunities to redesign the built and external environments in order to improve liveability and sustainability (Mace et al., 2007). Where populations are growing and cities are expanding spatially, or are confined by physical or political boundaries, there is a decrease in per capita space and often a need to address issues of the loss of urban green space.

Whilst an understanding of the multiple functions of urban green spaces is reasonably well developed, it is not well integrated into the planning, design and management process (Yli-Pelkonen and Niemelä, 2005; Sandström et al., 2006). Furthermore, reliable and robust approaches to the valuation of urban green space that effectively support decision-making are often absent (Tyrväinen, 2001; Neilan, 2008). Therefore, it is desirable to identify the key issues requiring research, to develop evidence on which to base decisions and to present these in a way that is accessible to academics, practitioners and decision-makers.

This paper reports on the outcomes of a symposium held at the University of Salford, United Kingdom, during June 2007. This symposium was developed in recognition of three important gaps in urban green space research: the need to encourage interdisciplinary and multidisciplinary approaches, the need to develop joint, multidisciplinary initiatives across Europe and the need for comparative research. Experts from different disciplines, countries and job roles (e.g. academics, practitioners and decision-makers) attended the symposium with the goal to develop, and subsequently agree on, an integrating framework that would bring together

different discipline and professional interests in urban green space. Emergent from this process was a catalogue of key research questions for urban green space research and the synthesis of these into an integrating framework to support multidisciplinary and interdisciplinary understanding and communication, decision-making and research efforts. In this paper the authors propose an international research agenda relating to this key component of urban living.

The paper is primarily informed by research relating to the European and North American context and by European issues and practices. It is intended that the agenda will influence regional, national and international research funding allocations and inform the discussions of those concerned with identifying the needs and priorities of urban green space.

Process

The need for a multidisciplinary approach in urban green space research was identified during discussions held amongst the participants at the European Society for Conservation Biology meeting in Eger, Hungary. Subsequently, the overall process was based around a modified Delphi Technique, a widely used technique in consultation exercises where consensus is required (Ndour et al., 1992; Medsker et al., 1995; Curtis, 2004; Okoli and Pawlowski, 2004).

In early 2007 a group of 40 people came together to address this need. The group included representatives of academic institutions (29), consultancy (4), voluntary organizations (2), politicians (1), statutory bodies (1), housing provider (1), practice and policy advisor (1), central government (1) and local authority (1). These people were all chosen because of their established record of interest in, and commitment to, academic, managerial or decision-making roles in urban environment. Also, the participants possessed knowledge of the historic and contemporary issues associated with open green space in cities and towns. Furthermore, the group was chosen to be representative of different academic disciplines (e.g. Psychology, Sociology, Planning, Ecology, and Health), with many contributors having expertise in more than one discipline. Representation from different parts of Europe was achieved – Austria (2), Finland (2), France (1), Greece (1), Denmark (1), The Netherlands (2), Poland (1), Sweden (1), Switzerland (2) and United Kingdom (28).

The purpose of the process was to identify key research themes and questions related to contemporary issues and future studies in urban green space. The need for a multidisciplinary approach was identified during conversations held at various conferences throughout 2006. Consequently, the overall process was based around a modified Delphi Technique. This is a widely used technique in consultation exercises where consensus is required (Ndour et al., 1992; Medsker et al., 1995; Curtis, 2004; Okoli and Pawlowski, 2004).

In the research reported here the Delphi Technique was divided into three stages. The initial stage was to invite all individuals to partake in an email-mediated discussion. The initial list of invitees was compiled by the Urban Nature Research Group in the Research Institute for the Built and Human Environment at the University of Salford. The list grew to 40 as existing members suggested other prospective members. All emails were shared amongst the whole group with periodic publication of a compendium of emails covering specific time periods. In this way all contributors were made aware of the ongoing debates, the chronology of ideas and the provenance of the ideas. Early on in the process the symposium chair was identified. This person also mediated the pre-symposium preparations ensuring that all emails were available to all members. These email exchanges began the process of developing a rich picture of the scope and concerns related to the topic. Thereafter participants were invited to submit a list of key research questions relevant to the previous email-mediated discussions. In total 215 questions were submitted.

The second stage was a two-day expert symposium that was held in Salford in early June 2007, to which all 40 contributors were invited, 29 were able to attend. The symposium was based on facilitated group discussions and subject presentations around the core principles of open discussion and consensus building. The participants were first split into three multidisciplinary teams. The aim was that each group would have representatives from all the disciplines represented at the symposium. Each group had one session discussing the research areas and emergent research themes, and three sessions focused on refining the emergent research questions. The discussions in these sessions were facilitated by a group chairperson. At the end of each session the outcomes from each group were combined and discussed in plenary session. The subject presentation focused on introducing and summarizing the different components of the symposium.

By the close of the symposium, three specific outcomes were achieved. Firstly, the themes that surfaced during the email-mediated discussions were revisited, discussed and amended. Secondly, the long list of 215 questions was distilled to a short list of 50 questions. This reduction came through a process that involved combining similar questions, developing composite questions from those that addressed similar themes and testing each question for relevance and suitability for research. Thirdly, a self-selected steering group of 17 people, covering the range of disciplines represented in the symposium, agreed to take forward

detailed discussion of the points raised during the symposium, to distil further the short list of questions and to draw the list and themes together into a research paper. This further iteration of questions formed the third and final stage of the Delphi process.

Emergent research agenda

Five research themes and 35 research questions

The pre-symposium email discussions enabled the original catalogue of 215 questions to be categorised into five emergent themes: the physicality, the experience, the valuation, the management and the governance of urban green space. Further refinements during the symposium and post-symposium email discussions reduced these to 50 questions and finally to 35 questions. This catalogue of questions in conjunction with the integrated framework, which is discussed later in this paper and presented in Fig. 1, forms the proposed research agenda for urban green space. The questions are discussed below under the headings of the five emergent themes.

Theme 1: The physicality of urban green space

The physicality of urban green space covers ecological, microclimate, soil, air and water quality functions (i.e. provisioning and regulating services; Breuste et al., 1998; Marzluff et al., 2001; Berkowitz et al., 2003). Several physical factors differ greatly between urban and rural environments. The location, structure, composition and spatial configuration of urban green spaces will influence their ecological qualities and functions (Pauleit and Duhme, 2000; Whitford et al., 2001; Turner et al., 2005). These ecological functions may include population dynamics, community interactions and resilience, species migration or plant pollination.

The ecosystem services provided by urban green spaces are related to the physical aspects of these spaces (de Groot et al., 2002) and are central to maintaining

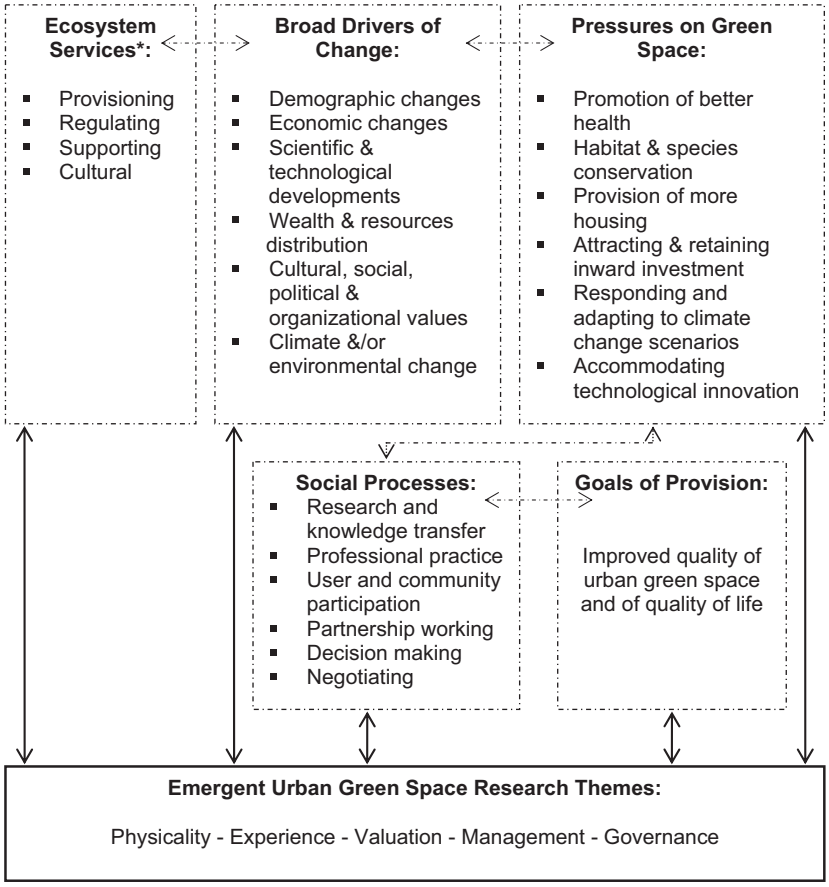

Fig. 1. Integrating framework for a research agenda for urban green space. Key: Dashed boxes indicate broad research areas that are changing over time and across geographical areas; solid box indicates specific research themes that remain constant in time and geographical areas; dashed two-way arrows indicate dynamic relationships between different research areas; solid two-way arrows indicate that research themes are drawn from, and are applicable to, the different research areas. (*) *Source*: Millennium Ecosystem Assessment (2005).

human health and viable wildlife populations (Tzoulas et al., 2007). Within the context of climate change, urban green spaces can play a central role in both climate-proofing cities and in reducing the impacts of cities on climate (Gill et al., 2007). While the role of green areas in sequestering carbon is small compared to carbon dioxide emissions produced in cities (Nowak, 1994; McPherson, 1998), urban green spaces may reduce energy consumption and thus also carbon dioxide emissions by reducing the need for air conditioning in the summer and the need for heating in the winter (McPherson, 1994; Jo and McPherson, 2001). Within the theme of 'The Physicality of Urban Green Space', the following seven key research questions (1–7) are identified:

1. What are the ecosystem services provided by urban green spaces and how can these services be quantified?
2. What benefits does the creation of urban green space provide in areas that have poor environmental conditions or social problems?
3. What, in relation to urban form, are the required quantity, quality and configuration of urban green spaces to maintain, sustain and enhance ecosystem services and ecological function compatible with other functions?
4. What are the direct and indirect effects of the climate changes predicted in current scenarios on urban green spaces and how do these changes impact people's well-being (quality of life) in urban areas?
5. How resilient are current green space designs (including street trees) to climate change and how can resilience be improved?
6. How can urban green spaces that are robust to harsh urban environments (e.g. lack of water and sunshine) be designed and managed to mitigate the effects of climate change in urban areas and allow cities to adapt to these changes?
7. How can the provision and management of freshwater quantity and quality be promoted through urban green spaces?

Theme 2: The experience of urban green space

Urban green spaces are important in cities due to the opportunities they provide to people to come in contact with nature and with each other. Contact with nature has psychological benefits by reducing stress (Ulrich, 1984; Ulrich et al., 1991), restoring attention (Kaplan and Kaplan, 1989), reducing criminal and anti-social behaviour (Kuo and Sullivan, 2001) and by positively affecting self-regulation and restorative experiences (Korpela et al., 2001; Hartig et al., 2003; Korpela and Ylén, 2007; van den Berg et al., 2007). In addition to psychological benefits from contact with nature, there are direct physical health benefits (Pretty et al., 2006), such as addressing issues associated with obesity (Department of Health, 2004), increased longevity (Takano et al., 2002) and self-reported health (de Vries et al., 2003; Maas et al., 2006). In terms of social well-being urban green space contributes to social interaction and to bringing people together, reduces negative social behaviours such as aggression and violence, contributes to a sense of place and plays an important role in fostering social cohesion and identify (Newton, 2007). These psychological, physical and social health effects of urban green spaces make them an important component of public health provision (Henwood, 2003; Newton, 2007).

However, green spaces that are perceived to be unmanaged may have a negative effect on the well-being of people by increasing anxiety caused by crime and fear of crime (Bixler and Floyd, 1997; Kuo et al., 1998; Jorgensen et al., 2007). The occurrence of wild animals in cities, for example, large mammals such as fox (*Vulpes vulpes* L.), badger (*Meles meles* L.), wild boar (*Sus scrofa* L.) and bear (*Ursus arctos* L.), bring with them a need to address the changing relationships between people and wildlife. Urban and peri-urban ecological changes can affect the geographical range of diseases such as Lyme disease (Patz and Norris, 2004) and West Nile Virus (Zielinski-Gutierrez and Hayden, 2006). Hence, further research will show whether it is possible to quantify environmental influences and subsequent positive or negative health outcomes from different types and configurations of urban green spaces.

The aesthetic contributions of urban green spaces to city life are equally important. There is a plethora of theories and studies showing the preference amongst urban dwellers for urban areas with green spaces in them (Wilson, 1993; Appleton, 1996; Stamps, 2004; Staats and Hartig, 2004; Regan and Horn, 2005; Hartig and Staats, 2006). The character of urban green spaces has been, and continues to be, important in expressing contemporary values, beliefs and cultural trends in urban societies (Thompson, 2004).

Closely linked with aesthetic and public health aspects of urban green spaces are the cultural backgrounds of the communities that use them (Ward Thompson, 1996; Tzoulas, 2006). Different cultures have different value systems and relationships with nature. So, the role of urban green spaces in improving local quality, identity and character may be different amongst different cultural groups within the same city and also amongst individuals. Understanding how different cultural and sub-cultural groups in cities use urban green spaces is central in developing appropriate management systems (Johnston and Shimada, 2003). Hence, within the theme of 'The Experience of Urban Green Space', nine key research questions (8–16) are identified:

8. How can urban green spaces be designed and managed and provide access to experience nature for the urban population and still meet national and regional biodiversity targets?
9. What are the personal and social influences that result in greater use of urban green spaces?
10. What are the dynamic interactions between societal, personality, situational, and temporal factors and individual and group engagement with urban green spaces?
11. How do the cumulative effects of cognitive, emotional, psychological and physical health benefits from multisensory contact with green spaces influence individual and community health and well-being?
12. What aspects and types of urban green space stimulate positive and negative physical and psychological health effects?
13. What are the necessary quantities, qualities and configuration of urban green spaces that contribute to their regular use such that different segments of a society with changing socio-demographic characteristics may gain benefits?
14. How can actual and perceived levels of crime and anti-social behaviour be managed through manipulation of landscape design in green spaces whilst maintaining ecological, landscape and aesthetic benefits?
15. How does green space affect anti-social behaviour and community development generally?
16. How can urban green spaces be used for greater benefit in environmental education and in education more generally?

Theme 3: The valuation of urban green space

In her review of English language literature on the link between quality of life and economic competitiveness of city regions Donald (2001) focused on the links between a city region's economic competitiveness and, with regard to environmental quality, concluded there was evidence suggesting a relationship between environmental quality, high technology and the attraction of knowledge workers. As the knowledge society continues to become an ever more dominant feature of the 21st century, so does the importance of creating places where people wish to live and work. Luttik (2000), reporting on a study of 3000 house transactions in the Netherlands, found that a view on a park or water leads to an increase in house prices. The observation, based on the willingness to pay concept, clearly indicates the value attributed to nearby green space by individuals. At a policy level the importance of urban green space to economic development is increasingly recognised (Ahern, 1995; Sandström, 2002; Benedict and McMahon, 2002; Konijnendijk, 2003; Li et al., 2005; Benedict and McMahon, 2006). However, at a local authority level this may not always appear to be the case (Barber, 2007; Britt and Johnston, 2008).

The contribution made by urban green space to ecosystem services and to psychological, social and health experiences is difficult to value (Ulrich, 1984; Kaplan and Kaplan 1989; Takano et al., 2002; de Groot et al., 2002; Tzoulas et al., 2007). However, there is still a need for quantitative economic evaluation of both physical and social ecosystem services provided by green spaces (McPherson, 1998; Tyrväinen, 2001; Lambert, 2007; Neilan, 2008). Traditional valuation techniques such as Cost Benefit Analysis and Contingent Valuation may not be able to cope with valuing the ecological and social functions of urban green spaces, which are required to strengthen their role in the decision-making process within local communities. New valuation techniques may be required. Hence, within the theme 'The Valuation of Urban Green Space', the following four key research questions (17–20) are identified:

17. What global competitive gains are delivered to cities through the provision of high-quality green spaces and how can these gains be sustained/increased through green space planning and management?
18. How can transdisciplinary considerations be integrated into the development of widely accepted methodologies for quantifying and valuing ecosystem services that are provided by urban green spaces?
19. How can the multiple 'public good' and 'market' benefits of urban green spaces be valued and built into governance and funding decision support tools?
20. How can ecosystem services be given an appropriate valuation so that they can be considered more equitably alongside other urban system functions?

Theme 4: The management of urban green space

The management of urban green space including planning, design and resource management requires the collaborative working of many disciplines at different spatial scales. There is variability in the mechanisms and structures governing green space management and maintenance within the same country but even more so across Europe (Werquin et al., 2005). Overall responsibility for urban green space rarely rests with national ministries, departments or agencies concerned with city planning or the environment (Carmona et al., n.d.). Usually urban green spaces are the remit of municipal or regional authorities (Niemelä, 1999).

Various schemes have been proposed and implemented to differing degrees across Europe including the urban forest (Konijnendijk, 2000), greenbelt and green heart (Kühn, 2003), green fingers or wedges (Jim and

Chen, 2003), greenways (Walmsley, 2006), green infrastructure (Sandström, 2002), ecological frameworks (Kazmierczak and James, 2008) and ecological networks (Opdam et al., 2006; Sandström et al., 2006). Some of these and other open space planning models have been reviewed by Maruani and Amit-Cohen (2007) who organised the various models into a comparative classification framework. They found that no model was universally applicable to all functions and needs and that the different models reflect different planning concepts of the spatial or functional configuration of urban green spaces. This variability in the mechanisms of governance of green spaces, in conceptual spatial models and in concerned agencies, creates a difficulty in comparative analysis and importantly in the comprehensive assessment and planning of green spaces at a transnational, national or regional level. Hence, within the theme 'The Management of Urban Green Space', the following seven key research questions (21–27) are identified:

21. What are appropriate indicators and typologies for the comparative assessment, monitoring and prediction of the state and trends of urban green spaces and their ecosystem services across Europe?
22. What are the mechanisms by which green space can be successfully planned, designed and managed at local, regional and national levels, and how can different levels effectively work together?
23. How effective is the current theoretical basis of urban and restoration ecology in supporting sustainable urban ecosystem management strategies, and informing urban planning?
24. How can the resilience and adaptability of urban areas to future economic, housing and environmental demands be enhanced through appropriate design and management of urban green spaces?
25. How will changing social values and behaviours guide the provision and maintenance of urban green spaces?
26. How can the views and experience of all local residents inform the planning and design process of urban green spaces?
27. How can the skills base required for delivering integrated planning, design, management and maintenance of urban green spaces in supporting urban sustainability be improved?

Theme 5: The governance of urban green space

Governance is the process of making decisions that define expectations, grant authority and verify performance. Green space governance and management is commonly a local authority responsibility, often divided amongst different departments and geographical areas (Britt and Johnston, 2008). However, Carmona et al. (n.d.) recognised that the way that green space governance and management responsibilities are coordinated is more important than their distribution amongst different departments. They also identified that important issues in the coordination of responsibilities of urban green space management and governance may include limitations on existing statutory and non-statutory powers, availability of skills and effective communication amongst departments. Hence, within the theme 'The Governance of Urban Green Space', the following eight key research questions (28–35) are identified:

28. How do differing governance and management systems of urban green space influence the planning for delivery of sustainable ecosystem services and ecological function of urban green spaces?
29. What are the consequences of changing patterns of urban green space ownership?
30. What are the social and governance implications of different funding and tenure models for the delivery of high-quality urban green space in which the local community is engaged fully?
31. What are the critical factors that affect the extent to which local communities are empowered to participate in local decision-making processes?
32. How is the power relationship between local authorities, developers and local communities changing as communities are encouraged to become more involved in the decision-making process about development and adaptation of their neighbourhood green spaces?
33. How can financial commitments of developers be reconciled with the time requirements of inclusive public consultation?
34. Which models of governance effectively facilitate meaningful participation in decision-making in an environment where ownership of land parcels changes over time?
35. What is the evidence that urban green spaces have risen up the local political agenda and what difference has it made to green space resources and quality of stewardship?

An integrated framework for multidisciplinary and interdisciplinary research on urban green space

The questions identified under the previous five themes, distilled from the Delphi process described previously and underpinned by the existing urban green space evidence base, have enabled the development of an integrated contextual framework for interdisciplinary and multidisciplinary research (Fig. 1). Such a framework aids interdisciplinary and multidisciplinary understandings, and the communication of the complexity of the issues identified during discussions. This framework,

along with the detailed questions catalogued above, forms the basis of an agreed research agenda.

Ecosystem services are primarily, but not exclusively, concerned with the environmental functions provided by urban green space (Whitford et al., 2001; de Groot et al., 2002; Tratalos et al., 2007). Such environmental functions may include the provisioning of resources (e.g. food or fuel), the regulating of microclimates, the supporting of bio-geophysical process and cycles (e.g. soil formation) and cultural interpretations (e.g. aesthetic, recreational or educational facilities; Millennium Ecosystem Assessment, 2005). The ecosystem services provided by urban green spaces are inextricably related to broad socio-economic and environmental drivers of change. Such broad drivers of change include demographic, economic and scientific developments, evolving socio-political values, and climate change or other environmental hazards. Ecosystem, environmental and socio-economic drivers of change create specific pressures on urban green spaces such as adapting to technological and societal changes, attracting inward investment, and promoting nature conservation and health.

Social processes are important in bringing together broad drivers of change and specific pressures that act upon the management and use of urban green space. Social processes are also important in integrating public sector, professional, academic and voluntary sector practices. Such process may include research and knowledge transfer, professional practices, community participation and inclusive decision-making. The goals of urban green space provision are the outcome of the multiple, dynamic and complex interplay between social, economic and environmental factors. These are primarily focussed on improvements in the quality of life in urban areas and in the quality of urban green space.

These broad research areas (ecosystem services, drivers of change, pressures, social processes and goals of provision associated with urban green space) are interrelated and this is indicated by the dotted two-way arrows between them (Fig. 1). Five research themes, namely physicality, experience, valuation, management and governance of urban green space, emerged from the Delphi process, and have been used to structure the presentation of research questions in this paper. These research themes, and associated research questions, are drawn from and are applicable to all of the research areas of the integrating framework. This is indicated by the solid two-way arrows in Fig. 1.

Discussion

An important aspect of the integrated framework developed during this research and presented in Fig. 1 is that changes in the urban environment, as elsewhere, are the result of the complex interactions of natural and spontaneous processes as well as of the planned actions by humans (Antrop, 1998; Wood and Handley, 2001). Thus, an understanding of the detail of, and interactions between, the five broad research areas is important. Furthermore, this integrated framework demonstrates explicitly that the outcomes from different research themes of urban green space are inextricably linked and include physical and social systems and processes. What emerges from this contextual conceptualisation is that an interdisciplinary, multidisciplinary and transdisciplinary understanding of the emergent research themes are required. The proposed research agenda (Fig. 1 and the 35 questions) facilitates the development of such studies in two ways. First, Fig. 1 identifies broad interrelationships between research areas and thus gives an indication of the potential for collaboration between disciplines. Second, the 35 questions provide an initial catalogue of identified questions that require further research. This catalogue of questions is not definitive, nor is it prioritised, and the questions may vary in different geographical locations and at different historical times. However, it does provide a common framework for researching current urban green space topics in Europe.

Our analysis shows that whilst the general functions and benefits of green spaces are reasonably well understood, when looking to the future there is insufficient understanding of the following:

(a) how to plan, design and manage green space (e.g. how large, how to connect); and
(b) how green spaces will behave under socio-demographic and environmental change.

The framework presented here offers an overview for how such research might be structured. As with all such frameworks this is very much a product of its time and place. Hence, the relative importance of specific issues will vary over time. However, the framework (Fig. 1), and the research questions presented here, should be seen as a tool for developing working practices that transcend disciplinary boundaries in order to develop new insights and understanding of urban green spaces: it has been designed to be resilient in order to accommodate changes in knowledge. As these issues are developed by others, the general model can be expanded by incorporating standard (quantitative) indicators for each of the five emergent urban green space research themes.

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